

# CATALYSE CREATE CONNECT

**Centre for Invasive Species Solutions**

**Phase 1 Implementation Plan for the CISS  
10-Year National Investment Plan for  
Weeds Research, Development &  
Engagement (2020-2030)**

# CATALYSE CREATE CONNECT

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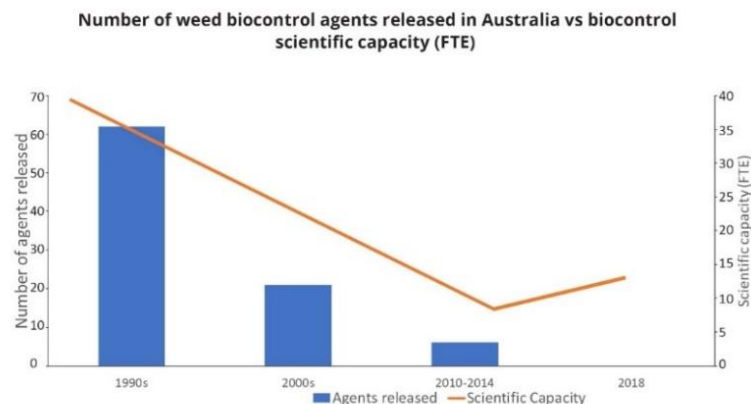
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## SNAPSHOT: THE 10-YEAR INVESTMENT PLAN FOR WEEDS RD&E

### The need

- The weeds of the future are already here - over 5,900 non-native plant species have weed histories overseas but are yet to naturalise in Australia (Randall 2007);
- About 20 exotic plants naturalised annually between 1880 and 2000 or 1 every 18 days, with an apparently lower rate since then (Dodds et al , 2015);
- Weeds cost industry about \$5.8 billion annually (McLeod 2018);
- Australia's parks, reserves, world heritage sites, rivers, wetlands, coastlines and other environments are being invaded by weeds; eroding their uniqueness and values; and
- The impact of weed RD&E has been dampened by boom bust funding cycles and the impact this has on making solutions available (see below).



Source: Winston et al. (2014), Palmer et al (2014), Louise Morin, CSIRO (2018) pers. comm

### The objectives

The CISS 10-year Investment Plan for Weed RD&E (CISS 2018) aims to put in place an enduring model of co-investment to enhance the impact of current and future weed management efforts, particularly where they address the priorities of

the Australian Weed Strategy 2017-27 (IPAC 2016). The three key objectives of the Plan, and hence giving the Plan its title, aim to:

1. **Catalyse** innovation and action to occur that might not otherwise through shepherding sustained RD&E co-investment and collaboration;
2. **Create** rigorously tested, evidence-based tools and systems to enhance the effectiveness of weed management and expedite time to impact; and
3. **Connect** people and institutions through collaborations and networks to share knowledge and experience.

### The outcomes

The main deliverables from the Plan include:

- adoption of best practice in national weed incursion management, including prevention, early detection and adoption of risk-based surveillance systems;
- R&D support for integrated landscape management approaches that target multiple weed species with multiple control techniques at the regional scale;
- reduction in impacts of established weeds through a strategic pipeline of control tools, including biocontrol integrated with industry/community delivery;
- improvement in the human and institutional aspects of weed management including through enhancing communities, industries, and organisational capacities; and
- enabling adoption of cost-effective weed management through better information and communication systems.

### Focus and scope of the Phase 1 Implementation Plan

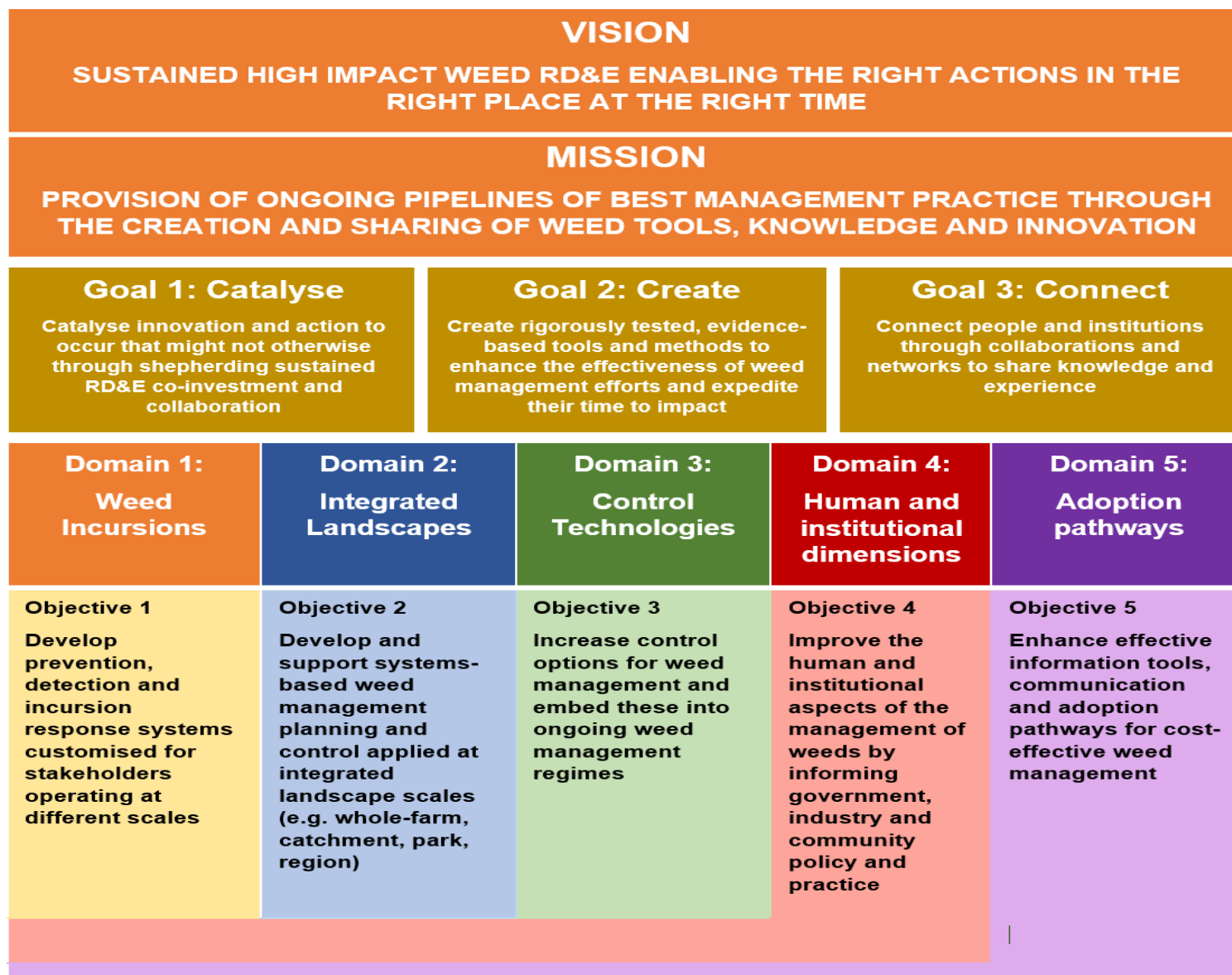
This Implementation Plan details priority activities to be supported under or supplement CISS Portfolio No.2 (Weeds) as a contribution towards meeting the initial three years of the 10-Year Plan's objectives and outcomes by:

- providing a logical framework connecting longer-term activities to outputs, outcomes, objectives and the returns on investment; and
- defining initial (Phase 1) programs and projects identified by local, regional, State and national stakeholders as priorities for implementation.

