A new qualitative tool for informing feasibility of eradication

Final report for CEBRA project 24E

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1. Executive summary

The Centre of Excellence for Biosecurity Risk Analysis (CEBRA) was commissioned by the Australian Department of Agriculture, Fisheries and Forestry (DAFF) to enhance tools for assessing the feasibility of pest and disease eradication in Australia. The project focused on improving decision-support systems for biosecurity responses, particularly for the Consultative Committee on Emergency Plant Pests (CCEPP).

CEBRA evaluated two existing tools: a qualitative Microsoft Excel tool developed by DAFF and CCEPP, and a quantitative web-based tool from the Centre for Invasive Species Solutions (CISS).

The DAFF/CCEPP Excel tool assesses socio-political, technical, and economic feasibility, aligning with PLANTPLAN requirements. It compiles input from various stakeholders but has seen limited adoption due to its complexity, reliance on subjective interpretations, and lack of clear links to eradication strategies.

Conversely, the CISS web-based tool simulates pest dynamics and evaluates control costs, excelling in user-friendliness and visual outputs. However, its narrow focus, data requirements, and inability to integrate multiple stakeholder inputs – as required by PLANTPLAN – hinders its usefulness in informing feasibility of eradication decisions made by CCEPP.

To ground their evaluation, CEBRA consulted stakeholders from government, Plant Health Australia, and industry groups. Feedback from a workshop informed the design of a new decision-support prototype tool, emphasizing the need to retain core evaluation criteria while reducing redundancy and structuring questions thematically. Stakeholders agreed that the tool should primarily focus on technical feasibility, with contextual questions addressing social, legal, and economic constraints. Moreover, this tool should be used to facilitate CCEPP discussions by identifying areas of agreement and disagreement across a range of criteria used in the original CCEPP excel tool.

The new prototype tool features:

- A simplified user experience with 28 evaluation criteria across six thematic modules.
- An intuitive online interface for structured stakeholder input.
- Visual summaries highlighting consensus and gaps in evidence that can be viewed on platform or downloaded as individual or group summary reports.

- Iterative evaluation capabilities and options for recording private notes and shared comments.
- Flexibility regarding hosting options, including internal DAFF systems or external systems such as those available within AWS, Plant Health Australia or Biosecurity Commons (www.biosecuritycommons.org.au).

The tool was trialled on retrospective case studies, demonstrating improved clarity and utility for evidence-based decision-making. Future enhancements may include a staged decision-making framework, comparative analysis of eradication strategies, tailored user access, refinement to criteria questions to further reduce subjectivity, and expanded socio-political modules.

This project establishes a more robust, transparent, and adaptable system for facilitating CCEPP stakeholder discussions on eradication feasibility that aligns with nationally agreed standards such as PLANTPLAN.

2. Project overview

2.1. Background

When an invasion of a pest or disease is first discovered, an immediate response is triggered to determine the most appropriate management option based on the biology of the threat and the nature and extent of its incursion. Controlling detected outbreaks as quickly as possible is critical for preserving the feasibility of all management options – whether they be eradication, containment, or longer-term asset-based protection measures, such as impact reduction or mitigation (Fig. 2.1).

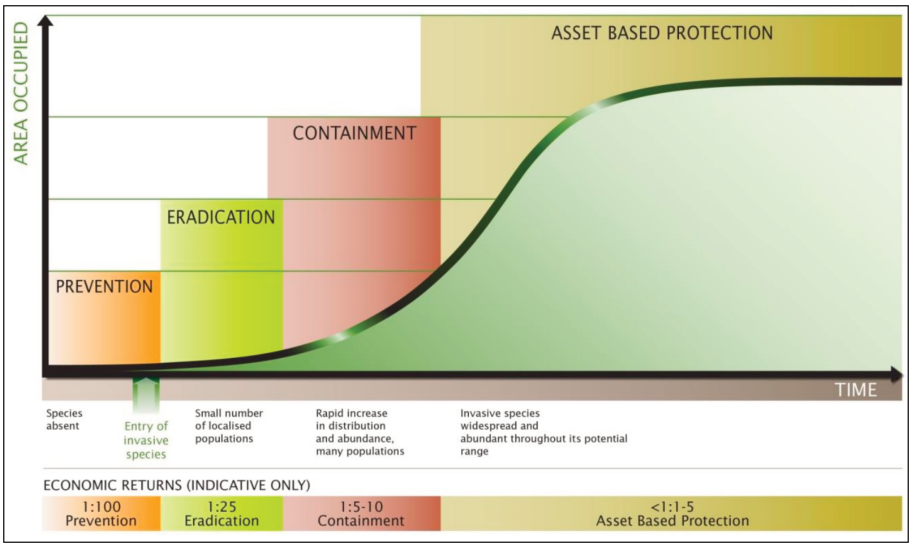

Figure 2.1.: Generalised invasion curve showing the extent of the invasion (i.e. area occupied), and the appropriate management actions at different stages. Note how as invasion proceeds, the return on investment for management actions is expected to decrease. *Source: Biosecurity Victoria.*

Eradication involves the complete removal of the target pest or disease from an infested area. Given eradication has an expected end-date to expenditure and impacts, it is always the preferred management option when a threat is first detected. However, while very appealing, eradication may not always be the most appropriate management strategy, and should not be undertaken unless its feasibility has been assessed and agreed upon by government and stakeholders.

Decisions regarding whether eradication of an exotic species is feasible (and should therefore be attempted as the preferred management action) can be made either at the early stages of an incursion response or at key points throughout a response. In any case, making a decision regarding the feasibility of eradication is a complex process, and decision-makers tasked with it face three main challenges:

1. Decisions must be made in a timely manner despite a paucity of information;
2. Feasibility of eradication is a multi-faceted concept, spanning socio-political, technical, and economic aspects (Parkes, 1990; Bomford & O'Brien, 1995; Panetta & Timmins, 2004; Horn *et al.*, 2022). Some of these aspects are difficult to estimate (especially when information is poor) and often open to a degree of interpretation; and
3. There is an obligation to consult and coordinate with a potentially wide group of impacted stakeholders, who likely bring different and undisclosed mental models and values.

Feasibility of eradication is determined by the interplay of multiple factors, which can be broadly classified as socio-political, technical, or economic; each must be accommodated for eradication to be successful.

Socio-political feasibility relates to sociopolitical considerations. These include aspects such as land tenure over which eradication will be required, political will, public support for the proposed eradication methods (e.g., live trapping and euthanasia of grey squirrels in Italy; Bertolino & Genovesi, 2003), and crucially whether long-term financial and political commitment to an eradication strategy is possible (Panetta & Timmins, 2004).

Technical feasibility relates to whether the proposed surveillance and control methods meet the requirements and challenges posed by the biology of invasive species, as well as the current conditions of incursion. Thus, technical feasibility refers to a diverse set of factors, including the ability to detect the threat, the effectiveness of control methods, logistic considerations associated with the number, spatial distribution and accessibility of incursions (Panetta & Timmins, 2004), and the availability of expertise and other resources.

Economic feasibility relates to whether the benefits generated for society outweigh the costs of eradication (e.g. cost of control and surveillance methods) over time (Cacho *et al.*, 2007).

A final decision regarding eradication feasibility must present one or more management options that are explicitly assessed for their socio-political, technical, and economic feasibility. If eradication options are determined to not be feasible in any one of these three dimensions, then managers should consider alternative management options, e.g., containment or asset-protection strategies (Fig. 2.1).

Inadequate examination of one or more of these dimensions can ultimately lead to eradication attempts that have a high likelihood of failure. For example, disregarding the lack of public support for the control methods used has been identified as a primary reason for the failure of recent attempts to eradicate the light brown apple moth in

California (Carey *et al.*, 2023). Despite the significance of these three dimensions, it is not uncommon practice to inform eradication feasibility solely or strongly based on aspects of technical feasibility. Technical aspects are somehow easier to assess based on available (even if limited) scientific knowledge, while socio-political aspects can be more subjective and economic assessments are time-demanding.

2.2. Guidelines and tools

Government bodies and practitioners worldwide acknowledge the complexity of eradication decision-making, and the importance of a multi-faceted approach. This has led to international guidelines describing the type of information and the steps involved in assessing the feasibility of undertaking an eradication program. For example, in 2016, the International Plant Protection Convention (IPPC, 2016) published their 'Guidelines for pest eradication programmes', focused on eradication of plant pests. Some decision-support tools have been developed across the globe to help managers assess eradication feasibility. These are designed to assist in the process of gathering relevant information, consider the evidence (and lack thereof), and make a final decision regarding eradication feasibility. In doing so, these tools provide a formal, transparent and more-or-less robust approach to interpret national and international guidelines for consistent decision-making across incursion events, exotic species, and decision-makers. Given the large volume of eradication initiatives carried out around the world – at least 1,500 eradication attempts of vertebrate species on islands since 1950 (DIISE, 2018), a generalised approach to use standardised protocols and tools to support eradication feasibility decisions shows high potential to identify key factors leading to feasibility decisions linked to successful eradication attempts. Examples of these tools include: the Resource Kit for Rodent and Cat Eradication[1], which is offered by Pacific Invasives Initiative and walks managers through the steps needed to gather information and decide whether eradication of rats and cats on islands is feasible; and the Invasive Plant Management Decision Analysis Tool (IPMDAT)[2], whose development was led by The Nature Conservancy and allows users to formally gather relevant evidence to inform the feasibility of several weed management options, including eradication.

