Australian Weeds Strategy 2017–2027

Invasive Plants and Animals Committee

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Overview

Weeds have major economic, environmental and social impacts in Australia, causing damage to natural landscapes, agricultural land, waterways and coastal areas. The extent, persistence and impacts of weeds are such that they will remain a challenge for Australia and require an ongoing strategic and coordinated response.

Effectively managing weeds demands a collaborative approach between landholders, community groups, industries and all levels of government.

If permitted to spread to their full potential, most weed species can impact extensive areas of land, affecting multiple local, state and territory jurisdictions, often multiple agricultural industries and a variety of significant environmental assets. For example, prickly acacia poses a serious threat to 20 to 30 million hectares of grazing land in Queensland, the Northern Territory and Western Australia.

If a weed is controlled in one area, it will tend to re-invade from any surrounding areas where it has not been controlled. Hence, it makes sense to coordinate effort across the species' entire range. Similarly, it makes sense to restrict and prevent the entry of a potentially invasive weed in every jurisdiction that could potentially support that weed. Much like bushfires, it only takes one point of ignition for a large area to be put at risk.

The foundations for national level weed management were established in 1997 with the National Weeds Strategy, which was revised in 2007, to become the Australian Weeds Strategy (AWS).

This strategy, building on the last two decades of achievements, outlines the principles that underpin weed management in Australia. It follows an independent evaluation of the previous strategy in 2013 (refer to Appendix A for further details on the evaluation) and captures significant recent developments in the national biosecurity framework more broadly, including the Intergovernmental Agreement on Biosecurity (IGAB).

Purpose of the strategy

The strategy provides national guidance on best practice weed management. It aims to guide coordination of effort across all jurisdictions and affected stakeholders and to inform plans and actions by state and territory governments, local governments, regional natural resource management (NRM) agencies, as well as by industry, landholders and the wider community.

The strategy provides information on where improvements can be made at the national level that will result in benefits across Australia. It draws attention to areas that require national collaboration and will drive the development of consistent and coordinated national approaches by providing clarity around priorities, roles and responsibilities.

This strategy supports three national goals: prevention, detection and early intervention; minimise the impact of established weeds; and enhance Australia's capacity and commitment to weed management. It also identifies priority areas where improving the approach to weed management has the potential to reduce instances of new weeds establishing and spreading in Australia as well as the negative impacts of established weed species.

The Invasive Plants and Animals Committee (IPAC) has oversight of the Australian Weeds Strategy and will use it to guide development of its annual work plan.

Scope of the strategy

A weed is considered pragmatically as a plant that requires some form of action to reduce its negative effects on the economy, the environment as well as human health and amenity. Although most plants that are considered weedy in Australia are exotic, some are also native to Australia. For example, Sydney Golden Wattle (*Acacia longifolia*), which was introduced to Western Australia, invades bushland, roadsides and creeks. The focus will be on preventing the establishment of, and managing existing exotic weeds. Native plants as weeds should be managed in accordance with state and territory legislation.

The strategy is a national strategy encompassing principles, goals and priorities across the four stages of weed management: prevention; eradication; containment; and asset protection.

Principles of effective weed management

Seven principles underpin weed management in Australia and these should be used to guide planning, investment and actions.

1. Effective weed management is a responsibility shared between landholders, community, industry and government.
2. Evidence-based decision-making should underpin the approach to weeds.
3. Risk-based prevention and early intervention is generally the most cost-effective approach for managing weeds.
4. Prioritisation of weed management must be informed by a risk based approach, considering feasibility, likelihood of success and impact.
5. Coordination amongst landholders, community, industry and government is necessary to manage weeds at a landscape scale.
6. Sustaining capability and capacity across landholders, community, industry and government is fundamental to effective weed management.
7. Individuals, organisations and industry groups that create risks that may result in a weed entering, emerging, establishing or spreading in Australia have a role in minimising the impacts and contributing to the costs of management.

Strategy goals and priorities

The strategy has three goals, each with priorities that aim to focus national action, coordination and investment (Figure 1).

Delivery of the priorities will require cooperation and collaboration between communities.

FIGURE 1 Vision, goals and priorities of the strategy

Vision

Protect Australia's economic, environmental and social assets from the impacts of weeds.

Goal 1. Prevention, detection and early intervention

Priorities:

1.1 commit to and continuously strengthen effective risk-based approaches to pre-border and border activities
1.2 adopt consistent risk assessment and prioritisation approaches within Australia
1.3 develop and implement early detection, diagnostics and monitoring systems for priority weed species.

Goal 2. Minimise the impact of established weeds

Priorities:

2.1 develop and improve national approaches to coordinate, invest and manage the impacts of weeds on values and assets
2.2 increase participation in coordinated management approaches across all land tenures
2.3 improve national approach, capacity and commitment to weed containment
2.4 enhance weed control techniques and integrate management options.

Goal 3. Enhance Australia's capacity and commitment to weed management

Priorities:

3.1 develop the knowledge, capacity and commitment of key stakeholders to play an active and constructive role in weed management
3.2 maintain and enhance long-term research, development and extension capacity and capability
3.3 develop and apply national data, information and knowledge infrastructure to support effective weed management
3.4 improve institutional arrangements and decision support resources to increase the effectiveness of weed management.

The impact of weeds in Australia

A weed is considered to be a plant that requires some form of action to reduce its negative effects on the economy, the environment and human health or amenity. Of the approximately 3,207 species of introduced plants that have naturalised in Australia, about 500 taxa (species and genera) have been declared noxious or are under some form of legislative control in Australia. Most of the significant weeds in Australia have been introduced.

Economy

Weeds reduce the quantity and quality of Australia's agricultural, horticultural and forestry products, which affects both industry and consumers. It is estimated that the cost to the Australian economy from the agricultural impacts of weeds is in the vicinity of $4 billion per annum (Sinden et al., 2004). This estimate includes the direct costs of weed control, reduction in yield and contamination of agricultural products. The economic impact of weeds on nature conservation, tourism and landscape amenity, although not quantified, is thought to be of a similar magnitude. A 2016 report by the Grains Research and Development Corporation found that weeds cost the Australian grains industry alone $3.27 billion annually in control measures and lost production.

Environment

Weeds affect the structure and function of land-based and aquatic ecosystems, and impact negatively on native fauna and flora. They can displace native plant species and harbour pests and diseases. Weeds can also increase the biomass of ecosystems leading to more intense bushfires, changing the composition and structure of native vegetation. For example, intense fires generated by Gamba grass can reduce tree density in tropical savannahs.

Weeds can threaten the integrity of nationally and globally significant sites, species and ecological communities, such as Ramsar-listed wetlands, cultural heritage sites and declared World Heritage areas. National parks and nature reserves, multi-use forest lands, urban and peri-urban public land all require ongoing weed control and monitoring.

Human health and amenity

Many weeds affect human and animal health, causing injury, allergies, dermatitis, poisoning, asthma and other respiratory problems. Weeds can form impenetrable thickets that hamper cultural activities, including food collection, recreational vehicle use and enjoyment of the bush. Weeds can also clog waterways, preventing boating and water sports, increase the risk of drowning and destroy fishing spots. Weeds have the potential to lower the aesthetic value of the Australian landscape and land values. The impact of weeds on the viability of an agricultural business can also place a great deal of stress on landholders, and can significantly impact psychological health.

Primary weed-spread pathways

The most cost-effective means of managing weeds is to prevent their entry into Australia at the border. While a zero-risk approach is not practically achievable, Australian biosecurity arrangements are in place to assess risks posed by plant and seed imports and minimise the entry of species that appear to pose a threat. Despite strong border controls, new weed species may arrive in Australia from overseas either deliberately through illegal activities and internet purchases, or inadvertently through trade, travel or weather.

A large percentage of weed species (at least 50% and possibly up to 70%) were originally imported for use as garden ornamentals. However, many of these species were imported a long time ago and modern improvements to biosecurity arrangements have significantly reduced this pathway. Post-border restrictions on the sale and trade of certain high-risk potentially invasive plant species are also in place to minimise the risk of new weed problems developing.