## From Vision to Implementation

### Vision, mission, goals and objectives

Since the development of the 10 Year Investment Plan for Weeds RD&E, the conceptual framework set out in that Plan has been adapted to underpin this Portfolio No.2 (Weeds) Implementation Plan. As with the 10 Year Plan, this implementation plan continues to evolve the Domain framework developed for CISS's Portfolio No.1 (Vertebrate Pests). This evolution is outlined over-page.



## The CISS Portfolio Platform Approach

### Portfolio No.1 model and relevant weed RD&E activities

The establishment of the Centre for Invasive Species Solutions in July 2017 saw the introduction of an RD&E structure based on five Domains: Incursions, Integrated landscape Management, Biocontrol, Management Tools and Systems, and Community Engagement and education. Applied to pest animal RD&E, the framework is readily transferable to other biosecurity challenges, including weeds.

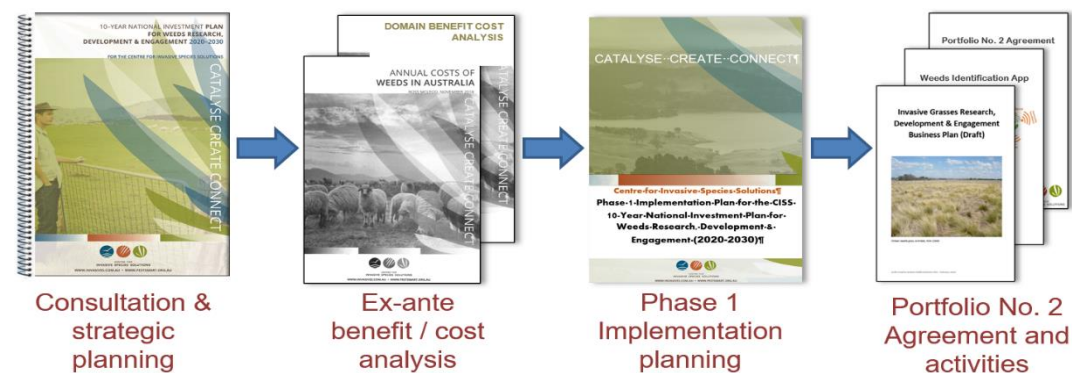
Anticipating the development of a Portfolio No.2 based on weeds, around 5 percent of the Portfolio No.1 budget has been allocated towards a range of weed RD&E activities. Consulting regularly with Australia's key biosecurity committee responsible for weeds, the Environment and Invasive Committee's Weed Working Group, the activities identified for Portfolio No.1 support include:

Portfolio No. 1 Weed Project	Relevant Domain
W-001: 10 Year Weed R&D plan, including associated economic analyses and engagement	All Portfolio No.1 and No.2 Domains
W-003: Biosecurity surveillance of e-commerce and other online platforms for illegal plant trade	Portfolio No.1 and No.2 Incursions Domains
E-002: Development of a WeedScan module for FeralScan	Portfolio No.1 Community Eng & Ed Domain and Portfolio No.2 Adoption Pathways Domain
E-008: Development of the Weeds Australia on-line portal supplementing the PestSmart website	Portfolio No.1 Community Eng & Ed Domain and Portfolio No.2 Human & Inst'nl and Adoption Pathways Domains
E-008 variation: Technical review of Weed Profiles for the Weeds Australia portal	Portfolio No.1 Community Engagement & Education Domain and Portfolio No.2 Adoption Pathways Domain

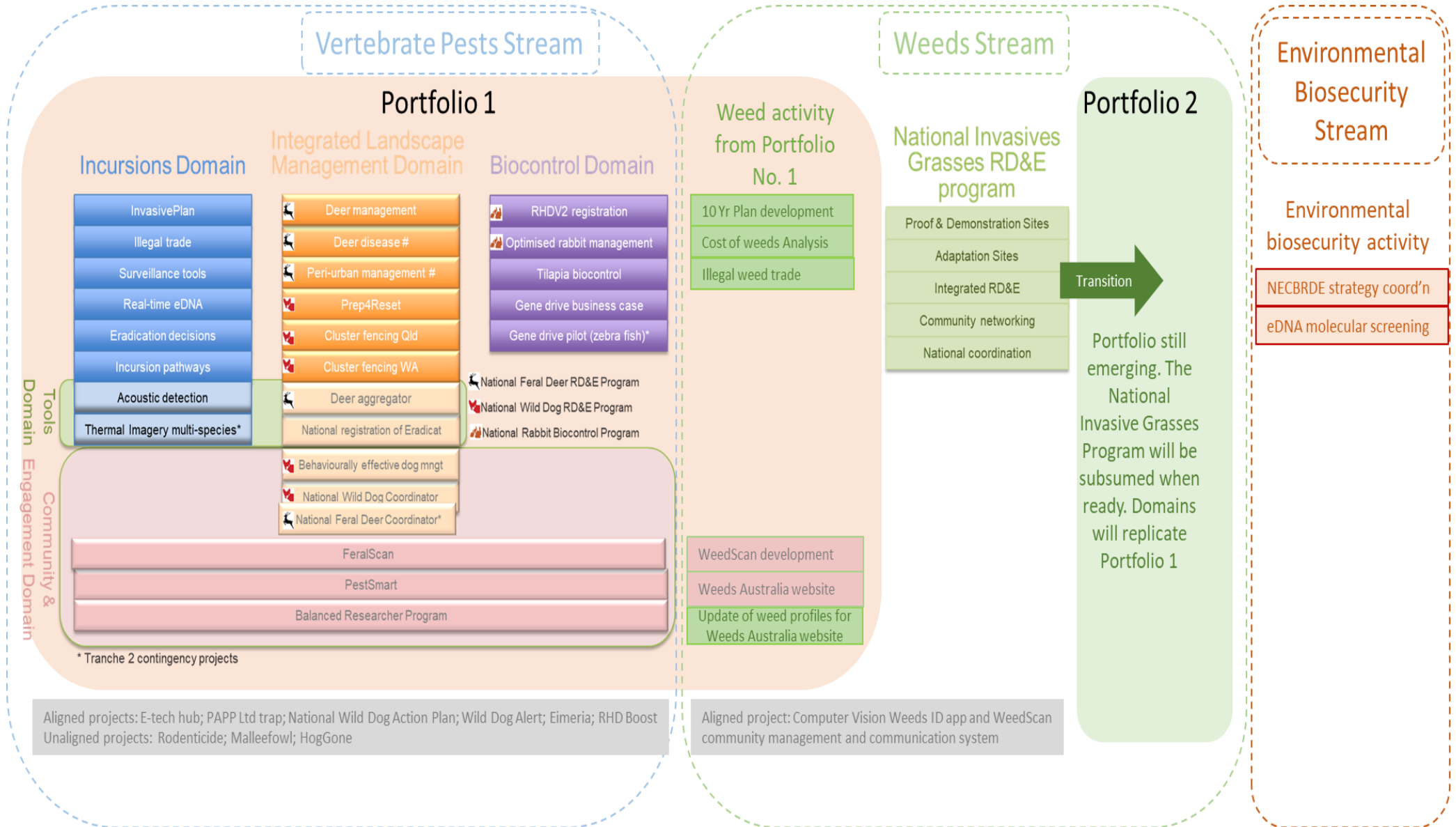
The contractual arrangements associated with these Portfolio No.1 activities means these weed projects cannot be transferred to new contractual and governance frameworks associated with a Portfolio No.2. That said, the activities have been designed to inform the development of a second portfolio, and new phases of these projects if contracted after July 2022 could well be fully incorporated into the new Portfolio No.2.