In Australia, several formal agreements detail the role and expected participation of government, industry, and other stakeholders in decision-making regarding eradication feasibility for exotic species. These include the Emergency Plant Pest Response Deed (PHA, 2025) for plant pest incursions, the Emergency Animal Disease Response Agreement (AHA, 2023b) for animal disease outbreaks, and the National Environmental Biosecurity Response Agreement (Commonwealth, 2021) for incidents that involve environmental threats. Following these agreements, independent organisations such as Plant Health Australia and Animal Health Australia have developed further detailed guidelines and plans to respond to invasive species incursions across the country. Plant Health Australia in particular has developed PLANTPLAN (Australian Emergency Plant Pest Response Plan; PHA, 2022), which describes the procedures to follow and the responsibilities of affected parties during the preparedness and emer-

[1] https://www.pacificinvasivesinitiative.org/rk
[2] https://www.ipmdat.org

gency response for pests and diseases that affect Australian plant industries. Although PLANTPLAN lists ten main criteria to consider for eradication feasibility evaluations, spanning socio-political, technical and economic feasibility aspects (Table 2.1), this document provides no further guidance as to how the criteria should be evaluated when assessing eradication feasibility, potentially resulting in significant subjectivity around how criteria are interpreted, assessed, and combined. Under the Emergency Plant Pest Response Deed, the ultimate responsibility for assessing technical feasibility for eradication of plant pest incursions in Australia lies with the Consultative Committee on Emergency Plant Pests (CCEPP).

To increase objectivity around eradication feasibility decisions, some eradication feasibility decision-support tools have been developed in Australia. These include:

- **WEEDSEARCH.** This support spreadsheet tool combines population dynamics and search theory (Cacho & Pheloung, 2007) and allows users to calculate the probability that a weed invasion will be eradicated based on the amount of time spent searching for it (Cacho *et al.*, 2006; Panetta *et al.*, 2011). To the best of our knowledge, WEEDSEARCH is no longer used or maintained.

- A **CISS quantitative** tool. The Centre for Invasive Species Solutions (CISS)[3] has recently completed the development of a prototype web-based decision tool for guiding assessments about eradication feasibility, with particular focus on the technical and economic feasibility of eradicating vertebrate invasive species.

- A **DAFF/CCEPP qualitative** tool. The Australian Department of Agriculture, Fisheries and Forestry (DAFF) along with the Consultative Committee on Emergency Plant Pests (CCEPP) have developed a Microsoft Excel tool translating the criteria presented in PLANTPLAN (Table 2.1) into a complex network of qualitative questions aimed at guiding eradication feasibility decision-makers. This tool is only briefly mentioned in a handful of government-led documents, mostly in relation to the Queensland Department of Agriculture and Fisheries (for an example, see Csurhes *et al.*, 2016).

There is a notable lack of publicly available scientific or technical reports on the use of decision-support tools to assess eradication feasibility in Australia. This absence makes it difficult to determine whether any particular tool is consistently or routinely adopted for this purpose. However, based on consultations with key stakeholders, the DAFF/CCEPP qualitative tool appears to be the primary resource currently used to inform decisions regarding the feasibility of eradication of plant pests and diseases in Australia.

Despite this, there remains significant potential to enhance the scientific rigour and transparency of decision-making during emergency responses. In particular, existing approaches to assessing eradication feasibility could be improved by relying on decision-support tools that can:

1. Efficiently incorporate input, in a timely-manner, from a wide range of stakeholders, each bringing different expertise, responsibilities, and exposure to impacts;

[3] https://invasives.com.au

Technical feasibility of eradication criteria	**Factors to be considered** *Note: not all factors listed may be relevant to the EPP or Incident and/or there may be additional factors to consider*	***Supports* or is an *impediment* to successful eradication or is *unknown***
1. Aspects of the species biology that influence the ability to eradicate the EPP		
1.1. Ability of the EPP to establish and spread	• Range of climate/environmental conditions EPP can survive/reproduce in • Extent of natural (e.g. wind, rain, invertebrate vectors) and human assisted (e.g. people, equipment, machinery) pathways of spread • Broad versus narrow host range (including alternate/weed hosts) • Reproduction rate, infectivity/virulence • Lifecycle/ability to rapidly reproduce/generate offspring, ability to infect at low inoculum load	e.g. supports successful eradication
1.2. Ability of the EPP to persist in the environment	• Persistence in soil, water, plant debris, vectors • Dormant stage, latency period and/or asymptomatic infections	
2. The current circumstances of the Incident that influence the ability to eradicate the EPP		
2.1. Suitability of current circumstances to establishment and spread	• Current EPP prevalence/inoculum load • Likely time from introduction to initial detection • Current extent of EPP distribution • Suitability of climate/environmental conditions in the affected area to establishment and spread • EPP likely to be present and persisting in soil, water, plant debris • Extent of host distribution (how wide and densely distributed) in the affected area (including alternate/weed hosts) • Presence and distribution of natural vectors in the affected area	
2.2. Ability of quarantine and other measures to contain the EPP	• Infected Premises quarantined • Pathways and risk mitigation measures known or can be determined • Quarantine areas can be determined and implemented	
3. The ability to accurately diagnose the EPP	• Reliability of diagnostic method/protocol • Sensitivity of diagnostic method/protocol (can detect EPP at low levels) • Resolution of taxonomy • Availability of diagnostic equipment/expertise	
4. The ability to find all sites in which the EPP may be present	• Detectability of the EPP (e.g. symptoms can be visualised or a variant form of an established pest can be easily differentiated) • Reliability of surveillance methodology • Sensitivity of surveillance methodology (e.g. detect at low expression/prevalence) • Extent of host range (wide versus narrow host range) • Extent of host distribution (density/abundance and how widely distributed) • Ability to find and identify hosts • Affected areas accessible • Ability to successfully conduct trace-back and trace-forward investigations • Pathways of movement/spread can be identified • Ability to model natural spread pathways (e.g. wind, water, vector distribution)	
5. The presence of an effective control method that will remove or destroy all EPPs present		
5.1. An effective control method is available/accessible	• Method effective at destroying/removing EPP • Chemicals, traps etc available and accessible • Control method has been used elsewhere to successfully eradicate • Availability of resistant crop varieties • Ability of EPP to rapidly develop resistance to chemicals/control • Effectiveness of control method at low prevalence levels	
5.2. Control method can be implemented to remove the EPP at a faster rate than it can propagate/spread	• Extent of infestation • Extent of distribution and accessibility of hosts (including alternate/weed hosts • Reproduction rate/virulence/infectivity • Persistence of EPP in plant debris, soil and water • Control effective during dormancy • Limitations to timely manual removal of affected hosts	
5.3. Whether there are control methods commonly employed for endemic pests and diseases, that may limit the establishment, spread and/or impact of the EPP	• Chemicals or cultural controls commonly in use in the affected area are likely to be effective at suppressing or controlling the EPP • Extent to which establishment, spread and/or impact of the EPP may be limited through common use of control methods for endemic pests and diseases	
6. The likelihood of repeated introductions	• Ability to identify pathway of entry into Australia or out of a defined area of containment within Australia • Whether likely pathway is regulated or non-regulated (e.g. entry through natural means) • Effectiveness of controls in place to mitigate re-entry	
7. The recommended response strategy is acceptable to stakeholders and the general public	• Direct impacts on industry • Flow on effects to allied /downstream industries • Impacts on health, community and lifestyle (e.g. cultural and social impacts, amenity and landscape impacts) and public acceptability of control methods • Environmental, non-target impacts • Stakeholder consultation and support	
8. Any legislative impediments to undertaking an emergency response	• Impediments to use of control methods e.g. environmental impacts • Ability to effectively apply legislation • Ability to access properties/land	
9. The resources e.g. chemicals, personnel etc. required to undertake an emergency response are accessible or available	• Chemicals/traps etc. available • Permits can be obtained • Expertise available • Work health and safety impediments • Logistical impediments (e.g. sufficient personnel available/accessible)	

Table 2.1.: List of criteria proposed in PLANTPLAN to evaluate feasibility of eradication of plant pests and diseases. *Source:* PHA (2022).