Once established in Australia, weeds can be spread across the landscape in a variety of ways including by birds, the wind or water. These dispersal pathways are impossible to restrict. However, dispersal caused by various forms of human activity can be regulated. There are legislative arrangements in most jurisdictions that aim to manage the movement of plant materials and goods that could be contaminated. Significant agricultural weed-dispersal pathways include transporting livestock and fodder, planting contaminated crop and pasture seeds, trade and other deliberate introductions of new species, and movement of contaminated machinery such as harvesters and tillage equipment. Railway corridors and roadsides are important dispersal pathways for agricultural and environmental weeds. Changing climatic conditions may allow tropical species to extend further south, temperate species to retreat further south and summer growing species to become prevalent in southern regions. Australia's public and private gardens harbour a large number of plants with long-term weed potential. It is estimated that an average of twenty plant species become naturalised (start to grow wild) in Australia each year (Dodd et al., 2015).

CASE STUDY 1

E-commerce: a high-risk pathway for invasive species entering Australia in the next decade

E-commerce includes buying and selling goods and services over the internet. In recent years, the internet has become a very popular way of obtaining ornamental plant seeds and bulbs. This poses significant threats to our ability to manage weeds, allowing potentially invasive species to enter Australia, competing with native species and introducing pathogens and pests that could adversely affect crops and native habitats.

Mexican Feather Grass (*Nassella tenuissima*) is a highly invasive ornamental grass that could dominate large areas of Australian woodlands and grasslands. Despite being banned, this plant is available for sale in garden centres and online through trading sites such as eBay and Alibaba.

Working with suppliers and building public awareness about the risks associated with purchasing seeds and bulbs online is important to ensure that potentially invasive plants such as Mexican Feather Grass do not enter Australia.

Mexican Feather Grass (*Nassella tenuissima*)

National approach to biosecurity and weeds

Australia has a sound reputation as a safe and reliable agricultural and trading nation, and has unique biodiversity that should be maintained. The continued strength of our agricultural sector is essential to our economy and national prosperity. It is in the national interest to continuously improve approaches to reducing potential risks and impacts of weeds in Australia.

The national biosecurity system encompasses the full range of activities undertaken by governments, industry, natural resource managers, custodians or users, and the community across the biosecurity continuum, including prevention, emergency preparedness, detection, response, recovery and on-going management of established pests and diseases.

This strategy aims to be consistent with current biosecurity policy, in particular the IGAB and is also guided by a range of other national strategies and action plans, including both the Australian Biodiversity Conservation Strategy and threat abatements plans under the *Environment Protection and Biodiversity Conservation Act 1999*.

It translates biosecurity and other related policies into an approach that governments, landholders, industry and the community can use to guide their weed planning and management efforts. Figure 2 depicts the relationship between the policies and strategies, and work at the national, state and local level.

Intergovernmental Agreement on Biosecurity

The Intergovernmental Agreement on Biosecurity, or IGAB, (Council of Australian Governments 2012) is an agreement between the Commonwealth, state and territory governments (with the exception of Tasmania) that aims to improve shared management of risks posed by pests and diseases entering, emerging, establishing or spreading in Australia.

The IGAB was developed to improve the national biosecurity system by identifying the roles and responsibilities of governments. It provides the direction and framework to achieve a national biosecurity system. The schedules to the agreement outline agreed priority areas for collaboration to improve the system.

This agreement outlines eight principles underpinning our national biosecurity system.

1. Biosecurity is a shared responsibility between all governments, industry, natural resource managers, custodians or users, and the community.
2. In practical terms, zero biosecurity risk is unattainable.
3. The pre-border, border and post-border elements of the biosecurity continuum are managed to minimise the likelihood of biosecurity incidents and mitigate their impacts.
4. The biosecurity continuum is managed through a nationally integrated system that recognises and defines the roles and responsibilities of all sectors and sets out cooperative activities.
5. Activity is undertaken and investment is allocated according to a cost-effective, science-based and risk-management approach, prioritising the allocation of resources to the areas of greatest return.
6. Relevant parties contribute to the cost of biosecurity activities.
7. Risk creators and beneficiaries contribute to the cost of risk management measures in proportion to the risks created and/or benefits gained (subject to the efficiency of doing so).
    a. Governments contribute to the cost of risk management measures in proportion to the public good accruing from them.
    b. Governments, industry, and other relevant parties are involved in decision-making, according to their roles, responsibilities and contributions.
8. Australia's biosecurity arrangements comply with its international rights and obligations.

Established pests and diseases of national significance framework (IGAB schedule 5)

A key component of the national biosecurity system is a national management framework to ensure that nationally significant pests and diseases established in Australia are contained, suppressed or otherwise managed. The Established Pests and Diseases of National Significance (EPDNS) Framework provides a strategic, consistent, scientific, risk-based approach to managing the impacts of established pests and diseases.

The framework:

- establishes policy principles to guide government decision-making and cooperation to better manage the consequences of established pests and diseases of national significance
- clarifies the role of government, industry, community, landholders and risk creators in managing established pests and diseases of national significance–including when a particular party is to take a lead responsibility in managing a particular pest or disease
- establishes criteria to help determine which established pests and diseases should be deemed 'nationally significant'.

It highlights that the sustainable management of established pests and diseases is resource intensive and requires shared responsibility and effective coordination among the key stakeholders. This policy approach recognises the need to maximise the return on investment in weed management and consider who predominantly benefits from potential investments.

National surveillance and diagnostics (IGAB schedule 4)

Another important component is a comprehensive national surveillance and diagnostic system that provides for early detection and accurate and timely diagnosis of pests and diseases. Surveillance and diagnostic activities support weed management within the national biosecurity system by:

- enabling new incursions of exotic and emerging weeds to be detected
- providing evidence of the absence of a weed for ongoing access to overseas markets
- monitoring changes in the distribution of weeds, to allow associated risks to be identified and managed.

The National Surveillance and Diagnostics Framework provides an integrated approach to the funding and management of surveillance and diagnostics across jurisdictions. Under this framework, national plans and strategies will guide surveillance and diagnostic priorities and investment for weeds.

National emergency preparedness and response arrangements (IGAB schedule 7)

A third component identified is national emergency preparedness and response arrangements that:

- comprehensively cover industries, the environment and community under pre-arranged governance and cost-sharing agreements
- maintain an effective level of preparedness and response arrangements across jurisdictions to adequately respond to biosecurity incidents and emergencies across the biosecurity continuum.

The National Environmental Biosecurity Response Agreement (NEBRA) provides a cost-sharing mechanism for emergency responses to weed incursions impacting the environment. This agreement ensures a planned, rapid eradication response to exotic pest and disease incursions, with most of the often difficult decision-making and funding arrangements agreed in advance of an outbreak.

A new agriculture weed response agreement is being developed by governments and industry to fill the gap identified in the national emergency arrangements relating to managing exotic weed incursions with the potential to have serious impacts on agricultural production.

FIGURE 2 Context for the Australian Weeds Strategy

Intergovernmental Agreement on Biosecurity

Establishes national goals and objectives for biosecurity. Aims to strengthen the working partnership between governments and improve the national biosecurity system. The schedules under the agreement identify priority areas for collaboration.

National Environmental Biosecurity Response Arrangements

Establishes the national arrangements for responding to significant pest and disease incursions where there are predominantly public benefits.

National related strategies

Australian Biodiversity Conservation Strategy

Guides biodiversity conservation policies and programmes and is Australia's National Biodiversity Strategy and Action Plan under the *Convention on Biological Diversity*.

Australian Weeds Strategy

Translates higher level policies and strategies into nationally agreed principles, goals and priorities to guide weed management.

Implementing the strategy through the plans below will require leadership and commitment from landholders, industry, communities and governments.

State and territory governments

Biosecurity, weeds (strategies/plans).

Each state and territory has relevant plans or strategies that outline their weed policy and legislation.

Weeds of National Significance

WoNS have individual national strategic management plans. These plans define responsibilities and identify strategies and actions to control the weed species. They facilitate coordinated action from all stakeholders at a national level and improve linkages between research and ongoing control.