### Portfolio No.2 development

The development of the CISS Portfolio No.2 (Weeds) is based on the need to give immediate momentum in the implementation of the 10 Year Investment Plan for Weeds RD&E. It follows economic assessments of the returns on investment for activities outlined in the 10 Year Plan, consultation with the communities of interest involved in weed management across the country, and deliberations with those organisations with an immediate capacity to invest, such as Meat & Livestock Australia. This Phase 1 Implementation Plan operates at the nexus of completed planning, ongoing planning, collaboration building, contract execution and activity delivery. The pace of development is such that some opportunistic activities have commenced, and others may conceivably commence prior to formal execution of a Portfolio No.2 Agreement between partners. In reality, likely partners to a Portfolio No.2 Agreement have been consulted closely in developing these activities, as well as in developing longer-term plans for the Centre's evolution.







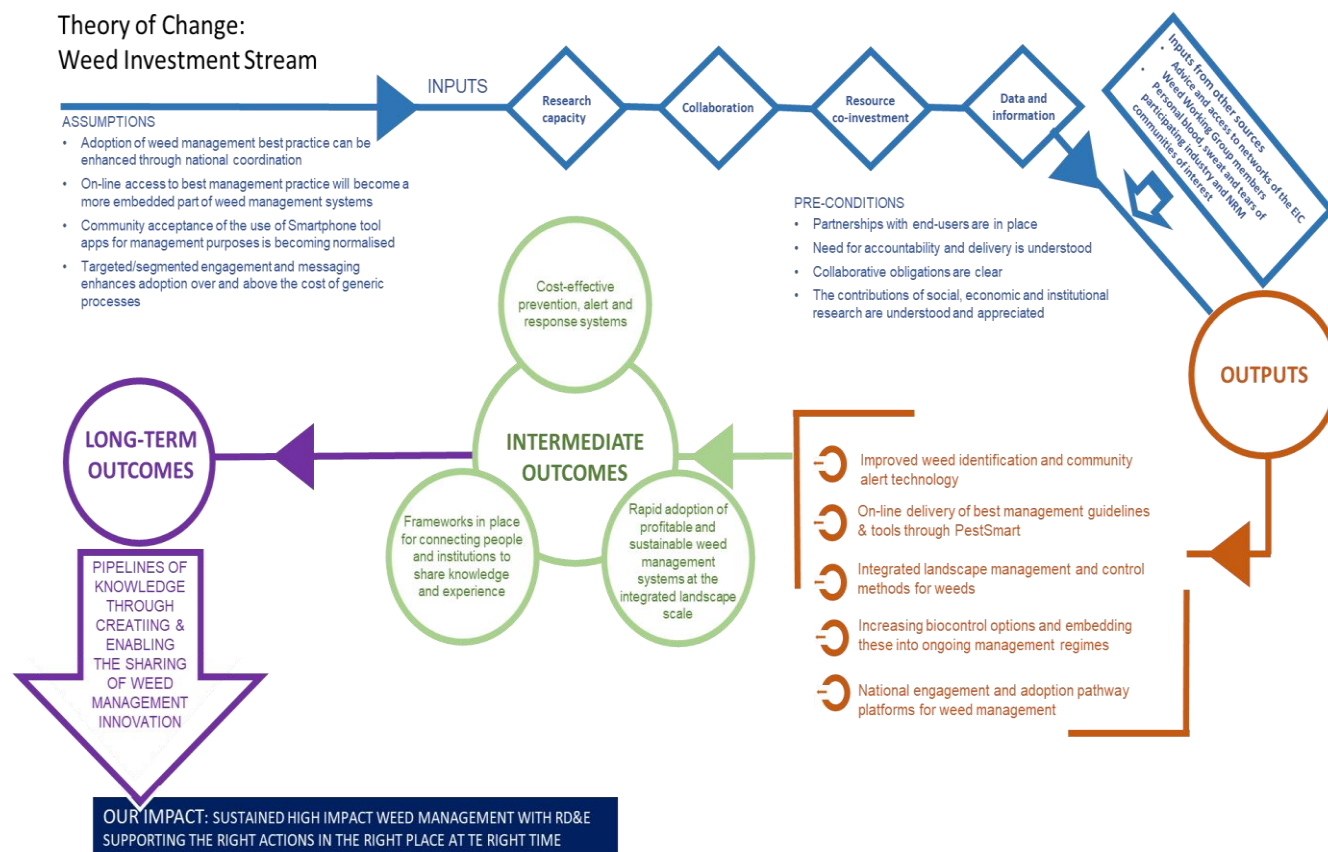
## The Strategic Framework

### Overview

This Implementation Plan includes a Theory of Change (ToC) as well as a Logical Framework (LogFrame) to outline the relationship between inputs and their pathway towards desired impact. The complementary frameworks in many planning documents amount to much the same roadmap using different presentational architecture. There is however an important distinction between the two, with Logframes often lacking the intangible inputs, relationships, enablers, and facilitation processes important in ToCs that help close the all too frequent gap between outputs and measurable change. With the evolving nature of the Weeds Portfolio 2 including a mix of known activities that have already commenced or are close to commencement, and priorities that have been identified for future prospective investment, the ToC in this Plan relates specifically to the known activities where tangible pathways to adoption and change must be clear and must guide management, facilitation and coordination action. The ToC therefore represents a subset of longer-term activities envisaged by the LogFrame that are to some extent still speculative.

### Theory of Change

The Theory of Change over-page is based on projects that have been or are very likely to be funded during the initial life of this Implementation Plan (2020-2023). With adoption of outputs leading to impact clearly in mind, the ToC is careful to acknowledge that inputs will be both formal as well as informal (e.g. community “blood, sweat and tears”). It acts as a clear reminder that the role of coordination and facilitation cannot take any input for granted and time must be spent on all of them to ensure the adoption pathway operates from a social as well as technical perspective from the very commencement of activities. Likewise, the ToC acknowledges that outputs must be designed to deliver outcomes that strengthen the ongoing resilience in the social, institutional and technical management of weeds beyond the particular technology that is being adopted. A good example of this is reference in the ToC that the Implementation Plan must create ongoing networks of knowledge sharing that goes beyond sharing just the knowledge created by the program. This is reinforced by articulation of the desired long-term outcome being a pipeline of knowledge supporting the right actions in the right place at the right time long into the future.





## LogFrame

The LogFrame following the ToC is based on the 5-10 year framework that must be in place by the end of this Phase 1 Implementation Plan. It draws the relationship of intended activities to higher order national priorities. These activities were elicited from the priorities of CISS Members and Partners, and their collective aspirations for what is needed in a Portfolio No.2. It should be noted that CISS Members closely overlap with organisations associated with the Environment and Invasive Committee Weeds Working Group. The LogFrame links to finer resolutions of activity set out in the Domain descriptions that follow the LogFrame.