2. Explicitly acknowledge and account for uncertainty in the stakeholder elicitation process;

3. Make optimal use of available response data; and

4. Gather evidence, assess information, and reach consensus through a formal, transparent, and replicable protocol.

A decision-support tool with these capabilities would significantly strengthen the decision-making process of the CCEPP. It would help ensure that eradication feasibility decisions are based on scientific rigour, the best available evidence, and a standardised approach across multiple pest incursions by a single or multiple organisms. Furthermore, such a tool would support compliance with the Emergency Plant Pest Response Deed (PHA, 2025), by enabling structured, multi-stakeholder input within a transparent decision-making framework. Finally, it would enhance CCEPP discussions by identifying areas of stakeholder agreement and disagreement, as well as highlighting aspects of eradication feasibility where significant uncertainty remains.

2.3. Project summary

The Australian Department of Agriculture, Fisheries and Forestry (DAFF) tasked the Centre of Excellence for Biosecurity Risk Analysis (CEBRA) to critically review the current approach for decision-making in eradication feasibility, and identify opportunities to strengthen the process while complying with international and federal guidelines.

Specifically, CEBRA was tasked to review two existing tools for informing CCEPP recommendations related to the feasibility of eradication during an incursion response. The review was based on:

1. the critical evaluation of two recently developed tools – the qualitative Microsoft Excel tool developed by DAFF/CCEPP, and the quantitative web-based tool developed by CISS – to identify barriers and opportunities for tool uptake among stakeholders, and

2. a stakeholder-driven workshop to discuss these findings, with an emphasis on possible opportunities for improvement of feasibility of eradication decision-support tools.

The review findings, and the identified opportunities for improvement in eradication feasibility decision-making, are the base for the development of a refined or new decision-support prototype tool by CEBRA. This tool is designed to support discussions among experts, decision-makers and regulators so they identify uncertainties and disagreements, and eventually reach consensus regarding feasibility of eradication for a particular pest incursion event and time. It is not expected to provide a definite answer regarding the overall feasibility of eradication for particular incursions.

2.3.1. Project objectives

Given the tight nine-month timeline of the project, the objectives must remain focused and well-defined. This project is aimed at:

- Assessing how existing methods can be potentially integrated or improved to meet the needs of all stakeholders, while increasing the scientific rigour and transparency of decisions that are derived from it.
- Building on existing tools, developing a refined or new protytpe tool that will enable multi-stakeholder use of the simplest necessary model for data-poor environments to support decision-making on eradication, in agreement with EPPRD (PHA, 2025).
- Trialling the ability of the refined or new decision-support prototype tool to support the feasibility of eradication determination process with several case studies.

2.3.2. Project outputs and benefits

The outputs of this project include:

- A thorough review of two current feasibility of eradication decision-support tools – the DAFF/CCEPP Microsoft Excel tool and the CISS web-based tool, including their main capabilities, strengths and weaknesses;
- A prototype support tool for feasibility of eradication decision-making that draws on the benefits of existing tools but improves their usability and appeal for decision-makers;
- Several case studies of the technical feasibility of eradication of hypothetical incursion scenarios, based on past incursions, using the new prototype tool; and
- A technical report detailing the benefits of the new prototype tool, a guide on how to use it, and the identification of several opportunities for its future extension.

Ongoing engagement with state and territory jurisdictions, Plant Health Australia (PHA) and industry representatives will ensure the outputs of this project are fit-for-purpose and implementable. With appropriate follow-up work, including further case studies and the generalisation of the underlying model framework, long-term benefits of this project may include the following:

1. Barriers for widespread uptake and use of the tools to be identified and minimised;
2. Incursion response to become more agile and comparable across decision-makers and biosecurity threats;

3. Knowledge uncertainties and disagreements among stakeholders to be more easily and quickly identified;

4. Reasons and rationale used to support feasibility decisions to become clearer; and

5. Collection of comprehensive data to evaluate the relationships between emergency response decision-making and emergency response efficiency and success.

2.3.3. Methodology and approach

This project presents a critical review of the two primary decision-support tools for assessing eradication feasibility in Australia, as identified by DAFF: the DAFF/C-CEPP Microsoft Excel tool and the CISS web-based tool (Appendix A). No additional frameworks or tools were assessed. The review evaluates each tool's key capabilities, strengths, and weaknesses, and assesses their overall fitness for purpose in informing eradication feasibility in contemporary responses under the Emergency Plant Pest Response Deed (PHA, 2025). Based on this assessment, a series of opportunities for improving decision-making in eradication feasibility are outlined (Chapter 3).

These findings and proposed opportunities for improvement were shared and discussed during a stakeholder workshop involving individuals with direct experience in incursion responses and the practical use of current decision-support tools (Chapter 4). Participants included a small but representative group of stakeholders from DAFF, state government agencies, Plant Health Australia, and industry sectors (see Table B.1). The workshop was instrumental in validating the review's findings, identifying additional barriers and opportunities for tool adoption, and providing valuable context regarding stakeholder requirements, perceptions, and experiences.

Drawing on both the review and the stakeholder feedback, the project proceeded to develop a new prototype decision-support tool to evaluate the feasibility of eradication (Chapter 5). This tool is designed to be generalisable across plant pest threats (animal health is outside the current scope), user-friendly, and capable of incorporating input from a diverse range of stakeholders. A variety of stakeholders were engaged to test the prototype's functionality and the interpretability of its outputs through case studies agreed upon during the workshop (Chapter 6). This testing phase led to the identification and integration of additional improvements, further refining the tool's functionality.

The report concludes with a user guide for the new prototype tool (Chapter 7) and a brief discussion of potential future enhancements and extensions (Chapter 8).

3. Review of existing decision-support tools and opportunities for improvement

The Centre of Excellence for Biosecurity Risk Analysis (CEBRA) has been commissioned to undertake a critical review of existing procedures and decision-support tools developed to guide assessments of eradication feasibility during incursion responses in Australia. These procedures and tools are designed to assist decision-making bodies, such as the Consultative Committee on Emergency Plant Pests (CCEPP), in determining whether eradication is a feasible option for a given incursion. Based on this assessment, the appropriate course of action can be determined: whether to initiate an eradication response or pursue alternative management strategies if eradication is deemed unfeasible (Fig. 2.1).

To support decision-making, tools should be capable of facilitating structured discussions around eradication feasibility. Specifically, they should help identify: (i) areas where stakeholder consensus exists; (ii) areas of stakeholder disagreement; and (iii) aspects where a degree of uncertainty remains, i.e., scientific or technical evidence is limited or ambiguous. Importantly, such tools must align with the expectations and standards outlined in Australia's emergency response Deeds, Agreements, and Plans (AHA, 2020, 2023a; PHA, 2022, 2025).

In particular, DAFF has expressed interest in the evaluation of two recently developed decision-support tools:

- a qualitative Microsoft Excel tool, co-developed by DAFF and CCEPP, that builds on the criteria presented in PLANTPLAN (PHA, 2022) and is tailored to evaluate feasibility of eradication for plant pests and diseases; and
- a quantitative web-based tool, developed by the Centre for Invasive Species Solutions (CISS), focused on assessing eradication feasibility for vertebrate species.

At present, there is limited publicly available scientific or technical evidence indicating that either tool has been consistently or widely adopted by decision-makers engaged in emergency responses. According to discussions with DAFF, the DAFF/CCEPP Microsoft Excel tool remains the primary formal resource used to support CCEPP assessments of technical eradication feasibility for plant pests and diseases. However, DAFF personnel have indicated that barriers to stakeholder adoption likely exist, impeding the broader and routine use of the tool across incursion responses.

A range of factors may contribute to the limited uptake of these decision-support tools. These include perceived complexity or time demands, unclear input requirements or output interpretation, the absence of key feasibility criteria (suggesting the tools may not be fully fit-for-purpose), and challenges in accommodating input from diverse stakeholders.

This review focuses on identifying the main capabilities, strengths, and weaknesses of the DAFF/CCEPP Microsoft Excel tool and the CISS web-based tool. In doing so, it provides a valuable opportunity to critically evaluate whether these tools are aligned with current decision-making needs under the Emergency Plant Pest Response Deed (PHA, 2025) and other biosecurity emergency response frameworks (e.g., AHA, 2023b). Additionally, the review seeks to uncover potential barriers that may have hindered broader stakeholder engagement and adoption of these tools to date.

3.1. Summary of the tools' strengths and weaknesses

Here, we present a brief summary of the review undertaken by CEBRA. For a full review of the tools' main capabilities, strengths, and weaknesses, see Appendix A.