Threat abatement plans

These plans describe the research, management and any other actions necessary to reduce the impact of a listed key threatening process under the *Environment Protection and Biodiversity Conservation Act 1999* on native species and ecological communities.

Regional

National Resource Management plans

Regional weed plans

Each NRM region and organisation has a plan or strategy that identifies local weed priorities and coordination and control approaches.

Local government

Weed plans and actions

Local governments are responsible for the implementation of weed control on public lands they manage. These identify weed risks and control approaches at the local level.

Community groups

Local community groups and actions

Groups are present in many local communities that plan and drive collective action across landholders in their area.

Industry

Best practice and quality assurance programs

Industry best practices often specify weed species and preferred management approaches relevant to the industry.

Property

Property management plans

Landholders can draw on the relevant aspects of all of these plans to develop their own property level plans.

Includes all private and public landholders and keepers of exotic species.

Farm biosecurity plans

Landholders can utilise farm biosecurity measures to protect their properties from the entry and spread of diseases.

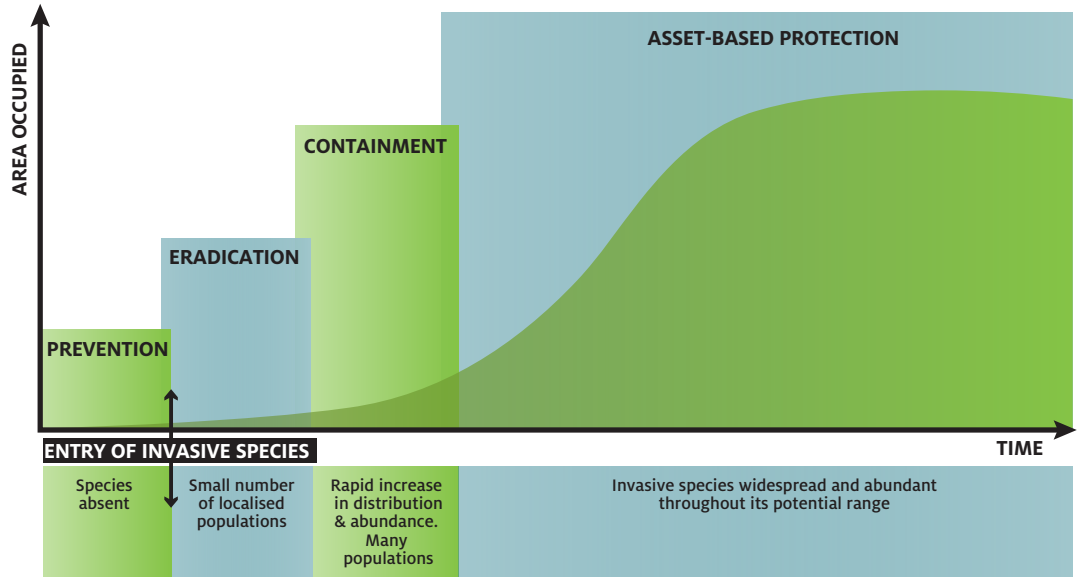
Stages of weed management

Over time, a weed invasion/incursion consists of sequential phases of introduction, establishment and spread until, in the absence of control, the population can fill its entire potential range. Some species spread slowly, whereas other spread rapidly. The full range of weed management options generally fall into four categories or types, depending on the stage of invasion: (1) prevention, (2) eradication, (3) containment and (4) asset protection. This helps demonstrate the wide range of tactics, management approaches and people required to successfully respond to weed challenges.

The four types of management are illustrated on the generalised invasion curve (Figure 3) and described in detail in Appendix C.

These stages of management can be applied at the national scale (for example, preventing a new weed species from entering Australia) or at a state, regional or local scale (such as preventing a weed from entering a property). The nature of weed dispersal pathways means coordinated action by all stakeholders is necessary to effectively prevent new incursions and minimise the impacts of established weeds. The nature of weed dispersal pathways means coordinated action by all stakeholders is necessary to effectively prevent new incursions and minimise the impacts of established weeds.

FIGURE 3 Four stages of weed management—the generalised invasion curve



Source: Victorian Government (2010) Invasive Plants and Animals Policy Framework, DPI Victoria, Melbourne.

Roles and responsibilities

Weed management is a shared responsibility, involving people and organisations from the local to the national scale.

The broad roles and responsibilities for different stakeholders vary across prevention, eradication, containment and asset protection, based on who is best placed to undertake that role. There can also be differences between jurisdictions and landscapes.

However, everyone has a responsibility to ensure that their actions do not introduce new or exacerbate existing weed problems.

There are challenges ensuring that all stakeholders undertake their responsibilities in weed management.

Landholders (public and private) and co-existing land users

Responsibilities include:

- detect and report new weed occurrences
- control and manage weeds to mitigate, as necessary, the impacts on their own assets, or as required by regulation
- take reasonable steps to minimise the impacts of weeds on other landholders, particularly through participation in programs of collective industry or community-led action, and on people and the broader environment
- identify and manage all biosecurity risks, including risks associated with goods, vehicles and people entering the property
- implement weed seed hygiene procedures to minimise establishment or spread of high risk weed species
- cooperate with and plan weed management activities jointly with neighbours, including state, territory and local governments, within a landscape scale/cross-tenure approach
- apply knowledge and skills to improve weed management and understand the need to use multiple approaches (e.g. chemical, physical, biological) to prevent weeds from adapting to existing controls.

Australian Government

Responsibilities include:

- honour international treaties and to contribute to global environmental and trade initiatives
- oversee herbicide and pesticide regulation
- provide leadership and coordination for emergency responses to weed incursions of national significance
- provide a legislative framework, including biosecurity and environmental legislation, to minimise the risk pre-border and at the border of weed incursions including undertaking enforcement actions and regulatory interventions with respect when necessary
- work with people or groups that have the potential to create weed risks before or at the border (for example importers) to assist adoption of risk management measures as part of normal business practices
- manage weed problems on Australian Government land in a responsible way, in co-operation with other landowners
- facilitate coordinated policy across jurisdictions for the management of established weeds of national significance
- provide support where there is sustained collective national action to manage an established weed by an industry or community
- support national research and development of improved weed control or management when there is a strong public interest to do so, and through matching industry contributions to rural research and development
- work with state and territory governments to provide mechanism by which weed issues of national significance can be identified and addressed
- coordinate, facilitate and promote national weed management policies and programs
- provide leadership, coordination and resources for research, evaluation and education to build public awareness and knowledge of weed issues of national significance
- encourage and support the development and integration of effective weed management strategies at all levels of management
- promote the development of ongoing partnerships between governments, industry, community and scientists
- support the collection and collation of national weed data and information.

State and territory governments

Responsibilities include:

- lead and coordinate emergency responses to priority weed incursions of state and territory significance and take all reasonable steps to eradicate state and territory prohibited weeds
- build coordination and collaboration in weed management at local, regional and state and territory levels
- encourage responsible weed management by providing a suitable institutional, legislative and regulatory framework; developing and implementing effective policies and programs; and where appropriate, providing positive support measures (not necessarily financial)
- provide leadership, coordination and resources for research, evaluation, advisory services and education programs about weeds
- encourage the development of effective weed management strategies at local, regional, state and territory and national scales
- provide support where there is sustained collective action to manage an established weed by an industry or community in their state or territory
- manage weed problems on state and territory government land, state and territory-managed corridors and waterways in a responsible way, in co-operation with other landowners
- when necessary for containment of an established weed, work with other state and territory governments to apply nationally consistent regulatory measures only to the minimum extent necessary to manage unacceptable risks
- work with other jurisdictions and stakeholders to coordinate policy for the management of established weeds of national significance
- work with people or groups that have the potential to create weed risks after the border (for example transport companies) to assist adoption of risk management measures as part of normal business practices
- undertake enforcement actions and regulatory interventions with respect to individual landholders only when necessary to support sustained management of widely established weeds by an industry or community
- provision of diagnostic services through herbarium and laboratory resources
- support research, development and extension of improved weed control or management when there is a strong public interest in the state or territory to do so
- support the collection of weed data and information that can be collated nationally.