High-level outcome	Intermediary outcome	High-level output	EIC (IPAC) National RD&E Invasive Species Priorities	National Weed Strategy Priority
Adoption of best practice in national incursion management, including prevention, early detection, and adoption of risk-based surveillance systems	Improved systems to identify and manage high-risk weed pathways	Surveillance mechanism for monitoring formal and informal e-commerce trade in weed species	1: New approaches to detection, prevention and eradication	1.3: Early detection, diagnostics and monitoring systems
	Establishment of National Weed Detection and Surveillance R&I Hub	Drone and camera sensing weed detection technology including use of hyperspectral imagery for remote surveillance	1: New approaches to detection, prevention and eradication 3.4 Improved standards and strategies for widespread species	1.3: Early detection, diagnostics and monitoring systems
		Community surveillance systems, e.g. development of systems and tools to enable a nation-wide harmonised weed spotter network		1.3: Early detection, diagnostics and monitoring systems
	Improved knowledge, technology and systems for rapid response to weed incursions	Alert and information system triggered through the R&I hub monitoring	1: New approaches to detection, prevention and eradication	1.3: Early detection, diagnostics and monitoring systems
	Improved national information and communication systems for sharing risk, surveillance and incursion data	National Biosecurity Committee endorsed system operating nationally under the guidance of its EIC Weed Working Group	1: New approaches to detection, prevention and eradication	1.3: Early detection, diagnostics and monitoring systems
	Predicting distributions of new, emerging and existing priority weeds under future climate scenarios	Model-based data synthesised into 5-yearly national updates of weed spread predictions	1: New approaches to detection, prevention and eradication	1.2: Risk assessment and prioritisation processes
	Managing cross border and landscape scale weed dispersion brought on by extreme events i.e. droughts and floods	Management guidelines for preventing weed dispersion due to extreme events	1: New approaches to detection, prevention and eradication 3.1: Climate change and invasive species	2.2: Coordinated management across all land tenures 2.3: Knowledge and capacity to play a role in management
R&D support for integrated landscape management approaches that target multiple species with multiple control techniques at the regional scale	National network of research sites, each supported by community-run satellite demonstration sites	Integrated application of weed detection/mapping systems utilising remote sensing and drones at property, regional and larger scales	1: New approaches to detection, prevention and eradication 4.2: Coordinated community engagement for better outcomes 4.4: Adoption of improved standards and strategies	2.3: Knowledge and capacity to play a role in management

High-level outcome	Intermediary outcome	High-level output	EIC (IPAC) National RD&E Invasive Species Priorities	National Weed Strategy Priority
		Integrated approaches in the application of tools and decision support systems for management and eradication at property, regional and larger scales.	3.2: Development of new non-biological control tools 4.2: Coordinated community engagement for better outcomes 4.4: Adoption of improved standards and strategies	2.4: Enhance control methods and integrated management
Reduction in the impacts of established weeds through a strategic pipeline of control tools, including biocontrol, integrated with industry and community delivery	National Weed Biocontrol R&I Hub	Completion of a strong national biocontrol agent delivery pipeline backed by a national cross-sectoral (community, government, industry) distribution network	2.1: Classical biocontrol	2.4: Enhance control methods and integrated management 3.2: Maintain long-term RD&E capability and capability
		Rearing and re-release of existing agents and delivery of historical agents to accelerate impact	2.1: Classical biocontrol	2.4: Enhance control methods and integrated management
	Mitigate herbicide resistance across systems	New and alternative herbicide technologies for natural and extensive production systems, and regimes that aim for low/no chemical approaches	3.2: New non-biological control tools and approaches	2.4: Enhance control methods and integrated management
	Evaluate potential for emerging gene technologies to manage weeds.	Business/investment case for the pursuit of new high priority technologies	2.2: New genetic approaches	2.4: Enhance control methods and integrated management
Improvement in the human and institutional aspects of weed management including through enhancing communities, industries and organisational capacities	Development of a national weed community engagement hub/community of practice	Coordination of enhanced community exchanges and the feedback of community management, responses and data collection into weed research, planning and ongoing management	4.2: Coordinated community engagement for better outcomes 4.4: Adoption of improved standards and strategies	2.2: Coordinated management across all land tenures 2.3: Knowledge and capacity to play a role in management
	Resilient capability and capacity building pipeline	Strengthening and harmonising accredited VET programs, training for next gen community weed leaders and champions and next gen innovators	4.2: Coordinated community engagement for better outcomes 4.4: Adoption of improved standards and strategies	2.3: Knowledge and capacity to play a role in management
	Effective methods for community weed action planning	Best practice manual learning from past successes to guide future planning approaches	4.2: Coordinated community engagement for better outcomes 4.4: Adoption of improved standards and strategies	2.3: Knowledge and capacity to play a role in management

Phase 1 Implementation Plan for the CISS 10-Year National Investment Plan for Weeds R, D & E

High-level outcome	Intermediary outcome	High-level output	EIC (IPAC) National RD&E Invasive Species Priorities	National Weed Strategy Priority
Adoption of cost-effective weed management through better information and communication systems	National Weed Community Support Hub	Supporting weed communities and farm managers through targeted and tailored training and coordination based on behaviourally effective methodologies	4.2: Coordinated community engagement for better outcomes 4.4: Adoption of improved standards and strategies	2.2: Coordinated management across all land tenures 2.3: Knowledge and capacity to play a role in management
	New and revised national best practice management weed guides, decision support tools and related materials	Annual releases of new and revised best practice manuals	4.2: Coordinated community engagement for better outcomes 4.4: Adoption of improved standards and strategies	2.3: Knowledge and capacity to play a role in management
	A nationally accessible digital weed information system	CISS national weeds portal	1: New approaches to detection, prevention and eradication 4.2: Coordinated community engagement for better outcomes 4.4: Adoption of improved standards and strategies	2.3: Knowledge and capacity to play a role in management
	A national weed identification app based on real-time mobile phone photo recognition integrated with national weed information to provide information on best management	WeedScan or equivalent based on artificial intelligence systems and machine learning	1: New approaches to detection, prevention and eradication 4.2: Coordinated community engagement for better outcomes 4.4: Adoption of improved standards and strategies	2.3: Knowledge and capacity to play a role in management

## DOMAIN 1: WEED PREVENTION, DETECTION AND EARLY INTERVENTION

**AWS Goal 1 Aim:** To prevent the entry of high-risk weeds and to intervene early in the event that a high-risk weed is detected.

**Domain 1 Outcome:** Adoption of best practice in national incursion management, including prevention, early detection, and adoption of risk-based surveillance systems

**Indicative Return on Investment (McLeod 2019):** 2.9 to 1

### Rationale

A focus on incursions enables both better prevention tools and systems and early interventions to improve outcomes. Committing to this overcomes the historic tendency for skewing investment to established weed problems. The proportional under-investment in prevention, where the greatest returns can be achieved, was highlighted as a matter of concern by the independent review of Australia's biosecurity system (Craik, Palmer and Sheldrake 2017).

### Scope

This domain involves the development and deployment of best practice tools and systems for early detection and prevention through use of risk-based surveillance systems. This domain ensures investment targeted to understanding and applying techniques focused on prevention of new weed introductions, movements within Australia or establishment.