3.1.1. DAFF/CCEPP Microsoft Excel tool

This tool was jointly developed by DAFF and CCEPP to evaluate feasibility of eradication for plant pests and diseases. Using Microsoft Excel spreadsheets, the tool translates the feasibility criteria presented in PLANTPLAN (Table 2.1) into 76 unique qualitative questions or criteria, which are presented as seven multi-tier decision-trees (Fig. A.2). After representatives from each jurisdiction and impacted industry are asked to evaluate the questions, their answers are manually compiled and presented as a colour-coded summary (Fig. A.3). The tool and its summary are designed to assess the level of consensus across stakeholders. Discussions can then focus on specific points of contention among different parties and determine why there are differences of opinion (i.e., where all or some parties feel that there is insufficient information or evidence to come to a conclusion about feasibility of eradication). Decision-makers have full discretion in interpreting the inputs from stakeholders and the output from the tool to conclude which levels of uncertainty and/or disagreement are ultimately acceptable for the eradication to be considered feasible overall.

The DAFF/CCEPP Microsoft Excel tool has the following strengths:

- **Structured, comprehensive, and aligned with PLANTPLAN evaluation criteria.** The tool evaluates multiple aspects spanning socio-political, technical and economic feasibility. The feasibility criteria presented in the DAFF/CCEPP Microsoft Excel tool are visually organised in a tree-like structure, giving users a thorough understanding of the links and relations among the different aspects that need to be considered simultaneously. However, it is worth noting that the

criteria representing economic aspects of eradication feasibility are only few, and rather vague in their language.

- **Easy to use.** Evaluation of the criteria is relatively straightforward by choosing one of a few predefined, qualitative categories (e.g. low, high, unknown).

- **Identification of uncertainty and knowledge gaps.** The tool is designed to identify knowledge gaps in the evidence needed to evaluate feasibility of eradication, as well as differences and disagreements in how stakeholders understand or interpret existing evidence.

- **Designed to collate input from multiple stakeholders and facilitate discussion.** The tool is designed to compile feedback from a diverse group of stakeholders and affected parties, including the Australian Government, state and territory governments, and industry signatories of the Emergency Plant Pest Response Deed (PHA, 2025). It does so in a structured, transparent and replicable manner, providing accountability and transparency to all parties involved in shared decision-making.

- **Potential to be used to evaluate several groups of invasive species.** Even though the evaluation criteria presented in the tool are tightly tailored to plant pest species – particularly insects and other invertebrates – its qualitative and flexible nature means it has potential to be applied to decisions of eradication feasibility beyond this group of species to plant diseases, pathogen complexes, and likely environmental weeds.

The DAFF/CCEPP Microsoft Excel tool shows the following weaknesses:

- **Large number of evaluation criteria, and some redundancy.** Assessment of 76 evaluation criteria is an arduous exercise, and having all these criteria in a single spreadsheet can easily be perceived as daunting and overwhelming. The colour-coded summary output of the tool is also quite involved and its interpretation can be challenging.

- **Lack of clarity around control/surveillance methods and overall strategy.** The tool lacks a dedicated space where the eradication strategy is described, despite multiple questions in the tool being focused on aspects of the control and surveillance methods. If individual users are thinking of different control methods, their responses to the evaluation criteria won't necessarily be comparable. In addition, the tool does not provide a way to evaluate and compare alternative eradication approaches.

- **Qualitative assessments heavily rely on subjectivity.** Due to the qualitative nature of the criteria presented in this tool, the evaluation heavily relies on the users' previous experience, abstract knowledge and gut-feeling. While experts' pest knowledge and experience in incursion response is invaluable to make sound decisions regarding feasibility of eradication, qualitative assessments make it challenging to separate objective evidence from the subjective values, opinions and expectations of the diverse stakeholders involved.

- **Vague language.** Some criteria display vague language, e.g. 'short maturation time', 'high reproduction rate', and 'low population levels'. Vague concepts add language uncertainty and may potentially translate into different interpretations of the same term or idea by different users.

- **Data handling is not automated.** This tool requires considerable manual handling of the individual responses by the designated compiler, which may introduce unnecessary errors.

3.1.2. CISS web-based tool

This R Shiny App (Fig. A.4) was developed by the Centre for Invasive Species Solutions (CISS)[1] under the name *Eradication Feasibility decision-support tool* (Ramsey *et al.*, 2022). It is a quantitative tool designed to simulate population dynamics of vertebrate pests under one or more control regimes. To do so, the user needs to provide specific parameters that describe: (i) the pest biology, (ii) its abundance and suspected spatial distribution, and (iii) the effectiveness and cost of the control method/s. The user can then evaluate the efficacy and cost-effectiveness of multiple user-defined eradication scenarios, each of which can include one or multiple concurrent control methods (trapping, bait stations, hunting, and aerial poisoning). For each scenario, the tool generates a series of quantitative outputs – including the ratio between total cost and killing efficacy, and the mean reduction of the pest population size over time (Fig. A.10) – that help decision-makers quickly conclude which (if any) of the scenarios resulted in the expected control efficacy within the required budget. Even though the tool does not guarantee the success of any given simulated eradication strategy, it can inform questions about cost-effectiveness of eradication operations and support decisions regarding feasibility of eradication for a particular pest incursion. This R Shiny App (Fig. A.4) was developed by the Centre for Invasive Species Solutions (CISS) under the name *Eradication Feasibility decision-support tool* (Ramsey *et al.*, 2022). It is a quantitative tool designed to simulate population dynamics of vertebrate pests under one or more control regimes. To do so, the user needs to provide specific parameters that describe: (i) the pest biology, (ii) its abundance and suspected spatial distribution, and (iii) the effectiveness and cost of the control method/s. The user can then evaluate the efficacy and cost-effectiveness of multiple user-defined eradication scenarios, each of which can include one or multiple concurrent control methods (trapping, bait stations, hunting, and aerial poisoning). For each scenario, the tool generates a series of quantitative outputs – including the ratio between total cost and killing efficacy, and the mean reduction of the pest population size over time (Fig. A.10) – that help decision-makers quickly conclude which (if any) of the scenarios resulted in the expected control efficacy within the required budget. Even though the tool does not guarantee the success of any given simulated eradication strategy, it can inform questions about cost-effectiveness of eradication operations and support decisions regarding feasibility of eradication for a particular pest incursion.

[1] https://invasives.com.au

The CISS web-based tool has the following strengths:

- **Quantitative, objective and action-oriented.** This is a strong quantitative tool, based on objective estimates of the pest biology, its distribution and the control method/s. It allows decision-makers to simulate various eradication scenarios to determine which one is most likely to achieve the desired level of pest population reduction for the minimum cost. This can be very insightful for managers tasked with decision-making under limited budgets.

- **Clear, informative outputs.** The visual summaries of this tool are easy to interpret and provide a clear picture of the cost-efficacy of different eradication strategies.

- **Uncertainty is incorporated into the outputs.** Since the tool is based on simulations of the population dynamics, the outputs incorporate uncertainty around the population size estimates (but note that costs are fixed; Figs. A.10, A.11).

- **Part of a larger pipeline supporting adaptive management for eradication initiatives.** This tool was developed along two sister tools, aimed at evaluating eradication progress and providing proof of absence of the pest. These tools together support an evidence-based approach for managing pest eradication in a cost-effective way, following a logical, staged framework from the initial pest incursion to complete pest eradication.

- **User-friendly.** The tool is user-friendly, designed as a point-and-click graphical user interface, and openly available online[2].

The CISS web-based tool shows the following weaknesses:

- **Key aspects of eradication feasibility are missing.** This tool presents an oversimplified picture of eradication. It focuses solely on whether the removal rate of the pest is high enough to eliminate the population (and its cost acceptable), and assumes that other factors – e.g., pest detectability at low densities, eradication vs. sustained control benefits, or socio-political support for eradication – are conducive to eradication without further consideration. Increasing the level of biological and operational complexity in the tool may increase the difficulty for users, the need for additional parameters, and require further support from quantitative ecologists.

- **Tightly tailored to vertebrate pest incursions.** The parametrisation of the pest species' demography (Fig. A.6) and the choice of control methods offered in the tool (Fig. A.7) are tailored to vertebrate species, limiting the transferability of the tool to other groups of invasive species.

- **Requires detailed information/estimates.** The simulation of the management scenarios requires a considerable amount of detailed, quantitative information (Fig. A.8). Information of this nature is particularly rare during the initial incursion response.

[2]https://landcare.shinyapps.io/EradSim/

- **Unable to incorporate input from multiple stakeholders simultaneously.** The tool does not allow the use of multiple estimates for a parameter, nor does it allow uncertainty around estimates. If disagreements exist with respect to parameter estimates, experts would need to reach an agreement prior to running the simulations, or run parallel simulations.

- **Medium- and long-term maintenance.** The web-based nature of the tool means that it requires ongoing maintenance and curation, both of which are dependent on the availability of sustained funding.