Local governments

Responsibilities include:

- exercise statutory duties to encourage responsible weed management
- manage weed problems on local government land in a responsible way, in co-operation with other landowners
- assist with the coordination of community weed management programs
- represent community interests in weed management
- support the activities of local groups undertaking weed management
- assist with data collection and information exchange
- develop and adopt 'good neighbour' policies, where appropriate, to help reduce the spread and impacts of high risk weed species
- support and build public awareness about weed issues.

Industry groups

Responsibilities include:

- lead, promote and participate in collective action based on industry needs at a local, regional or national level to mitigate impacts of established weeds of national significance on industry assets
- build weed risk mitigation measures into normal industry practices (for example, quality assurance programs)
- support and promote industry or market-driven approaches to established weed management where practical and applicable
- support research, development and extension of established weed management that provides industry benefit
- help provide their members with information on weed issues and best practice management approaches
- contribute to research and development programs to improve weed management best practice for different agricultural and natural systems, as appropriate
- help develop and encourage the adoption of codes, policies and plans that improve the effectiveness of weed management
- provide leadership and direction regarding weed risk minimisation
- assist with data collection and information exchange
- support and build public awareness about weed issues.

Community groups

Responsibilities include:

- lead, promote and participate in collective action based on industry needs at a local, regional or national level to mitigate impacts of established weeds of national significance on community assets
- provide leadership and direction regarding weed risk minimisation
- represent community interests in weed management
- assist with data collection and information exchange
- support and build public awareness about weed issues.

Natural resource management bodies

Responsibilities include:

- help monitor weed impacts and play a regional surveillance role for detecting high risk weed species that pose risks to their region or could spread to other regions
- work with landholders and government to develop effective regional weed management programs
- play a role in coordinating and implementing regional and catchment-based weed management plans
- represent community interests in weed management
- assist with data collection and information exchange
- support and build public awareness about weed issues.

Mouse-ear hawkweed (*Hieracium pilosella*)

National strategy, goals and priorities

The vision of the strategy is that Australia's economic, environmental and social assets are protected from the impacts of weeds.

It is useful to consider three key forms of weed management: prevention and early intervention of incursions; eradication and containment of established weeds and asset protection; and the underpinning tools, resources and skills that are required.

The goals and priorities in the strategy are shaped around these three key areas:

- **Goal 1** Prevention, detection and early intervention
- **Goal 2** Minimise the impact of established weeds
- **Goal 3** Enhance Australia's capacity and commitment to weed management.

Each goal is addressed by a suite of priorities building on experiences and achievements gained in weed management in the past decade. These priorities are areas where opportunities for improvement have been identified by stakeholders.

Goal 1 Prevention, detection and early intervention

Minimising the entry of potential weeds into Australia is the most cost-effective area for action. This goal aims to prevent the entry of high-risk weeds and to intervene early in the event that a high-risk weed is detected. It encompasses two key areas of weed prevention and management:

- prevention through pre-border and border activities
- eradication approaches for weeds when technically feasible.

Three priority areas are identified to support prevention, early detection and response to high-risk weeds.

Priority 1.1 Commit to and continuously strengthen effective risk-based approaches to pre-border and border activities

The Australian Government aims to provide a leadership and investment role in the pre-border and border activities that help minimise the entry of high-risk weed species into Australia. It is essential to maintain these risk-based approaches, and look for continual improvements.

Stakeholders that expose Australia to high risks also have an important role to play in preventing new weeds species from establishing.

There are a range of frameworks, guiding materials and resources to support early intervention. This priority identifies two key areas that will help improve prevention and early intervention:

- frameworks or agreements that help guide leadership responsibility, roles for different stakeholders and mechanisms to trigger and coordinate effort in cases where early intervention is in the national interest
- proactive plans and approaches for areas or stakeholders associated with high-risk pathways for the entry and spread of weeds in Australia.

At a national level, the National Environmental Biosecurity Response Agreement (NEBRA) guides responses to significant biosecurity incursions where there are predominantly public benefits. This includes, but is not limited to, environmental weeds.

However, there is a gap in national emergency arrangements that relate to managing incursions of exotic weeds with the potential to have serious impacts on agricultural production.

An agriculture weed response agreement is being developed by Australian, state and territory governments, in partnership with industry, to fill this gap.

There is considerable merit in pre-agreed institutional arrangements for early intervention, where such action is in the national interest. These agreed institutional arrangements should be monitored and improvements incorporated as new issues arise.

Risk-creators should play an active role in minimising risks and invest in risk mitigation measures, where appropriate and feasible to do so.

Priority 1.2 Adopt consistent risk assessment and prioritisation approaches within Australia

Risk-based approaches underpin effective weed management and need to be applied consistently by governments and industries. Risk-based approaches to weed prevention and early intervention include:

- identifying potential risks, both pre-border and post-border
- assessing the degree of risk of proposed plant introductions (for example, for agriculture, horticulture, forestry and gardening)
- identifying risk management measures.

Advances in science and evidence-based approaches to support risk management strategies need to be adopted and communicated to key parties. These risk-based processes are supported by knowledge of:

- which plants are potential weeds, what assets they threaten and what are the most likely invasion pathways
- the ways in which weeds spread to new areas (dispersal pathways)
- environmental conditions that may favour certain weeds (habitat suitability).

Priority 1.3 Develop and implement early detection, diagnostics and monitoring systems for priority weed species

To support early intervention, high-risk weed species must be detected as early as possible and processes and practices put in place to achieve a timely response.

This priority highlights the importance of continuing to improve systems and structures for the collection, verification, storage and analysis of surveillance information. In particular, there are four areas where effort can be focused:

- increase effectiveness of invasive plant management through earliest detection of new incursions (both new and range expansions of existing invasive plants)
- develop and implement consistent post-border surveillance systems and structures to improve earliest detection capabilities and facilitate rapid response where required
- integrate invasive plant surveillance into biosecurity policy and processes at all levels of government
- increase the understanding and recognition of the importance of surveillance.

Consistent with the National Surveillance and Diagnostics Framework developed under the IGAB, a National Invasive Plant Surveillance Framework is being developed with national objectives and actions that will enhance the effectiveness of existing jurisdictional surveillance programs.

It is important for the framework to detail the roles of the community and other key stakeholders in surveillance, what systems need to be established to support their role, and how information will be communicated and shared.

CASE STUDY 2

Mouse-ear hawkweed eradication

Hieracium pilosella, known as mouse-ear hawkweed, is a herb in the daisy family that is native to Europe. It is highly invasive in New Zealand, North America and Japan. Mouse-ear hawkweed has impacted over six million hectares of the south island of New Zealand, reducing grazing lands for livestock and displacing native grassland species. Four incursions are documented from Australia, all of which are subject to eradication. If it were to spread, mouse-ear hawkweed would have severe conservation and agricultural consequences throughout south-east Australia.

Hawkweeds are able to tolerate a wide range of environmental conditions, including poor soil and snow. They invade grasslands and other habitats, and secrete chemicals that damage the roots of other plants. They reproduce vegetatively by creeping stems that form mats over native vegetation, and seeds are spread by wind, and moved by animals and humans. Hawkweed limits the availability of nutrients in the soil, making it difficult for other species, such as pasture species, to grow. In New Zealand, mouse-ear hawkweed has become established in vast areas of extensively-grazed, tussock grassland.

In December 2014, a bushwalker discovered a small infestation of mouse-ear hawkweed in Kosciusko National Park. The bushwalker reported the weed to the NSW National Parks and Wildlife Service (NPWS), who then investigated and confirmed an infestation which covered 0.015 ha (150m^2). As the location is a popular camping area, the cause is thought to be from seeds carried on camping or hiking equipment.

The NSW incursion response was led by NPWS, and within six days of the identification the site was quarantined, mapped and the weed controlled. The surrounding area was surveyed, and monitoring plots were established to determine the response of hawkweed to the herbicides used, and ensure no re-establishment.

The response was continued in the 2015/16 season by NPWS with support from the NSW Department of Primary Industries, and continues to delimit the infestation and ascertain any further seed dispersal. Although seeds are commonly only viable for two years, some are able to survive up to five years in soil, making it vital to maintain surveillance throughout the eradication program.