### Australian Weed Strategy Priorities to be implemented:

Priority 1.2 Adopt consistent risk assessment and prioritisation approaches within Australia

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

### EIC/IPAC National RD&E Priorities for Invasive Plants and Animals to be implemented:

1. New approaches to detection, prevention and eradication

1.1 Community surveillance systems

1.2 Development and implementation of surveillance tools

1.3 Establishing proof of freedom for eradication targets

1.4 Improved eradication and containment standards and strategies

1.5 Pre-border – analysis of future pest and weed risks

1.6 Rapid diagnostics and taxonomy

1.7 Molecular tools – eDNA, next generation biosensor approaches

### Other Strategies or Frameworks:

National Invasive Plant Surveillance Framework

## National Priorities Domain 1: Weed prevention, detection and early intervention

Note: Highlighted priorities will be addressed by projects in the CISS pipeline (see footnotes). Other priorities will be pursued within Portfolio No.2

RD&E Priority	Priority		Timeframe	Dependencies & relationships
	highlighted by	Collaborative Capability		
<b>1.1 Improved systems to identify and manage high-risk weed pathways</b> , such as on-line and international sales <sup>1</sup>	NSW, Qld, SA	Lead: UoA	<ul style="list-style-type: none"> <li>Short-term development</li> <li>Long-term surveillance</li> </ul>	Project 1.2
<b>1.2 National Weed Detection and Surveillance R&amp;I Hub.</b> Establish a national network (the Hub) to coordinate R&I on methods and standards to improve detection of weeds, including surveillance, mapping, information analysis, integration and sharing (including remote sensing and molecular tech such as environmental DNA techniques)	ACT, NSW, Qld SA, NZ	Lead: NSW Support: Selected universities, ACT	<ul style="list-style-type: none"> <li>Medium term development</li> <li>Long-term operation</li> </ul>	Projects 1.1, 1.2a, 1.2b, 1.3, 1.4
<b>1.2a Drone and camera sensing weed detection technology</b> including use of hyperspectral imagery for remote surveillance		Lead: NSW Support: SA, WA, selected universities, ACT	<ul style="list-style-type: none"> <li>Medium term development</li> <li>Long-term surveillance</li> </ul>	Projects 1.2, 2.3
<b>1.2b Community surveillance systems</b> , e.g. development of systems and tools to enable a nation-wide harmonised weed spotter network <sup>2</sup>		Lead: IAL Support: ACT, NSW, WA, selected universities	<ul style="list-style-type: none"> <li>Medium term development</li> <li>Long-term surveillance</li> </ul>	Projects 1.2, 2.3
<b>1.3 Improved knowledge, technology and systems for rapid response</b> to weed incursions e.g. eradication and rapid response toolkits, including risk, biological and ecological R&D	NSW, Qld	Lead: TBD Support: NSW, IAL	<ul style="list-style-type: none"> <li>Medium to long-term development</li> </ul>	Projects 1.2, 2.2, 2.3
<b>1.4. Improved national information and communication systems</b> for sharing weed risk, surveillance and incursion data <sup>2</sup>	NSW, SA, WA	Lead: TBD Support: TBD	<ul style="list-style-type: none"> <li>Short-term development</li> <li>Long-term operation</li> </ul>	Project 1.2

1. Project contracted: P01-W-003: Biosecurity surveillance of e-commerce and other online platforms for illegal trade in declared plants
2. Project contracted: A-021: Computer Vision Weeds ID App and WeedScan Community Management and Communication System

## DOMAIN 2: INTEGRATED LANDSCAPE MANAGEMENT

**AWS Goal 2:** Minimise the impact of established weeds

**Domain 2 Outcome:** R&D support for integrated landscape management approaches that target multiple species with multiple control techniques at the regional scale

**Indicative Return on Investment (McLeod 2019):** 1.8 to 1

### Rationale

Established weeds cause considerable costs to agriculture, threaten natural systems and can affect community wellbeing. Moving from a focus on species or specific control techniques to approaches based on integrated management, and focused on outcomes rather than problems, helps to deal with many weeds (and even other issues) by combining different techniques simultaneously or in sequence. Such approaches try to have managers across different land uses within a catchment or region coordinate actions to reduce the impacts of weeds. As such, management at this scale is depends upon community, industry and NRM organisation led solutions.

### Scope

Planned investment in this domain focuses on systemic approaches applied at the bioregional or landscape scale. These often rely on sustained interventions that make conditions less suitable to targeted weed species, including shading, grazing and fire regimes and competition, coupled with other control techniques, particularly herbicides. Ecosystem managers faced with multi-species invasions need cost-effective management techniques. In grazing systems, decision tools can help inform profitable and integrated approaches. RD&E on understanding the landscape ecology of weeds, developing practical solutions and getting them adopted will underpin integration of landscape management approaches suitable for pastoralism and agriculture, environmental managers and communities.



### Australian Weed Strategy Priorities Implemented:

Priority 2.4 Enhance weed control techniques and integrate management options

### EIC/IPAC National RD&E Priorities for Invasive Plants and Animals Implemented:

3. New and sustainability of existing management options

3.1 Climate change and invasive species

New and sustainability of existing management approaches

3.4 Improved standards and strategies for widespread species

3.6 Multi-species interactions and management

### Other Strategies or Frameworks

National Established Pests and Diseases of National Significance Management Framework



## National Priorities Domain 2: Integrated landscape management

Note: Highlighted priorities will be addressed by projects in the CISS pipeline (see footnotes). Other priorities will be pursued within Portfolio No.2

RD&E Priority	Priority highlighted by	Collaborative Capability	Timeframe	Dependencies & relationships
<b>2.1 Predicting distributions of new, emerging and existing priority weeds under future climate scenarios</b> , e.g. modelling and a computational platform/toolbox (link to Domain 1)	SA, NSW	Lead: CSIRO, NSW Support: National collaboration across all states, selected universities	• Medium-term	Projects 1.2, 1.4
<b>2.2 Managing cross border and landscape scale weed dispersion brought on by extreme events</b> e.g. droughts and floods	National	Lead: TBD Support: National collaboration across all states	• Medium-term	Projects 2.1, 1.4
<b>2.3 Demonstration and trial sites – Preventing new incursions.</b> Integrated application of weed detection/mapping systems utilising remote sensing and drones at property, regional and larger scales. Includes approaches on farm to improve adoption of existing ‘best management’ farm surveillance by property managers (linked to Domain 1). Also integrate/coordinate with State, inter-State and national responses	NSW, SA, MLA	Lead: TBD Support: National collaboration across all states	• Medium-term establishment • Medium-to-long-term operation	Projects 1.2, 1.3, 1.4, 2.3
<b>2.4 Demonstration and trial sites – Managing established incursions.</b> Integrated management approaches to established weeds, including application of tools and decision support systems for management and eradication at property, regional and larger scales. Includes approaches on farm to improve adoption of existing ‘best management’ (greater southern focus (MLA). Also integrate/coordinate with State, inter-State and national responses <sup>1</sup>	Qld, NSW, MLA	Lead: TBD Support: National collaboration across all states	• Medium -term establishment • Medium-to-long-term operation	Projects 1.2, 1.3, 2.3, 3.1

1. Program proposal in evaluation: National Invasive Grasses RD&E Program

## DOMAIN 3: CONTROL TECHNOLOGIES

**AWS Goal 2:** Minimise the impact of established weeds

**Domain 3 Outcome:** Reduction in the impacts of established weeds through a strategic pipeline of control tools, including biocontrol, integrated with industry and community delivery

**Indicative Return on Investment (McLeod 2019):** 2.4 to 1

### Rationale

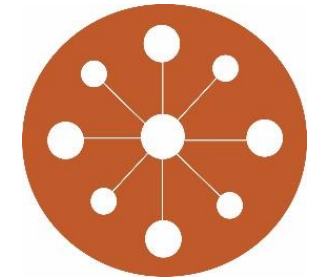
Irrespective of the need to move towards integrated management of weeds (Domain 2) or to pursue implement specific tactical responses, mitigation of weeds is costly and not always effective. There will continue to be a demand for a range of weed control options that can be used alone or in combination.

Chemical (herbicide) options have been pursued commercially by industry for agricultural related application, while classical biological control options have received support from government and industry for agricultural and broader outcomes.

With biocontrol there are opportunities to enhance R&D by incorporating modern approaches for selecting, screening and prioritising agents and through increased engagement by industries and communities.