3.2. Are the decision-support tools fit-for-purpose?

Both tools have been proposed as useful for supporting and informing decisions related to feasibility of eradication; however, the DAFF/CCEPP Microsoft Excel tool has some features that make it better suited to support the role of CCEPP during emergency response, compared to the CISS web-based tool (Fig. 3.1). In particular, the DAFF/CCEPP Microsoft Excel tool:

1. is comprehensive, and covers the complexity and multidimensionality of eradication feasibility across the socio-political, technical and economic dimensions;

2. closely aligns with the key criteria of eradication feasibility as described in PLANTPLAN (Table 2.1);

3. is designed to gather and compile input from multiple impacted stakeholders, following federal agreements for shared responsibilities in incursion response decision-making (AHA, 2023b; PHA, 2025);

4. can be readily used in data-poor settings, and revised as new information becomes available or the incursion progresses (noting that this comes at the expense of the assessment being highly reliant on experts' subjectivity); and

5. aims to identify feasibility aspects around which expert disagreement exists or for which evidence is lacking or poor, highlighting the uncertainties and unknowns that need to be acknowledged during decision-making.

Although the DAFF/CCEPP Microsoft Excel tool offers valuable benefits for CCEPP decision-making, its broad adoption among stakeholders and during emergency responses has proven challenging. Several factors may help explain this limited uptake. Based on the review, three main barriers were identified. First, the tool includes >70 assessment criteria. The considerable length of the assessment, combined with the presentation of all the criteria within a single spreadsheet, creates an interface that may be perceived as overwhelming and not user-friendly. In addition, while the criteria are arranged in a tree-like structure to illustrate connections between them (Fig. A.1), this does not effectively translate into a structured framework for decision-making. Second, the summary output of the tool, which displays all criteria using multiple colours and shading combinations (Fig. A.3), are visually dense and complex, making them

	DAFF/CCEPP Excel tool	CISS web-based tool
		
Covers social/legal feasibility dimension	✓	✗
Covers technical feasibility dimension	✓	?
Covers economic feasibility dimension	?	✓
Aligned to PLANTPLAN feasibility criteria	✓	?
Used in a timely manner, i.e. easy to fill in	?	?
Objective, quantitative assessment	✗	✓
Incorporates uncertainty	?	?
Action-oriented, evaluates several eradication strategies	✗	✓
Designed to compile input from multiple stakeholders	✓	✗
User-friendly	✗	✓
Potential to evaluate different types of threats	✓	✗

Table 3.1.: Summary of the strengths, weaknesses and general fit-for-purpose of the reviewed decision-support tools. Green tick means the tool aligns with a requirement, red cross means the tool does not align with a requirement, and yellow question mark means the tool only partially aligns with a requirement.

difficult to navigate and interpret. Third, the tool does not incorporate information about the incursion context or the specific eradication strategy under evaluation.

The CISS web-based tool offers an objective approach to assessing the feasibility of eradication, it is action-oriented (enabling users to define and evaluate one or multiple eradication strategies), and features a more user-friendly interface compared to the previous tool. However, its potential to effectively guide and support CCEPP decision-making on feasibility is significantly constrained. Key aspects of feasibility are absent from the tool, it lacks the capacity to accommodate input from multiple stakeholders, and it requires detailed information for simulations, particularly regarding pest biology and control methods.

3.3. Conclusion and opportunities for improvement

By leveraging the strengths and capabilities of existing tools, and addressing current barriers and limitations, these tools can be refined or redesigned to better support CCEPP decision-making related to eradication feasibility. Given that the current features of the DAFF/CCEPP Microsoft Excel tool provide a stronger fit-for-purpose solution for feasibility assessments compared to the CISS web-based tool, this section high-

lights opportunities to overcome its identified limitations and improve stakeholder uptake, thereby **further enhancing the potential of the DAFF/CCEPP Microsoft Excel tool**.

CEBRA recommends the development of a new eradication feasibility decision-support tool that builds on the strengths of existing tools – particularly the DAFF/CCEPP Microsoft Excel tool – but improves their functionality by considering the following identified opportunities.

Comprehensive, staged approach to decision-making

In line with Australian guidelines (e.g., PLANTPLAN; PHA, 2022), a final decision on the feasibility of eradication should identify one or more management options that are simultaneously socio-politically, technically, and economically feasible. Reaching such a decision requires the evaluation of multiple feasibility dimensions and numerous individual criteria. However, it is not necessary to assess all these aspects concurrently. In fact, a staged assessment approach offers several advantages.

First, focusing on one aspect at a time – and only proceeding to the next if the preceding one supports eradication feasibility – not only aligns with structured decision-making principles, but can also save time and resources. A staged approach can divide the assessment into sequential modules that each address a specific dimension, such as socio-political, technical, or economic dimensions of feasibility (Fig. 3.1). Within this framework, **stopping rules** can be established for decision-making: if one dimension is found to be unfeasible, the remaining dimensions need not be assessed, thereby reducing the workload for experts. For example, socio-political feasibility may need to be confirmed first. If a control method is socially unacceptable, or if there is insufficient political commitment to support eradication, the program is unlikely to succeed (Carey *et al.*, 2023). Once socio-political conditions are deemed favourable, the focus can shift to technical feasibility. At this stage, some strategies may be validated – or ruled out – based on technological capabilities or the scale of the incursion. Finally, even strategies that are both socially and technically feasible must also be economically justified. Only those options that remain viable through all stages are considered suitable for implementation (Fig. 3.1). If no such strategy emerges, managers should consider alternative responses, such as containment, suppression, or mitigation (Fig. 2.1). In this way, a staged approach streamlines the evaluation process, as strategies deemed unfeasible in earlier stages do not require full evaluation across all dimensions.

Second, organising the assessment into independent sections or **modules** can improve usability and accessibility for stakeholders. Each module can focus on a single feasibility dimension or a specific component within it – such as pest population dynamics within the technical dimension. Because modules are targeted at specific areas of expertise, and stakeholders are not expected to be knowledgeable across all aspects of feasibility, these modules can be **tailored for different organisations or stakeholder groups**. For example, economic feasibility may be best evaluated by economists; technical aspects by surveillance officers or technical experts at the state level; and industry representatives may be well positioned to assess the pest or disease impacts. This targeted approach allows stakeholders to focus on a smaller, more relevant set of questions, making the process more efficient and less time-consuming.

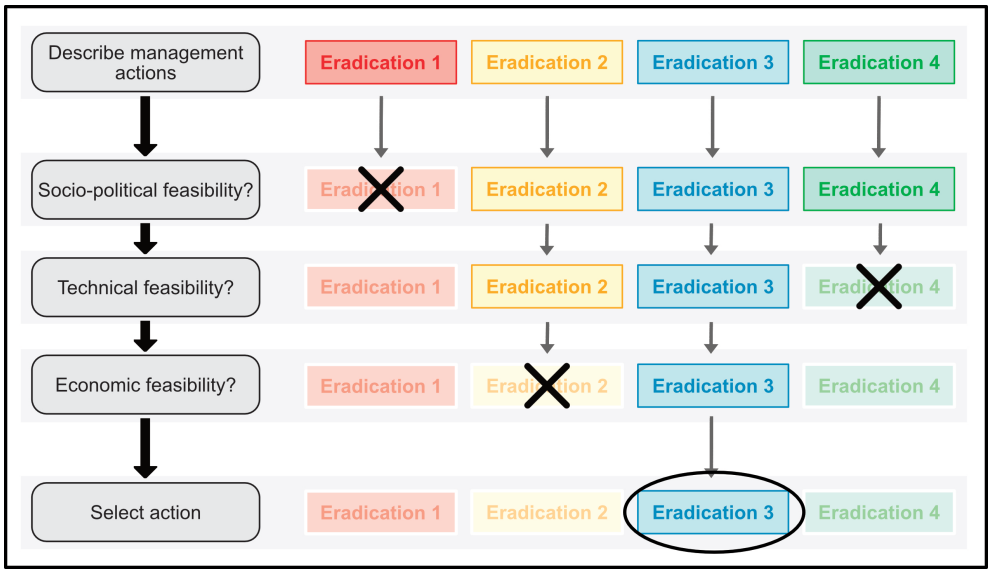

Figure 3.1.: Decision-making framework to select a feasible and cost-effective management strategy to respond to a pest incursion. Socio-political feasibility, technical feasibility and economic feasibility are evaluated in a staged manner. *Adapted from: Hester & Bland (2024).*

Finally, a staged or modular framework also introduces flexibility in how assessments are conducted. Modules can vary in the degree to which they rely on quantitative or qualitative data. For instance, technical feasibility may benefit from simulation-based modelling, while socio-political factors are more effectively assessed through qualitative methods. This adaptability enhances the overall robustness and practicality of the decision-support process.

Objective language and interpretation of evidence

Clarity and objectivity regarding the meaning of key concepts presented in the tool are critical to avoid conflicting interpretations by different experts. In addition, the relevance of the evidence must be considered based on its implications for deciding whether eradication may or may not be feasible, not just in terms of availability and agreement across experts.