Surveillance is continuing with the assistance of the NSW Weed Eradication Detector Dogs. For this eradication program, detector dog Sally was employed. Sally is able to detect very small plants and seedlings via scent, and is skilled at detecting hawkweed plants at low densities, as well as those growing under dense cover. Every time Sally finds a mouse-ear hawkweed plant or seedling, she is rewarded with a tennis ball. In March 2016, Sally, together with her human team, discovered three new plants within 100m of the core infestation area that have now been controlled. Together with human surveillance teams, the dogs are working to delimit the infestation.

Surveillance will continue in areas considered as high priority to ensure mouse-ear hawkweed does not establish elsewhere, and that all plants are eradicated. To prevent accidental spread of hawkweed, hygiene protocols have been put in place. Growing publicity concerning hawkweeds has increased community awareness about hawkweed eradication. Only when every individual plant has been located and controlled, and the seedbank is exhausted, can mouse-ear hawkweed be considered eradicated. Based on the positive outcomes of the eradication program so far, eradication of mouse-ear hawkweed in NSW appears achievable in the foreseeable future.

Goal 2 Minimise the impact of established weeds

This goal addresses two broad stages of weed management—containment and asset protection. Four priorities are identified.

Priority 2.1 Develop and improve nationally coordinated approaches to manage the impacts of weeds on values and assets

Some weeds are best addressed at a regional or local level. However, for species that are either nationally significant, widespread or highly damaging, a more strongly coordinated approach to investment and management is often more desirable.

Governments can play an important leadership role, especially where a weed has already been assessed as nationally significant. In other cases, industry and communities may be better placed to develop and lead action plans and recruit support from other stakeholders.

The National EPDNS Management Framework guides this process. The scientific, risk-based approach and methodology contained in the National EPDNS Management Framework will be applied and continuously improved to help prioritise where national coordination, investment and action is most needed.

This framework outlines the criteria for assessing and listing weeds of national significance, based on impact, feasibility of management intervention and benefits from national coordination.

Where a weed species has been agreed to be nationally significant, a customised plan will be developed.

For the existing 32 Weeds of National Significance (WoNS), customised and targeted plans have been developed (see Appendix B for more information on WoNS). Their local, regional and national implementation often necessitates a joint stakeholder approach. These plans, as well as lists of nationally significant species, should be reviewed over time to ensure they remain relevant and advances in best practice are incorporated. The National EPDNS Management Framework outlines the process for de-listing weed species.

Further weeds may be assessed and listed as nationally significant in the future, using the criteria in the National EPDNS Management Framework, and subsequent plans would be developed for these species.

Priority 2.2 Increase participation in coordinated management approaches across all land tenures

This priority recognises the importance of cross-tenure weed management, as well as the need for increased community involvement in weed management. When management practices are coordinated, the benefits rise as the number of participants increases. It is not about creating new technology to battle weeds, but the community based approach means that management is more effective. Resolving weed management conflicts across tenures is one of the many challenges of weed management.

All of the existing 32 WoNS have transitioned to Phase 3, a period of continued maintenance overseen by states and territories, with management predominantly the responsibility of landholders. This transition is because achievements have been made for all species, such as the development of management plans and best practice guides.

To continue to realise the benefits of this approach over the long-term, a commitment is needed from all landholders to fulfil their roles and responsibilities and work together. The strategy acknowledges resolving conflicts in priorities to manage weeds is a challenge.

Blackberry in Victoria is a great example of the effectiveness of a community driven management approach.

CASE STUDY 3

Blackberry—a community-driven approach in Victoria

Blackberry the weed (*Rubus fruticosus* aggregate) was first introduced to Australia by European settlers in the mid-1800s as a fruit. It was recognised as a weed by mid-1880s. Blackberry is a serious issue across Australia. It is estimated that blackberry infests approximately 8.8 million hectares of land at an estimated cost of $103 million in annual control and production losses.

Blackberry can severely decrease the productivity capacity of land, alter water flow, lead to erosion problems and provide harbour for pest animals. The available evidence also points to blackberry inflicting a high emotional toll and causing significant distress to farmers with negative flow-on effects for rural communities.

An integrated approach is required for effective management of blackberry using a combination of control measures. These includes slashing, grazing, fire, grubbing, herbicides and biological control. The goal is to prevent new infestations, reduce current infestations and rehabilitate infested land. Blackberry management strategies are most successful when people work together.

In Victoria, the Victorian Blackberry Taskforce (VBT) was established to work with Victorian communities and government agencies to provide a collaborative effort to control blackberry.

The taskforce encourages a cross-tenure landscape level approach led by the community that focuses on the 'common problem'. Through this initiative, blackberry control groups are supported to work together to apply a nil-tenure model. On-ground work by the blackberry control group has included planning and coordination as well as other weed control activities.

Listening is an important part of the approach—to local problems, local experience and landholder ideas, both their potential and their constraints. Blackberry action groups act locally and feed their experience into the VBT, who then feed these experiences back to government agencies.

This initiative has built the capacity of the communities and brought them together to develop a shared ownership of the blackberry problem. It provides a great example of the approach highlighted in the EPDNS framework, delivering positive economic, environmental and social outcomes.

Priority 2.3 Improve national approach, capacity and commitment to weed containment

There is a need to improve decision-making support tools that can advance containment planning and implementation. For example, tactics and guidance tools that help inform which stage of weed management is appropriate (for example, eradication versus containment or asset protection). When a weed requires a nationally coordinated containment approach, a similar evidence-based decision process to that of nationally significant species should be adopted. This includes:

- assessment of the current and future impact of the weed
- understanding the feasibility of controlling spread and management of the weed
- a demonstrable benefit from a national approach.

The National EPDNS Management Framework will help guide this process for weeds that are established, including when national coordination is appropriate. Containment activities should be supported and promoted by industry and the community. For an activity to be successful, this means engaging affected landholders in cross-tenure management, as well as landholders at the edges of the infestation and risk creators (for example, a trucking company where weed seed spread is an issue).

Where containment within a boundary is the aim, institutional arrangements that support investment and coordinated action may also be needed. In particular where a small number of landholders might bear a high cost for managing the weed at a boundary where the benefits of this protection are received by others. Developing ways to ensure that a fair approach is taken to reduce risks and impacts for other parties is important for encouraging participation.

Industry-driven approaches such as codes of practice and quality assurance can assist with containing weed species. These approaches can facilitate overseas market access for farmers by contributing to demonstrating area of freedom for certain weed species.

Priority 2.4 Enhance weed control techniques and integrate management options

The complexities of weed management are such that rarely will a single approach achieve the desired outcome of eradication, containment or asset protection. Improved understanding of the biology and ecology of individual weeds and the environmental and human-induced factors that influence abundance and distribution should be based on sound science and presented in ways that are meaningful to different stakeholders working in different conditions. Significant contributors to this priority include:

- research, development and extension (RD&E) to support improving best practices for weed management
- RD&E to sustain the effective and safe use of herbicides as an important tool in agricultural production systems
- continuous improvements in knowledge and resources for landscape-scale weed management
- nationally coordinated approaches to selecting new biological control agents for priority weeds.

Goal 3 Enhance Australia's capacity and commitment to weed management

This goal identifies four priorities that support requirements and resources needed to improve weed management across the four broad types of weed management: prevention, eradication, containment and asset protection.

Priority 3.1 Develop the knowledge, capacity and commitment of key stakeholders to play an active and constructive role in weed management

Landholders in different parts of the landscape, those operating under different conditions, and those from different educational or learning backgrounds will benefit greatly from information that is appropriately targeted to their needs. Rarely does a 'one size fits all' approach to information and training suffice.

In many instances, even with knowledge, landholders may not have the finances, time or other capacity to play an active role in weed management, especially if they do not recognise the benefits to their enterprises from improved weed management.

In striving to build stakeholder knowledge, capacity and commitment to become actively involved in weed management, it is important to:

- provide information in different formats
- encourage learning from each other
- encourage and empower stakeholders to build their understanding of weed management and to work with others to develop actions customised to their own weed management needs.