Combining biocontrol within integrated models of landscape management has significant synergies and untapped potential.

Technological advances in cognate areas of science and engineering are rapidly becoming available as options for weed management. Refining and adapting technologies such as robotics / drones so they are fit for purpose in the weed detection and control will require ongoing R&D.



### Scope

This domain proposes nesting a range of control technologies, including biocontrol, within a wider network of land managers and practitioners involved in applying, monitoring and managing these technologies. These investments will be enhanced by industry and community engagement and delivery (Domain 4) and deploying control options within integrated programs of landscape management (Domain 2).

### Australian Weed Strategy Priorities Implemented:

Priority 2.4 Enhance weed control techniques and integrate management options

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

A nationally coordinated approach to the selection of new biological control agents for priority weeds

### EIC/IPAC National RD&E Priorities for Invasive Plants and Animals

#### Implemented:

2. Biocontrol
  - 2.1 Biocontrol – Classical
3. New and sustainability of existing management options
  - 3.2 Development and implementation of new non-biological control tools and approaches

## National Priorities Domain 3: Control Technologies

RD&E Priority	Priority highlighted by	Collaborative Capability	Timeframe	Dependencies & relationships
<p><b>3.1 National Weed Control R&amp;I Hub.</b> Establish a national network (the Hub) to coordinate R&amp;I on Biocontrol and alternative control approaches to controlling weeds</p> <p><b>3.1a</b> Completion of a strong <b>national biocontrol agent delivery pipeline</b> based on an agreed prioritisation process and feasibility assessment, and that gives consideration to strains and new agents from bioregions that equate to future climate change scenarios. National cross-sectoral (community, government, industry) distribution network and accessible monitoring/reporting system.</p> <p><b>3.1b Rearing and re-release of existing agents</b> with greater emphasis on northern Australia and driving delivery of historical agents to accelerate impact.</p>	ACT, NSW, Qld SA, MLA	Lead: TBD Support: National collaboration across all States and CSIRO	<ul style="list-style-type: none"> <li>• Medium -term establishment</li> <li>• Medium-to-long-term operation</li> </ul>	Projects 3.1a, 3.b, 3.3, 2.4,
			<ul style="list-style-type: none"> <li>• Medium term</li> </ul>	Project 3.1
			<ul style="list-style-type: none"> <li>• Medium-to-long-term</li> </ul>	Project 3.1
<p><b>3.2 Tools and techniques to mitigate herbicide resistance</b> across systems e.g. new and alternative herbicide technologies for natural and extensive production systems (including to fill current management option gaps, e.g. certain aquatic situations), and regimes that aim for low/no chemical approaches (e.g. using animals in weed control).</p>	NSW, Qld, SA, MLA	Co-Leads: Qld (north), SA (south) Support: National collaboration across all states	<ul style="list-style-type: none"> <li>• Medium-to-long-term</li> </ul>	Project 2.4
<p><b>3.3 Evaluate potential for emerging gene technologies</b> to manage weeds.</p>	SA, CSIRO	Lead: CSIRO	<ul style="list-style-type: none"> <li>• Medium-to-long-term</li> </ul>	Project 3.1

## DOMAIN 4: HUMAN AND INSTITUTIONAL

**AWS Goal 2:** Minimise the impact of established weeds

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

**Domain 4 Outcome:** Improvement in the human and institutional aspects of weed management including through enhancing communities, industries and organisational capacities

**Indicative Return on Investment (McLeod 2019):** 2.0 to 1

### Rationale

Factors that enable development and deployment of best management practices for weeds span from reform of government policies, through communities of practice, to individual enterprise or community adoption. This sub-domain seeks to value-add to the other domains by enabling adoption, continuous learning and adaptation.

### Scope

Engaging governments, industries, landholders and others to achieve maximum long-term reductions in impact of weeds. The domain focuses on the many complex socio-economic, institutional and policy dimensions of weeds, including through enhancing agency and industry performance and professional capacity.

### Australian Weeds Strategy Priorities Implemented:

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

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



### EIC/IPAC National RD&E Priorities for Invasive Plants and Animals Implemented:

4. Socioeconomic drivers of adopting best practice
  - 4.2 Coordinated community engagement for better invasive species outcomes
  - 4.3 Governance and institutional research to support better outcomes

### National Priorities Domain 4: Human and institutional dimensions

RD&E Priority	Priority highlighted by	Collaborative Capability	Timeframe	Dependencies & relationships
<b>4.1 Effective methods for community weed action planning</b> – learning from past successes to guide future planning approaches	SA	Lead: TBD Support: TBD	<ul style="list-style-type: none"> <li>• Short-medium term</li> </ul>	Project 4.2
<b>4.2 Development of a national weed community engagement hub.</b> Establish a national network (the Hub) to coordinate support for communities of practice, enhance community exchanges, constantly receive community management, responses and data collection into weed research, planning and ongoing management	IAL	Lead: TBD Support: National collaboration across all states	<ul style="list-style-type: none"> <li>• Medium -term establishment</li> <li>• Medium-to-long-term operation</li> </ul>	Project 4.2, 1.2, 1.3, 1.4, 2.3, 2.4, 3.1, 5.1, 5.2
<b>4.3 Ongoing capability and capacity</b> building through strengthening and harmonising accredited VET programs, and training for next gen community weed leaders and champions, next gen innovators (Masters and PhDs, early career researchers) and taxonomists and commercial operators (link to Domain 5)	National, including industry	Lead: IAL Support: National collaboration across all states	<ul style="list-style-type: none"> <li>• Medium term</li> </ul>	Project 4.2, 5.3

## DOMAIN 5: ADOPTION PATHWAYS

**AWS Goal 2:** Minimise the impact of established weeds

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

**Domain 5 Outcome:** Enabling adoption of cost-effective weed management through better information and communication systems

**Indicative Return on Investment: 2.0 to 1 (McLeod 2019)**

### Rationale

This sub-domain exists to facilitate the effective communication and resourcing of ways to ensure adoption of R&D outputs, that will result in meaningful outcomes for specific user groups.

For example, R&D targeting pre-border risk assessments may be packaged into management systems for biosecurity services, while a program focused on community and industry engagement in biocontrol dispersion may be packaged in entirely different ways, targeting different managers and citizen science and farmer groups.

### Scope

This domain will ensure that research generated innovations will lead to effective changes in management practice.

The communication, packaging, refinement and testing of techniques sits within this domain—it is therefore synergistic with all other domains. This domain specifically focuses on how to meet the needs of users of the R&D, and how to package and communicate outputs to enable extension.

PestSmart, Feralscan and the Atlas of Living Australia biocontrol portal are three digital platforms that provide an avenue for data, information and knowledge sharing and delivery. Systematic convergence of existing weed management and information sources into a single harmonised platform is a high priority of the Australian Government.