Context for pest incursion and control strategy

Providing one (or several) detailed contexts regarding the current incursion and the management alternatives has the potential to increase objectivity in experts' responses, increasing the power of the tool. The assessment of criteria within specific scenarios of eradication makes the comparison of responses across different experts more reasonable and realistic.

Open, user-friendly platform

Assessing eradication feasibility using a modern, digital tool, rather than traditional offline files, offers several benefits:

1. **Automation and Error Reduction**: Operational tasks are automated, reducing manual errors and ensuring users always access the latest version.

2. **User-Friendly Interface**: Digital tools are designed to be visually appealing and easy to use, presenting criteria in a staged manner to avoid overwhelming users.

3. **Streamlined Summaries**: Answers are compiled into visual summaries to support decisions, with automated summaries reflecting both individual and aggregated expert responses.

4. **Modular Structure**: The web platform can embed a hierarchical module structure, allowing decision-makers to identify and follow stopping rules. For example, strategies lacking social support can be removed from subsequent evaluations.

5. **Transparency and Accessibility**: Digital tools enhance transparency by storing expert input in the cloud, reducing gatekeeping issues. Access rights can be managed across multiple tool managers, ensuring redundancy.

This approach ensures a more efficient, transparent, and user-friendly process for evaluating eradication feasibility.

4. Stakeholder workshop

4.1. Workshop details

A day-long workshop was organised on October 16, 2024 at the University of Melbourne, Parkville campus. Considerable effort was made by both DAFF and CEBRA to maximise inclusiveness of stakeholders from a diversity of bodies concerned with emergency response for plant pests and diseases, including the Federal Government, State and Territory Governments, Plant Health Australia, and industry sectors (Appendix B). The workshop was run by staff from CEBRA, with support from DAFF.

The workshop was divided into two segments. During the first, the participating stakeholders were presented with: (i) the findings from the review of current decision-support tools (Chapter 3), with particular emphasis on the DAFF/CCEPP Microsoft Excel tool, and (ii) a working version of a newly developed tool prototype to support eradication feasibility decisions, which had been developed by CEBRA following the findings of the review. The second segment of the workshop, which covered most of the day, was centered on discussing and extending the review findings, gaining deeper insights into stakeholders' needs, and collecting their feedback on the newly developed tool prototype. The discussion concluded with an agreement by the workshop participants to trial an updated version of the prototype tool through a series of case studies.

4.2. Stakeholder requirements and initial feedback

The participants of the workshop expressed a general consensus that the newly developed tool prototype was a great improvement from the DAFF/CCEPP Microsoft Excel tool, and they showed a high degree of enthusiasm about its main features and improved functionality. The prototype was developed as a digital tool, with an efficient and user-friendly interface. It included a section to describe the evaluation context (e.g., background information about the pest and details of the incursion) before the users conduct the evaluation. It presented the evaluation questions as qualitative criteria across several thematic modules, covering socio-political, technical and economic aspects. The tool can be easily disseminated across a wide range of stakeholders, whose responses are automatically compiled, creating a summary that is shared across users. The summary outputs are presented using a traffic-light system – where 'green' means eradication is feasible, 'red' means it is not feasible, and 'yellow' means not enough evidence is available – that visually highlights uncertainties and disagree-

ments among users.

An overview of the feedback received from stakeholders in the workshop is presented below, along with statements about how that feedback was ultimately incorporated in the Feasibility of Eradication tool prototype developed by CEBRA (Chapter 5).

- The workshop participants were broadly happy with the evaluation criteria presented in the DAFF/CCEPP Microsoft Excel tool. However, they expressed a desire to consolidate and reduce the number of questions, by removing redundancies and tightening up the tree-like presentation of the criteria (Fig. A.1) into a more intuitive structure, while still keeping the dependencies among different ideas and criteria explicit. The stakeholders were also supportive of the qualitative nature of the evaluation. While qualitative approaches limit the formal treatment of uncertainty – particularly in how uncertainty influences final feasibility judgments – they offer valuable flexibility for incorporating expert input in data-poor contexts.

  > **Integrated:** *The feasibility of eradication criteria from the DAFF/CCEPP Microsoft Excel tool were retained without making significant overall changes. They were restructured within the prototype by limiting the questions to fewer main criteria (similar to the higher-rank criteria of the DAFF/CCEPP Microsoft Excel tool; Figure A.1) and presenting the remaining sub-criteria (similar to the lower-rank criteria of the DAFF/CCEPP Microsoft Excel tool; Figure A.1) as reasons or ideas the users can select to justify their evaluation of the main criteria.*
  >
  > The main evaluation criteria included in the prototype tool, as well as the options to support agreement/disagreement for a the main criteria, can be found in Appendix C. For an example of the structure used in the prototype tool to present the criteria, see Figure 5.8.

- The stakeholders saw value in dividing the questions into different thematic modules and broadly maintaining the themes originally developed for the DAFF/CCEPP Microsoft Excel tool. Modules focus their attention on a given topic, which makes answering the survey less overwhelming. The modules should encapsulate questions around somewhat independent aspects of eradication feasibility; however, the stakeholders showed a strong preference for the evaluation of modules without a hierarchical or staged approach.

  > **Integrated:** *The feasibility of eradication questions are organised and presented across six short modules in the prototype tool following those originally present in the DAFF/CCEPP tool. The users are required to evaluate all the modules: no stopping rules are applied.*
  >
  > The themes covered by each of the six modules of the prototype tool can be found in Appendix C.

- General consensus across workshop participants was that the tool will be used to evaluate technical feasibility of eradication (as was the case for the DAFF/CCEPP Microsoft Excel tool), so the evaluation criteria should primarily focus on the technical dimension of eradication feasibility. Following the original criteria

presented in the DAFF/CCEPP tool, some aspects related to other dimensions of feasibility should be part of the prototype tool; however, the prototype should overall be used to intentionally focus on aspects of technical feasibility. The rationale behind this suggestion was that each feasibility dimension (technical, socio-political, economic) is quite complex on its own, and other tools exist and are regularly used to assess dimensions other than technical independently (e.g. appreciation process, cost-benefit analysis) or for structured decision-making (e.g. options analysis, PESTEL analysis). Often, many economic and social considerations have already been made, and are presumed conducive to successful eradication, before technical feasibility is evaluated through a tool like this. It is also important to remember that the decision-support tool is aimed at supporting CCEPP, who is ultimately responsible to make a decision on the technical feasibility of eradication during an emergency response.

> 🔗 **Integrated:** *Building on the content presented in the DAFF/CCEPP Microsoft Excel tool, most evaluation criteria in the prototype focus on the technical feasibility of eradication, while still including some questions to assess economic, legal, and social aspects.*
>
> The evaluation criteria included in the prototype tool can be found in Appendix C.

- The few original criteria (from the DAFF/CCEPP Microsoft Excel tool) that touch on economic aspects should be rephrased in terms of resource availability.

  > 🔗 **Integrated:** *The few questions related to economic feasibility in the tool are aimed at practitioners evaluating whether the resources needed for eradication are generally reasonable and manageable; the tool is not designed to perform a formal cost-benefit analysis.*
  >
  > The criteria included in the prototype tool to evaluate resource availability can be found in Appendix C.

- Despite the benefits of comparing multiple eradication strategies for more informed decision-making, the current expectations and needs of stakeholders are limited to the evaluation of feasibility for a single eradication strategy.

  > 🔗 **Integrated:** *At the moment, the tool is designed to evaluate a single eradication strategy, which can be described in the 'Background information' section of the prototype tool.*
  >
  > See Section 5.2 for the current structure of the prototype tool.
  >
  > See Chapter 8 for a possible extension of the prototype tool to include the evaluation of feasibility of multiple strategies for the eradication of a given incursion.

- The stakeholders showed support for a section within the tool where details of the suggested eradication method (surveillance and control) can be provided, as a way to increase clarity and consistency across stakeholders tasked with the evaluation of feasibility.

  > 🔗 **Integrated:** *The 'Background information' section of the prototype can be tailored to the specifics of the situation to be evaluated, and the information shared here with the users can cover as many aspects as necessary, including but not limited to the eradication strategy to be evaluated.*
  >
  > See Section 5.2 for the current structure of the prototype tool.

- The stakeholders further reiterated the key role of summary outputs in identifying existing knowledge gaps that need to be considered to make decisions of feasibility. They supported the traffic-light outputs produced by the prototype, as they simplified the multiple combinations of colours and shades presented in the DAFF/CCEPP Microsoft Excel tool, the interpretation of which was not straightforward. They also approved of the summaries being created at the module level.

  > 🔗 **Integrated:** *The traffic-light system used in the prototype summaries is simple, but highly effective at highlighting both knowledge gaps and disagreements across experts within each of the six modules.*
  >
  > An example of the summary outputs produced by the prototype tool can be found in Appendix D.