Priority 3.2 Maintain and enhance long-term research, development and extension capacity and capability

Research, development and extension are crucial to sound, evidence-based systems for the prevention and management of weeds. For established weeds, specific focus areas are:

- investment over appropriate timeframes and the support and maintenance of research capacity
- RD&E to sustain herbicide utility for productivity in agricultural systems
- a nationally coordinated approach to the selection of new biological control agents for priority weeds
- better understanding of landholder behaviour (barriers, attitudes, ways to better work with stakeholders to encourage improved weed management) and their related economic drivers.

This priority aims to keep research targeted and focused in areas that can strengthen the risk-based approaches adopted to cost effectively and feasibly respond to weed challenges. Research, development and extension also help to develop and update best practice, and to customise best practice for different stakeholders, industries and/or species.

Weed control methods often take years to develop, and require specialist scientific skills and capabilities. To deliver the control methods of the future it is important that research, development and extension activities, and associated funding arrangements are maintained with a long-term focus. Biological control is a great example of the importance of ongoing long-term commitment to research, development and extension.

The 2013 National Plant Biosecurity RD&E Strategy outlines RD&E priorities for plant biosecurity, which includes weeds that impact agricultural production.

CASE STUDY 4

Paterson's curse—biological control delivers billion dollar dividend

Echium plantagineum known alternatively as Paterson's curse, Salvation Jane and the Riverina Bluebell, was introduced to Australia from Europe during the mid-nineteenth century. It became Australia's worst broadleaf temperate pasture weed, covering more than 10 million hectares and costing nearly $40 million a year in lost production.

Not only does this weed crowd out more useful and productive pasture, it is also cumulatively toxic to livestock, with horses being particularly susceptible.

It has high seed production (thousands of seeds per square metre), seed longevity of more than seven years and an ability to germinate at any time of year, given the right conditions, which limits the effectiveness of herbicide and grazing control tools in containing its spread across the Australian continent.

But Paterson's curse has proved an excellent candidate for biological control.

In 1970 the CSIRO began a biological control program. Initial efforts were interrupted due to a court case involving bee keepers, but recommenced in earnest in the late 1980s.

Seven biological control agents were released through the 1990s and redistributed through the early 2000s.

Three of those agents—the root crown weevil, the taproot weevil and the flea beetle—proved highly successful in reducing the density and abundance of Paterson's curse.

Surveys in northern Victoria suggest weed densities and biomass have dropped between 80 and 90 per cent, with similar results being observed in South Australia and Western Australia.

An economic assessment for this control program has shown that for a research and development investment of $23.1 million the net present value benefits are on target to be $1.2 billion by 2050.

Priority 3.3 Develop and apply national data, information and knowledge infrastructure to support effective weed management

Monitoring and evaluation is needed to ensure the optimal return on investments. Infrastructure and agreed protocols for consistent data collection are necessary to address this priority. Some of the ways in which improvements can be made include:

- collect and share information on weeds, their impact and spread pathways
- develop improved resources to support evidence-based decision-making.

In the absence of sound data collection, monitoring, evaluation and reporting of the distribution and impacts of weeds across Australia, it is difficult to assess return on investments. While it is recognised that long-term and persistent effort is often required to a make real difference to the impacts of established weeds, consistent data collection and regular analysis of that data are essential to assess progress and maximise the effects of investment.

Areas where monitoring and impact assessment could be improved include:

- development of uniform methodology to assess and measure impacts
- asset assessments—to assess which assets in Australia need to be protected and the impact weeds have on these assets
- identifying management options available to respond to weed impacts, including the costs and unintended effects these management options have
- recognising effective industry and community-led weed monitoring of management practice and their effects (for example, encourage on-ground community led action as opposed to regulatory/top down actions).

Blackberry (*Rubus fruticosus*)

Priority 3.4 Improve institutional arrangements and decision support resources to increase effectiveness of weed management

Participants in the review of the 2007 AWS made frequent reference to the negative effects of differing policies, programs and legislative arrangements between jurisdictions. To the extent possible, consistency across different levels of government and between state and territory governments will better enable landholders and others to recognise, accept and implement their responsibilities in coordinated weed management. Some of the ways in which these improvements might be progressed include:

- developing consistent assessment criteria and approaches that guide government involvement (for example, investment and coordination)
- continue the development of resources to support risk-based and evidence-based decision-making and enhance understanding, including:
  - cost benefit analysis tools
  - coordination and strategic approaches
  - triggers for a weed to be accepted as nationally significant
  - support material to help guide response goals and whether they should be directed to prevention, eradication, containment or asset protection in particular circumstances
  - clarity of the roles of the various stakeholders
- resources, expertise and knowledge shared across relevant parts of state and local government within jurisdictions to support effective detection and response processes.

Paterson's curse (*Echium plantagineum*)

Implementation

IPAC is responsible for developing and maintaining this strategy. It comprises representatives from Australian, state and territory governments and reports to the National Biosecurity Committee.

The key to successful implementation is collaborative effort. People from different sectors with different roles and responsibilities should consider how they might best adopt the principles, goals and priorities and work with others to maximise outcomes. An action plan for each priority area should be developed by the key parties who might be best placed to play an active role in developing approaches and/or supporting material or delivering actions that respond to the priority.

The principles should be considered by all stakeholders. Where further guidelines, tools, training or resources are needed to help different stakeholders implement these principles, or to progress national goals and priorities, leadership is encouraged from stakeholders best placed to help develop this material and share it with others.

The goals and priorities are relevant to all stakeholders. There are some areas where governments need to play a leadership role and other priorities that may require leadership from other stakeholders.

This strategy guides weeds management over the next 10 years. The strategy will be reviewed at a midpoint and after 10 years to identify progress and incorporate changes to national frameworks and approaches as well as changes in weed priorities. Sound data collection and monitoring at all levels will inform any reviews and will be critical to future improvements.

Appendix A: National weed management achievements and lessons

Both the National Weeds Strategy released in 1997 and the updated and revised strategy released in 2007 provided strategic frameworks for managing weeds at a national level.

The effectiveness of the 2007 AWS was evaluated in a national survey in 2013. More than 200 people from all states and territories and all sectors responded. Fifty-two people from across local, state and territory and Australian governments, regional organisations, landholders, industry, scientific research and interested community members were interviewed to obtain a more in-depth understanding of feedback provided on the AWS. Input from these stakeholders has helped strengthen the national approach to weed management.

Key messages from evaluation of the 2007 AWS are summarised in this section.

Overall achievements

The AWS provided an important strategic framework for weed management in Australia. This was valued by government agencies, researchers, NRM facilitators, landholders and others involved in weed management across Australia.

The principles agreed within the strategy were important in building and maintaining collaborative effort in addressing weed management. The principles informed weed management planning in consistent ways across different sectors and levels of government.

The prioritisation process developed for weeds (the identification of WoNS) provided a cost-effective mechanism for raising community awareness of Australia's weed problems, providing targeted and timely management information, facilitating collaborative effort among different stakeholders, and establishing strategic management plans and monitoring progress against them. Despite some concerns about the negative impacts of adopting a single-species approach, the prioritisation process was widely applauded as a major achievement.

Despite being seen as an aspirational document, the 2007 AWS was acknowledged as an important framework that aligned well with the then recently introduced IGAB.

Prevention

Science-based, pre-border weed risk assessment and protocols are well developed and highly regarded. There is support for retaining capacity for both risk assessment and the application of quarantine protocols.

There is a need to ensure that the science that underpins weed risk assessment is retained and focused. National and international research provides an important foundation for the latter.

Stakeholder awareness and prioritisation of the need to prevent or eradicate high-risk weeds is low and needs to be improved. Significant risks currently exist in the form of non-traditional entry mechanisms such as on-line mail order shopping.

Eradication and containment

Improved leadership, coordination and funding approaches are necessary to underpin eradication and containment of weed species.

Monitoring, early detection and response capability are critical to improve the likelihood of successful weed eradication and containment.

Attracting and maintaining investment in a timely manner for eradication is challenging but essential to the effectiveness of this effort.

Leadership, roles and responsibilities and coordination mechanisms need to be clearly defined so that, should an incident occur, urgent action towards eradication or containment can be effective across state/territory borders. Consistency of legislation across borders is an important element of this coordination.