### Australian Weeds Strategy Priorities Implemented:

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

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

Provide information in different formats

### EIC/IPAC National RD&E Priorities for Invasive Plants and Animals Implemented:

4. Socioeconomic drivers of adopting best practice

4.2 Coordinated community engagement for better invasive species outcomes

4.4 Adoption of improved standards and strategies



## National Priorities Domain 5: Adoption pathways

Note: Highlighted priorities will be addressed by projects in the CISS pipeline (see footnotes). Other priorities will be pursued within Portfolio No.2

RD&E Priority	Priority highlighted			Dependencies & relationships
	by	Collaborative Capability	Timeframe	
<b>5.1 Mechanisms to integrate behaviour change and social science</b> , and the use of behaviourally effective methodologies, to ensure best practice weed management is adopted and used effectively.	NSW, SA, MLA	Lead: UNE Support: National collaboration across all states	<ul style="list-style-type: none"> <li>• Short-medium term establishment</li> <li>• Medium-to-long-term operation</li> </ul>	Project 4.2, 2.3, 2.4
<b>5.2</b> Optimising engagement approaches to <b>improve community investment and participation</b> in weed management	SA	Lead: TBD Support: National collaboration across states	<ul style="list-style-type: none"> <li>• Short-medium term establishment</li> <li>• Medium-to-long-term operation</li> </ul>	Project 4.2, 2.3, 2.4, 1.2b
<b>5.3</b> Supporting weed communities and farm managers through <b>targeted and tailored training and coordination</b>	National, MLA	Lead: IAL Support: National collaboration across all states	<ul style="list-style-type: none"> <li>• Short-medium term establishment</li> <li>• Medium-to-long-term operation</li> </ul>	Project 4.2, 4.3, 2.3, 2.4, 1.2b
<b>5.4</b> Revise and develop <b>national best practice management weed guides (link to Domain 3), decision support tools and related materials</b>	National, MLA	Lead: IAL Support: National collaboration across states	<ul style="list-style-type: none"> <li>• Short term -medium term establishment</li> <li>• Medium-to-long-term operation</li> </ul>	Draws upon all projects
<b>5.5</b> Develop and maintain a <b>national weed information system</b> e.g. <b>CISS</b> national weeds portal	SA, NSW	Lead: IAL Support: CSIRO (Atlas of Living Australia)	<ul style="list-style-type: none"> <li>• Short-term</li> </ul>	Draws upon all projects
<b>5.6</b> Develop a <b>national weed identification app</b> based on real-time mobile phone photo recognition using artificial <b>intelligence</b> and machine learning integrated with national weed information to provide information on best management	IAL, NSW	Lead: IAL Support: National collaboration across all states	<ul style="list-style-type: none"> <li>• Short-medium term development</li> <li>• Medium-to-long-term operation</li> </ul>	1.2, 1.4

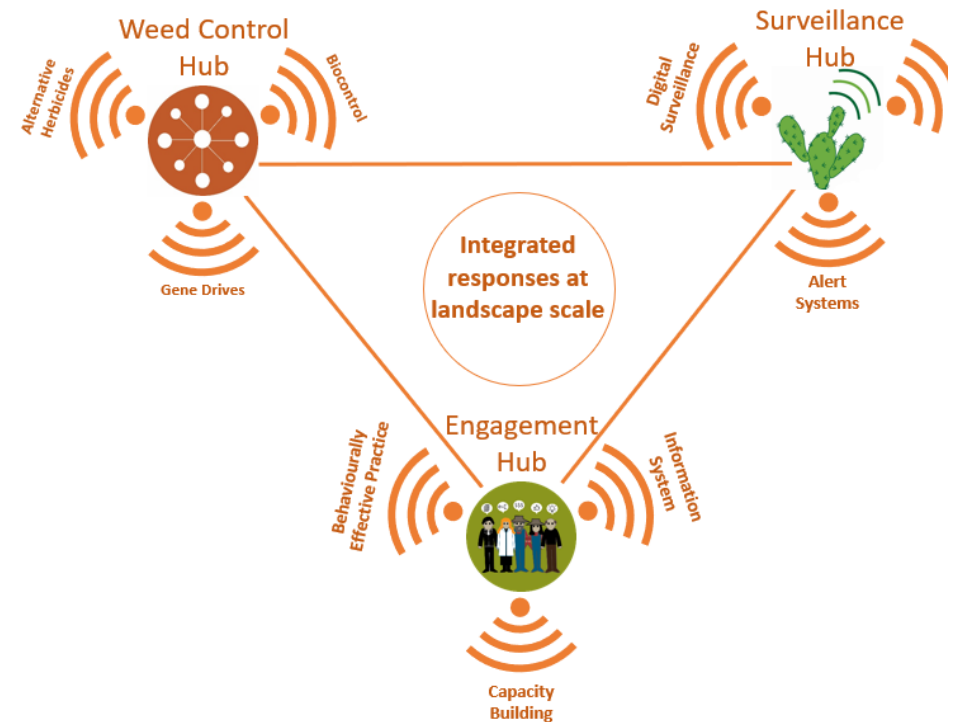
1. Project contracted: P01-W-003: Biosecurity surveillance of e-commerce and other online platforms for illegal trade in declared plants
2. Project contracted: A-021: Computer Vision Weeds ID App and WeedScan Community Management and Communication System

## THE HUB APPROACH

Embedded within the five Domains are three coordination hubs potentially dealing with control technologies, real-time surveillance and engagement. Implicit in this acknowledgement is the desire to maximise coordination within and across the Domains supported under this Plan and integrating this with existing and emerging knowledge, practice and experience from whatever origin. This is vitally important to ensure that the Plan's focus remains on integrated weed management responses at the landscape scale. Integration, however, doesn't come without effort, coordination, goodwill, investment and communication. For this reason, the Portfolio No.2 Agreement will seek to formalise Hub structures with dedicated coordination and facilitation resources.

### Hub Purpose of Coordination

- |              |   |
|--------------|---|
| Weed Control | <ul style="list-style-type: none"> <li>• Development of agreed priorities for control technologies</li> <li>• Development of standards and protocols</li> <li>• Collaboration to maximise access to scarce expertise</li> <li>• Synthesis of knowledge so it is easily translated into action</li> <li>• Instilling confidence through peer review, feedback &amp; encouragement</li> <li>• Facilitating stakeholder engagement that is ongoing and purposeful</li> </ul> |
| Surveillance | <ul style="list-style-type: none"> <li>• Facilitating shared systems for detecting and mapping weed incursions</li> <li>• Maximising community engagement in weed detection and reporting</li> <li>• Pushing the boundaries of science to improve the effectiveness and reduce the cost of surveillance</li> <li>• Facilitating stakeholder engagement that is ongoing and purposeful</li> </ul>  |
| Engagement   | <ul style="list-style-type: none"> <li>• Provide communities of practice with Best Management Practices</li> <li>• Facilitate sharing of community experience (both wins and losses)</li> <li>• Support communities' access to and use of community surveillance tools</li> </ul>   |