- The stakeholders saw value in designing the tool to be used in an iterative way, to evaluate a given incursion at different points in time. For each subsequent evaluation, the 'Background information' section of the tool should include the motivation behind the evaluation at a particular point during the emergency response. For example, it may be used early on for preparedness aspects by focusing on aspects of the pest biology, but revisited to identify and resolve gaps in understanding that may appear at different points along the eradication response.

  > 🔗 **Integrated:** *The tool is designed for users to evaluate an outbreak at different times of the incursion, in an iterative way. Surveys can be set up to have as many evaluation rounds as deemed necessary – for each subsequent round, the information provided within the 'Background information' section can be updated or modified to reflect the new circumstances or new knowledge.*
  >
  > See Section 5.2 for a description of the 'Background information' section.

- If the tool is used in an iterative way, including the output from the previous iteration as part of the survey would be very informative, according to the workshop participants.

  > 🔗 **Integrated:** *Subsequent rounds of a survey include: (i) an indication of the responses provided by the user on the previous round, and (ii) a high-level, colour-coded overall summary of the responses provided by all users.*

See Section 5.4 for a description of the iterative use of the prototype tool.

- In addition to information relevant to the proposed eradication method and the motivation to use the tool, the 'Background information' section should include other relevant pieces of information, e.g., is it fire season? Are the known locations close to a national park? What are societal expectations, resource limitations, or possible legal constrains?

  🔗 **Integrated:** *The 'Background information' section can be tailored to the specifics of the situation to be evaluated. All the relevant information can be shared by uploading one or multiple external documents into this section.*

  See Section 5.2 for a description of the 'Background information' section.

- Further consideration needs to be given to how the 'Background information' section needs to be presented – e.g., written summary, links to external documents, other sources – and whose responsibility it is to do so. If a summary is provided, care needs to be taken that the summary is aimed at standardising how informed respondents are without biasing their perspectives.

  🔗 **Integrated:** *The 'Background information' section can be tailored to the specifics of the situation to be evaluated, giving CCEPP (or the organism tasked with developing the information to be shared with users) a high degree of freedom to decide the best way to do so.*

  See Section 5.2 for a description of the 'Background information' section.

- The stakeholders were open to the possibility that training and guidance may be needed for users of the tool.

  🔗 **Integrated:** *CEBRA produced a comprehensive description and a User Guide of the prototype tool to facilitate the use of the tool by users and data managers.*

  See Chapter 5 for a description of the prototype tool, and Chapter 7 for the User Guide.

- Workshop participants agreed that it could be useful to provide users with the option to skip questions or sections for which they are not experts or confident enough to answer.

  🔗 **Not integrated.**

  Adding functionality to the prototype to limit user access to specific questions or modules, in line with their expertise, is presented as a potential extension (see Chapter 8).

- Workshop participants agreed that further consideration needs to be given to ways in which multiple people from the same organisation can provide expertise, in a collaborative instead of independent manner.

Not integrated.

Adding functionality that supports users' online collaboration to complete a single survey is being considered as a potential extension of the tool (see Chapter 8).

- Stakeholders showed enthusiasm about the fact that the tool allows users, as they are filling the survey, to collect personal notes for themselves as well as notes to share information with other users and the survey managers. This could be a great way to identify and make all users aware of key pieces of information that are specific to a particular group of stakeholders, e.g. industry.

  Integrated: *The tool includes two sections for users to collect notes: one to gather notes for oneself, and one to add notes to share with other users.*

  See Section 5.2 for an explanation of the prototype's 'Private notes' and 'General notes'.

- There were some discussions among the workshop participants regarding the potential for the prototype tool to provide a definitive answer as to whether eradication was feasible (at least technically feasible) or not.

  Not integrated.

  On one hand, this could be understood as the tool providing an overall summary of all the responses (as opposed to summaries by module, as the current outputs are presented). This could be done as a simple tally of the number of answers that either support or do not support feasibility of eradication; or as an aggregated summary based on weighting the different modules/questions according to some priorities.

  On the other hand, this comment can be understood as the tool having the functionality needed to support making a final decision, that is structuring the interpretation of evidence in a way that lead to a final stance on feasibility. One way of doing this is by using a staged approach in the way the criteria are evaluated.

Workshop participants agreed to trial a revised version of the prototype tool incorporating the suggestions discussed throughout the day. Several past incursions were proposed as potential case studies for retrospective re-evaluation, encompassing examples where eradication was successful and where it was not achieved, and involving a diverse range of organisms.

5. New Feasibility of Eradication tool prototype

Based on the opportunities for improvement identified through the review of existing decision-support tools for eradication feasibility (Chapter 3), and following the feedback and general suggestions provided by stakeholders involved with incursion emergency response (Chapter 4), CEBRA developed a new feasibility of eradication prototype tool. This prototype heavily builds on the themes and feasibility criteria originally presented in the DAFF/CCEPP Microsoft Excel tool. However, the prototype showcases a user-oriented and intuitive interface via its online platform, as well as simplified (yet highly informative) coloured outputs based on a traffic light system. The structure of the tool, with a lower number of eradication feasibility criteria presented to users in several thematic modules, reduces user overwhelm and makes assessment of feasibility more manageable and less time-consuming.

5.1. Aim of the tool

The prototype tool is aimed at providing decision-makers with support to ultimately decide whether eradication attempts may or may not be feasible during emergency response following pest incursion. Following recommendations from stakeholders who participated in the workshop, the prototype tool heavily focuses on the technical aspects of eradication feasibility, even though PLANTPLAN (PHA, 2022) requires aspects beyond the technical dimension to be considered to determine eradication feasibility. For example, although the tool draws on considerations of multiple legal, social and operational constraints that play a role on whether eradication is ultimately technically feasible, the tool does not provide the means to formally evaluate economic feasibility of eradication (i.e. a cost-benefit analysis). As the workshop participants stated, there are other tools they consider better suited to tackling the complexity of dimensions other than technical (e.g. cost-benefit analysis, appreciation process) or to draw multiple dimensions together for a final, structured decision of the overall feasibility of eradication (e.g. options analysis, PESTEL analysis).

The decision-support tool for technical feasibility of eradication:

- provides a user-friendly and robust way to consider multiple factors that play a role in technical feasibility of eradication, and creates a visual summary of the available evidence and support (or lack thereof) for eradication feasibility.

- does not provide an answer as to whether eradication will be technically feasible overall. The tool is designed to support discussions among experts, decision-makers and regulators so they identify uncertainties and disagreements, and eventually reach a consensus regarding feasibility of eradication for a particular pest incursion event and time.

5.2. Structure of the tool

5.2.1. Login and Authentication

After clicking through the landing page, the application presents a secure login page (Figure 5.1). Users authenticate using their email address and password. The system implements rate limiting and secure session management to protect against unauthorised access.

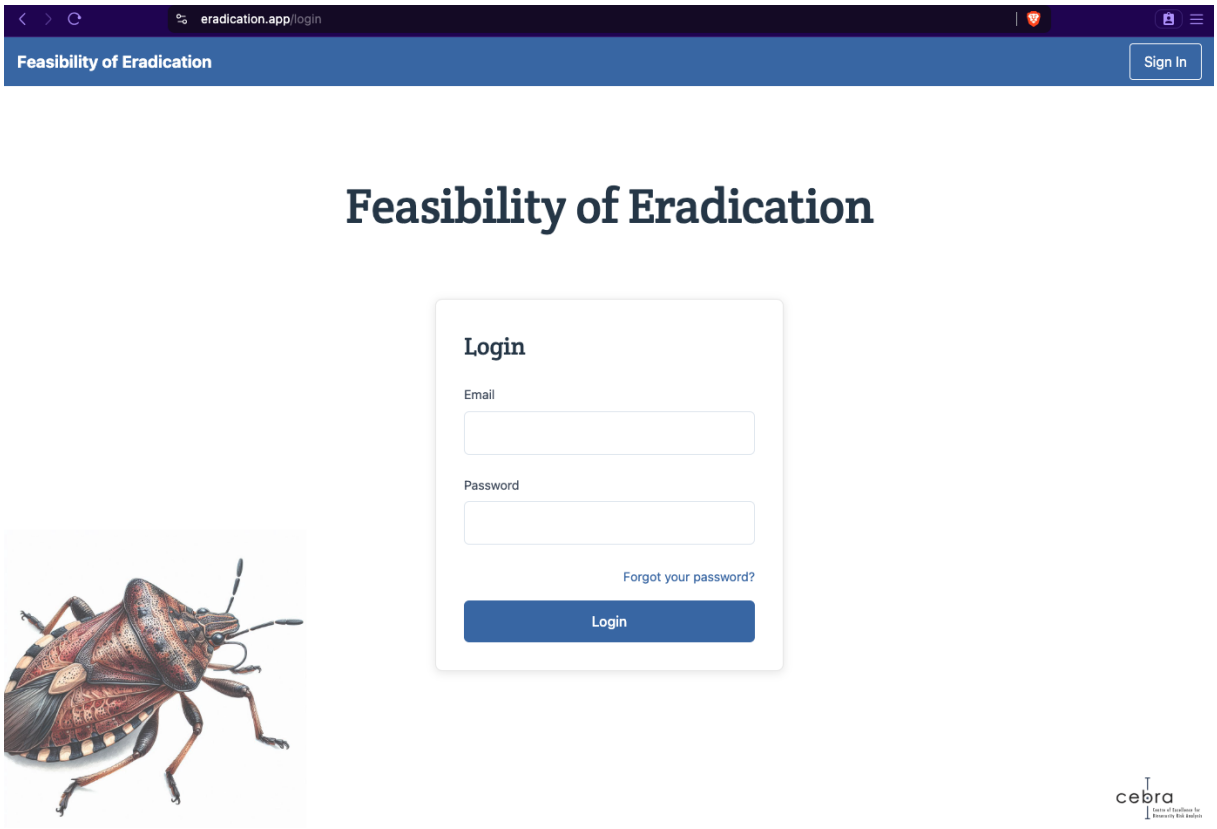

Figure 5.1.: The user login page.