Managing established weeds

Government resource constraints and lack of continuity of effort are important factors affecting the level of success in managing established weeds. This highlights the importance of sound prioritisation of national funding allocations and collaborative effort.

There is a need for greater clarity and coordination of roles and responsibilities for managing weeds in order to maximise return on effort.

Knowledge brokers have an important and ongoing role to play in educating and raising awareness among all stakeholders and in translating science into practical, on-ground management options.

Maintaining access to timely and affordable skills and training appropriate to landholders at all levels is vital.

Appendix B: Weeds of National Significance

The Weeds of National Significance (WoNS) are agreed by Australian governments based on an assessment framework.

In 1999 the Australian Government declared the inaugural list of 20 WoNS. In 2013 an additional 12 WoNS were approved. Nomination as a WoNS recognises a species as a priority current and future weed threat to Australia, requiring coordinated and strategic management along with shared stakeholder investment to develop and implement best practice to prevent, eradicate, contain and/or minimise its impacts in different parts of the nation. They are causing major economic, environmental and/or social impacts in a number of states or territories with strong potential for further spread.

All WoNS have individual national strategic management plans. The scope of these include developing foundational awareness and best practice management extension materials, establishing strategic, coordinated control programs, initiatives to limit further introduction spread, and research to develop new control tools such as biological control agents. As per the National EPDNS Management Framework, IPAC will routinely review the WoNS list.

TABLE 1 Weeds of National Significance

Common name	Scientific name
African boxthorn	*Lycium ferocissimum*
Alligator weed	*Alternanthera philoxeroides*
Asparagus weeds	*Asparagus aethiopicus*, *A. africanus*, *A. asparagoides* Western Cape form, *A. declinatus*, *A. plumosus* and A. *scandens*. Includes original WoNS *Asparagus asparagoides* Excludes *A. officinalis* and *A. Racemosis*
Athel pine	*Tamarix aphylla*
Bellyache bush	*Jatropha gossypiifolia*
Bitou bush/boneseed	*Chrysanthemoides monilifera*
Blackberry	*Rubus fruticosus agg.*
Bridal creeper	*Asparagus asparagoides*
Brooms, Scotch, Montpellier, Flaxleaf	*Cytisus scoparius*, *Genista monspessulana*, *Genista linifolia*

TABLE 1 Weeds of National Significance

Common name	Scientific name
Cabomba	*Cabomba caroliniana*
Cat's claw creeper	*Dolichandra unguis-cati*
Chilean needle grass	*Nassella neesiana*
Gamba grass	*Andropogon gayunus*
Gorse	*Ulex europaeus*
Fireweed	*Senecio madagas cariensis*
Hymenachne	*Hymenachne amplexicaulis*
Lantana	*Lantana camara*
Madeira vine	*Anredera cordifolia*
Mesquite	*Prosopis spp.*
Mimosa	*Mimosa pigra*
Opuntioid cacti	*Opuntia spp.* (excludes *O. ficus-indica*), *Cylindropuntia spp., Austrocylindropuntia spp.*
Parkinsonia	*Parkinsonia acuteata*
Parthenium weed	*Parthenium hysterophorus*
Pond apple	*Annona glabra*
Prickly acacia	*Acacia nilotica spp. indica*
Rubber vine	*Cryptostegia grandiflora*
Sagittaria	*Sagittaria platyphylla*
Salvinia	*Salvinia molesta*
Serrated tussock	*Nassella trichotama*
Silverleaf nightshade	*Solanum elaeagnifolium*
Water hyacinth	*Eichhornia crassipes*
Willows except weeping willows, pussy willow and sterile pussy willow	*Salix spp.* except S. *babvlonica*, S. *x calendendron* and S. *x reichardtii*

Appendix C: Detailed stages of weed management

Prevention

Australia has a range of pre-border activities in place to anticipate threats and manage risks before they arrive in the country.

Australia's enviable biosecurity system is estimated to be worth up to $17,500 each year to an average farmer, underpinning international market access.

Central to these activities are science-based risk assessments which determine risk levels for different products seeking entry to Australia. These risk assessments help the Australian Government gauge the level of biosecurity risk that may be associated with the importation, or proposed importation, of animals, plants or other goods into Australia. If the biosecurity risk is found to exceed the level of risk that is acceptable to Australia, then there may be measures put in place to ensure the safety of the trade. However, if the biosecurity risks cannot be overcome then trade will not be allowed.

Governments at all levels play an active and often critical role in pre-border, border and post-border activities to prevent the spread of weeds into their respective jurisdiction. For example, state-level laws restricting the sale of high-risk plant species play an important role in preventing entry and dispersal across borders. At the local level, prevention can be as simple as a landholder making sure all vehicles entering the property are free from weed seeds.

Scientists and industry have important roles to play in helping determine risk, particularly in understanding the attributes of different species, their spread pathways as well as the influences of Australia's climate and landscape.

Many weeds are products of unwise or unintentional plant introductions. It is important that Australia regularly scans for areas and stakeholders likely to increase the probability of high risk weeds entering Australia. Identifying ways to reduce the exposure to risks from these sources is important if prevention of new weeds species is to be effective.

Eradication

Complete eradication of a weed species at either a local, regional, state/territory or national scale is an important form of weed management.

Where a weed has recently arrived into Australia, or a state/territory, or particular region, its complete removal may be feasible, while the population is still small. However, the challenges of successful eradication should not be discounted. A range of weed species are currently targets for eradication in the states and territories and a small number of species are the targets of national eradication projects, funded by states and territories in partnership with the Australian Government.

Eradication at the local level tends to be less feasible, since on-going invasion tends to occur from adjacent areas, where the weed is not subject to the same high level of control. Eradication plans can be developed pre-emptively, or immediately following early detection, for certain high-risk weed species. This requires a number of actions, namely:

- risk-based analysis that underpins the determination of species considered high-risk and the type of strategy that may be required for eradication
- detection, monitoring and surveillance approaches to be in place. These should be supported by risk-based decision-making and outline ways that community members can detect and report high-risk weeds
- eradication techniques to be available and continuously improved. People and organisations need the capacity and capability to act quickly should a weed become a priority for action
- coordination and investment approaches that will enable key stakeholders to work together and invest in eradication, detection and spread-prevention in a timely manner
- clear decision points, informed by analysis of feasibility and benefit-cost, to help determine whether eradication should be attempted
- broader awareness and understanding by landholders, community, industry and government stakeholders of the risk of possible approaches used to reduce weed risks.

Governments play an important role in responding to weed incursions that have the potential to be nationally significant. However, for Australia to successfully minimise these risks, landholders, industries, natural resource and community groups also need to be actively involved and have the capacity to detect and report potential problems and work with other parties to implement management actions.

Containment

When responding to weed species that cannot be completely eradicated, measures to reduce or limit their spread into at-risk areas may be an option. These are broadly referred to as ‘containment’ actions.

Containment of a weed species in a strict sense aims to completely prevent further spread of that weed beyond the boundary of existing infestations. In some instances, the pragmatic containment goal may instead be to slow the spread of the weed in order to delay impacts and/or enable managers to be prepared for managing its impacts.

Containment may include reduction of the density or area of the infestation within agreed geographic boundaries (containment lines).

In Australia, there are examples of a weed being established in one state or territory, or a particular region, while other areas are free of that weed or have small, isolated populations that are still able to be eradicated. The mobility of our lives and the many pathways for weed spread mean that to manage the risk of that species spreading to new areas requires consistency across state and territory borders and the ability to work together to plan and manage weed containment.

For nationally significant weeds there are instances where effective containment may cross state and territory borders. These cases require partnerships, investment and coordination between of a range of stakeholders.

Weed containment is complex and requires:

- risk-based analysis which determines the level of risk and agreed decision points and approaches for moving from an eradication to a containment strategy and potentially from containment to asset based protection
- active surveillance, detection and information sharing approaches
- clear identification of the current spread of the target weed and the areas from which it should be eradicated or its invasion prevented
- scientific and risk management approaches which help to understand the risks, likely pathways for spread, feasibility and mitigation options
- the ability to act which includes legislative powers, funding and community support to enable investment and coordination of the required actions.