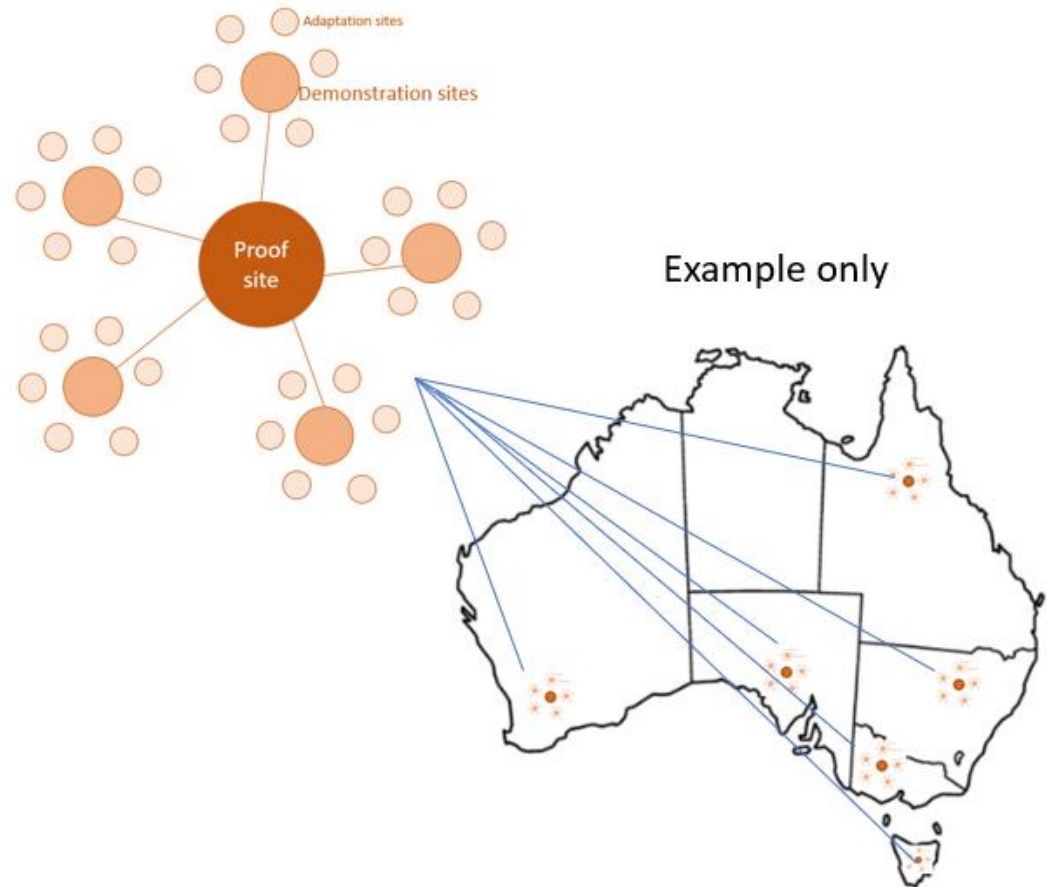


## THE PROOF, DEMONSTRATION AND ADAPTATION APPROACH

This draft Implementation Plan proposes the establishment of two significant networks of innovation and demonstration sites. The first deals with the development and trialling of new detection tools, while the second deals with the development of best management practices for weed control. Both utilise research-based Proof Sites and technology transfer-based Adaptation Sites<sup>1</sup>.

Proof Sites are required to pilot, validate and demonstrate technology products. Adaption sites are required to demonstrate management options in a co-learning environment which also allows adaptive weed management to be supported through the integration of tools under regionally relevant conditions. Adaptation sites will take two forms: first, larger more intensively monitored demonstration sites on selected farms that add to the overall experimentation data to strengthen confidence in practices emerging from Proof Sites, and second, devolved adaptation sites that provide feedback on the how recommended practices can be adapted to fit a range of local circumstances.

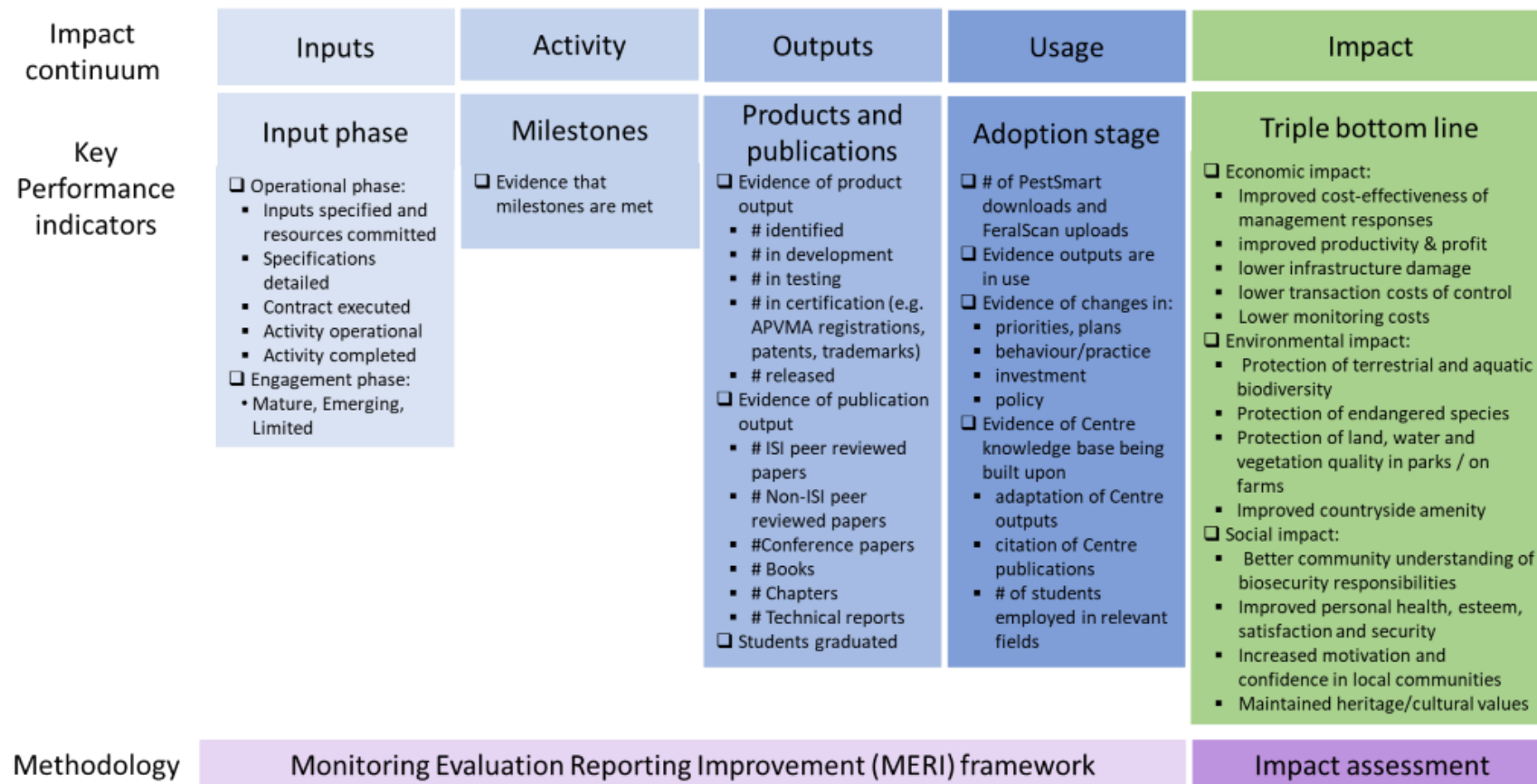
The accompanying figure shows how Proof and Adaptation Sites are networked. The priority species to be pursued through this approach will be limited so as to create the level of critical mass of effort needed to provide significant long-term outcomes. The prioritisation process will be undertaken early in the life of the 10-Year Plan, utilising an engagement approach that will also identify the communities of interest that will provide guidance to the Proof Site experimentation and oversight of the Adaptation sites.



<sup>1</sup> This approach will be piloted through the proposed National Invasive Grasses RD&E Program.

## THE MONITORING & EVALUATION APPROACH

The Centre’s Research Portfolio No.1 has been designed to deliver results leading to high impact. To demonstrate whether impact has been achieved or on-track towards achieving impact, the Centre has developed a Research Excellence and Impact Framework (REIF) based on continuous measurement of performance along the innovation continuum (see below). This allows progress to be tracked from input to impact, with the achievement of earlier stages acting as a proxy for the likely achievement of later stages. For each stage, Key Performance Indicators have been identified for all Centre Portfolio No.1 projects. This staging process is important as it is simply not possible to demonstrate the achievement of outcomes and impacts early in the life of multi-year projects. The REIF approach to M&E will be adopted for Portfolio No.2.



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