A challenge for many areas of weed eradication, containment and management is the length of time required to sustain efforts and achieve positive, lasting results. This involves the challenges of detecting all infestations, finding and controlling individual plants before they reproduce and waiting for soil seed-banks to decay.

The long term nature of weed control makes decisions to invest difficult. However, this is an essential element for success. Where containment within a boundary is the aim, institutional arrangements that support investment and coordinated action may also be needed—in particular, where a small number of landholders might bear a high cost for managing the weed at a boundary where the benefits of this protection are received by others. Developing ways to ensure that a fair approach is taken to reduce risks and impacts for other parties is important for encouraging participation.

Where the landscapes involved are vast (such as in remote parts of northern Australia) and the number of people living and working in those areas are low, effective monitoring and surveillance is a challenge.

Asset protection

The term ‘asset protection’ is generally applied to weed species that have existed in Australia for many decades and, over this time, have spread across large portions of their potential range. Eradication or containment of these species is considered to be impractical.

Instead, the goal becomes effectively managing weed (and other) threats to protect certain high-value assets, thereby strategically minimising economic, environmental and social impacts.

The approach used to mitigate impacts should consider feasibility, cost effectiveness, the nature of the impacts and the control options available. The approach shifts planning and management away from removal or elimination of the weed towards tactics and strategies focused on reducing adverse or harmful impacts.

The landholder (public or private) is generally best placed to protect their assets and stand to derive the greatest benefit. However, there is still a need for coordination and a targeted approach to help maximise the benefits to a particular region, state or to the nation.

In some cases, it is more appropriate to invest in biological control to achieve landscape-level, sustained impact reduction, rather than focusing efforts on ongoing, predominantly herbicide-based control programs with the associated required coordination. Biological control of weeds can generate attractive returns on investment, with benefit to cost ratios in the order of 23:1.

For most widespread and well established weeds, landholders need to work together and partner with industry and community groups, and with local and state governments, to effectively reduce the impacts created by that weed.

There is an expectation that all landholders who have declared weed species on their land will take appropriate action to avoid causing negative impacts on others. This includes governments, absentee landholders, private companies and people with lifestyle properties.

Despite the potential to achieve high returns from prevention and eradication, there is always pressure from the community and industries to concentrate effort on the control of widespread weed species that have immediate and highly visible impacts across substantial areas of land.

Moreover, it is often difficult to decide whether to invest in control of widespread weeds or in prevention, early intervention and containment of species that are in an earlier stage of population development.

'Conflict species' are plants that provide significant benefits to agriculture or other sectors of the economy but, at the same time, have the potential to be highly invasive (NSW Natural Resources Commission, 2014). Examples include buffel grass (*Cenchrus ciliaris*) and radiata pine (*Pinus radiata*).

Options to manage these species include the adoption of Codes of Management Practice, shared stakeholder commitment to contain species to the properties on which they are commercially valuable, and exclude them from areas of high conservation value or biodiversity significance.

Important considerations for determining how to respond to established weeds are:

- understanding the impacts created by the weed and the value (economic, environmental and social) of the assets being impacted
- the feasibility and cost effectiveness of management intervention
- the benefits that could be achieved through a coordinated and strategic approach
- using science to inform risk assessment, control or management options and ways to encourage landholder and other stakeholder adoption of best practice
- ongoing development of effective management options which take into consideration human safety, efficacy, possible adverse effects on the asset and cost effectiveness.

List of acronyms

Term	Definition
AWS	Australian Weeds Strategy
CSIRO	Commonwealth Scientific and Industrial Research Organisation
EPDNS	Established Pests and Diseases of National Significance
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
IGAB	Intergovernmental Agreement on Biosecurity
IPAC	Invasive Plants and Animals Committee
NBC	National Biosecurity Committee
NEBRA	National Environmental Biosecurity Response Agreement
NRM	Natural resource management
RD&E	Research, Development and Extension
WoNS	Weeds of National Significance

Glossary

Term	Definition
Asset protection	Refers to actions that mitigate the impacts or consequences of weeds, on assets (this includes public and private assets) and does not necessarily equate to direct control, reduction or destruction of the weed.
Assets	Things with significant environmental, social or economic value that are negatively affected by weeds
Biosecurity	The management of risks to the economy, the environment, and the community of pests and diseases entering, emerging, establishing or spreading.
Conflict species	Species that provide positive benefits to agriculture or other sectors of the economy, but also have the potential to impose negative impacts on other sectors or the community.
Containment	To prevent the spread of a weed species across a landscape, thereby restricting that species to a certain area.
Eradication	The complete elimination of a weed species, including its viable seed-bank, from a defined area.
Established weed species	A weed that is perpetuated, for the foreseeable future, within any area and where it is not feasible (whether in terms of technical feasibility or a cost: benefit analysis) to eradicate the weed.
Good neighbour	'Good neighbour' policies refer to the expectations placed on landholders who have declared pest animals or weeds present on their land. These expectations, including compliance and enforcement arrangements, are designed to try and manage the spread of the declared pest so that it does not cause undue harm or increase costs on neighbour's lands.

Term	Definition
High-risk weeds	Weeds that are not yet present in Australia, which have the potential to cause major economic, environmental and/or social and cultural impact in a number of states and territories, and have a strong potential for spread.
IGAB	The IGAB is an Intergovernmental Agreement on Biosecurity concluded between the Commonwealth and all state and territory governments, with the exception of Tasmania, which came into effect in January 2012 replacing AusBIOSEC.
IPAC	The Invasive Plants and Animals Committee is a cross-jurisdictional sectoral sub-committee of the National Biosecurity Committee (NBC). The committee is responsible for implementing the Intergovernmental Agreement on Biosecurity (IGAB) and providing policy and technical advice to the NBC on national weed, vertebrate pest and freshwater invertebrate pest issues. IPAC comprises representatives from the Australian, state and territory primary industry or environment departments and is supported by a number of technical groups to advise it on technical matters.
Landscape scale	A catchment, or series of interacting catchments or other natural ecological units, within larger land and resource management planning areas.
Nationally significant weed	A weed that has been identified as nationally significant based on its impact, feasibility of management and for which there is a clear rationale for why management would benefit from national coordination.
NRM	The management of natural resources (for example, land, water and biodiversity) in an integrated fashion recognising the values of both conservation and productive use of those natural resources and striving to achieve sustainability in all resource use.
NBC	The National Biosecurity Committee (NBC) is an advisory committee to AGSOC that provides strategic leadership in managing national approaches to emerging and ongoing biosecurity policy issues across jurisdictions and sectors. Membership of the NBC comprises senior representatives from the Commonwealth, state and territory primary industry or environment departments.
Noxious weeds	Weed species that are controlled and or managed under state or territory legislation. The legislation prescribes a variety of management options from prohibition of sale and trade to enforced control. Weed control is the responsibility of individual states and territories including the legislation.
Naturalised/naturalisation	Where an introduced weed begins to grow in the wild.

Term	Definition
Pathways	The activities that result in a weed being moved into an area. Possible pathways include air, surface water, groundwater, plants, animals and humans and their activities.
Prevention	Prevention in this strategy refers to risk-based assessment and application of practices that minimise the entry of high-risk species into Australia. This includes pre-border risk assessments, and the application of risk mitigation measures.
Ramsar	The Ramsar Convention is an intergovernmental treaty, also known as the Convention on Wetlands, which holds the framework for international cooperation and national action for wetland use and conservation.
Risk creators	Those individuals, organisations and industry groups that create risks that may result in a disease, weed or pest entering, emerging, establishing or spreading in Australia; and the disease, weed or pest causing harm to the environment, or economic or community activities.
Surveillance	Activities to investigate the presence/absence or abundance of a disease, weed and/or pest in a given plant or animal population and its environment. This includes: general surveillance, targeted surveillance, active surveillance, passive surveillance and sentinel surveillance.
Weed	For the purposes of the Australian Weeds Strategy, a weed is considered pragmatically as a plant that requires some form of action to reduce its negative effects on the economy, the environment, human health and amenity.

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