5.2.2. Dashboard

Upon logging in, users are presented with the main dashboard (Fig. 5.2). This central hub provides an overview of all available surveys (which may be for the same pest at different times of the incursion, or for different pest organisms), their current status (e.g., active, round complete), and quick actions such as starting, continuing, or viewing results for each survey. Users can also view their statistics, recent activity, and access profile settings from this page. The dashboard enables efficient management of survey participation and progress tracking in a single, user-friendly interface.

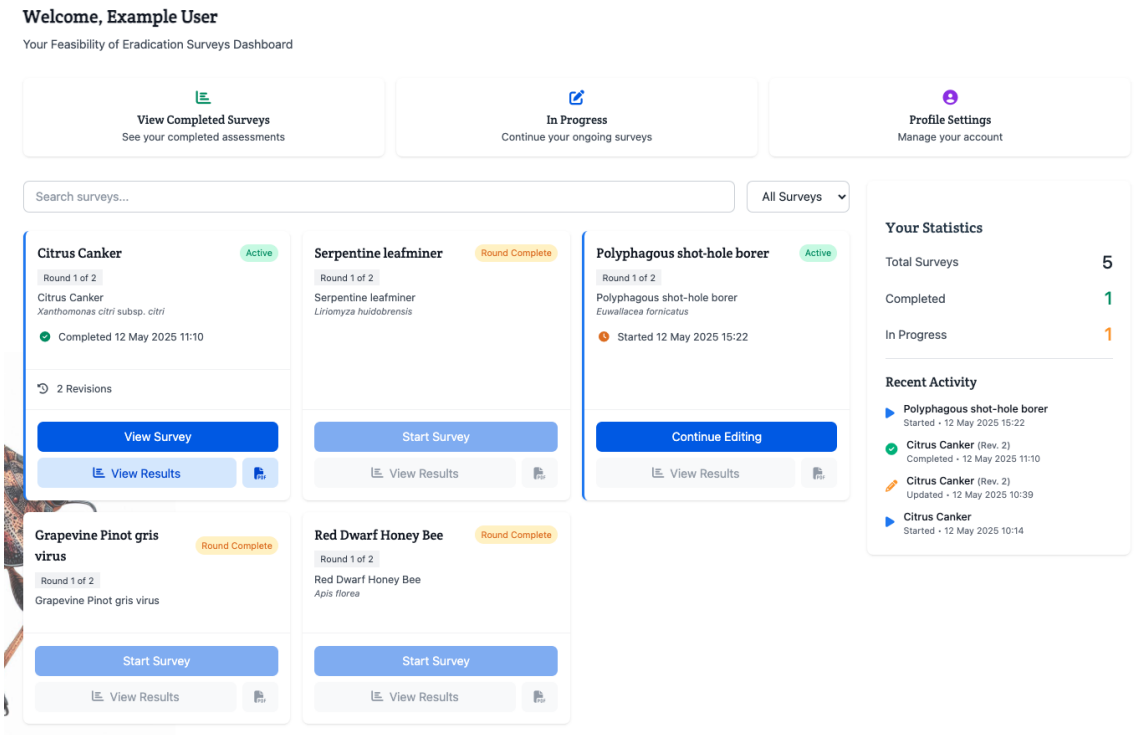

Figure 5.2.: Main dashboard showing active surveys, statistics, and recent activity.

The application features a built-in notification system that keeps users informed about important events and updates (Fig. 5.3). Notifications appear in a dedicated panel accessible from the top navigation bar, indicated by a bell icon and a badge showing the number of unread items. Users receive notifications for new survey assignments, and each notification includes a brief description and a timestamp, ensuring users can quickly review and act on new information as it becomes available.

The platform also includes a survey diff tool within the user dashboard , allowing users to compare different revisions of their survey responses. This feature provides a clear, side-by-side view of changes made between any two selected revisions, highlighting modified answers for each question (Fig. 5.4). Users can easily track how their responses have evolved over time, supporting transparency and reflective assessment. The diff tool is accessible directly from the survey's revision history panel, making it straightforward to review and understand the progression of individual assessments.

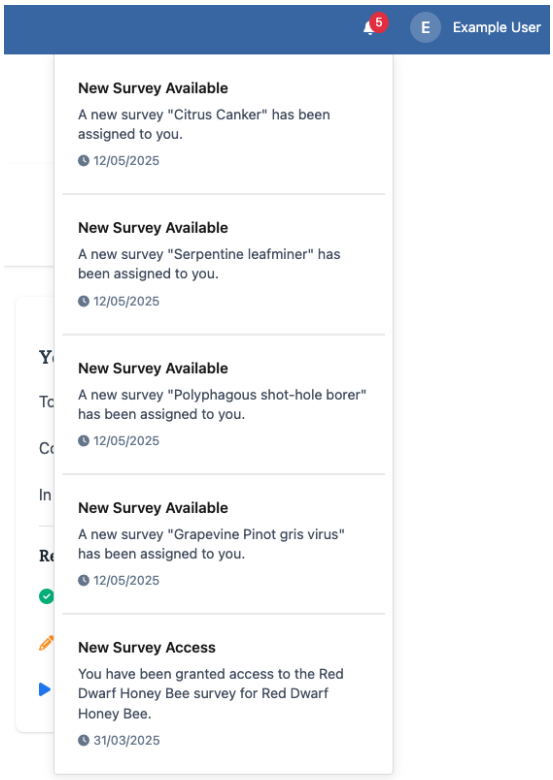

Figure 5.3.: Notification panel showing recent survey assignments.

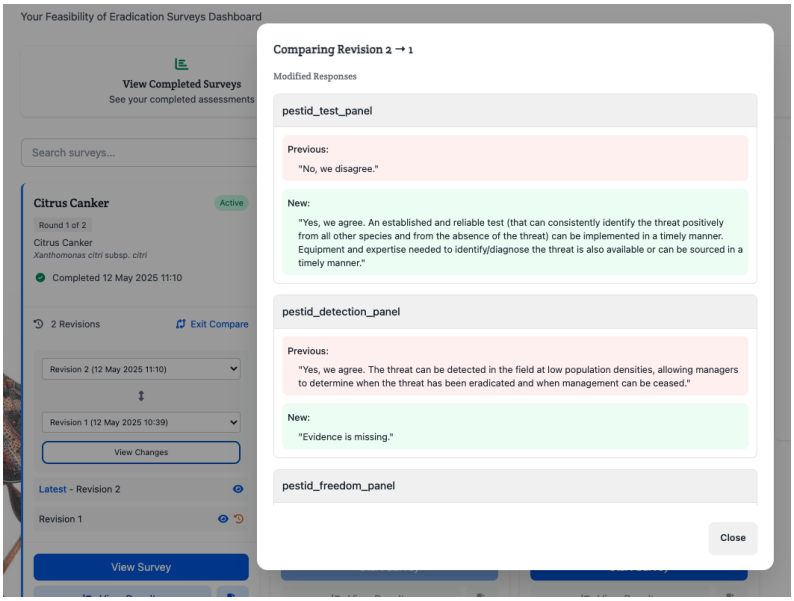

Figure 5.4.: Survey diff tool showing a user's changes between survey revisions.

5.2.3. Survey Response Interface

When a user opens a specific survey, they are presented with a tabbed interface that guides them through the assessment process. The main tabs are described below.

5.2.3.1. Instructions Tab

The Instructions tab provides an overview of the tool, step-by-step guidance on how to complete the survey, and explanations of the available response options (Fig. 5.5). This ensures that all users understand the assessment process and the meaning of each possible answer.

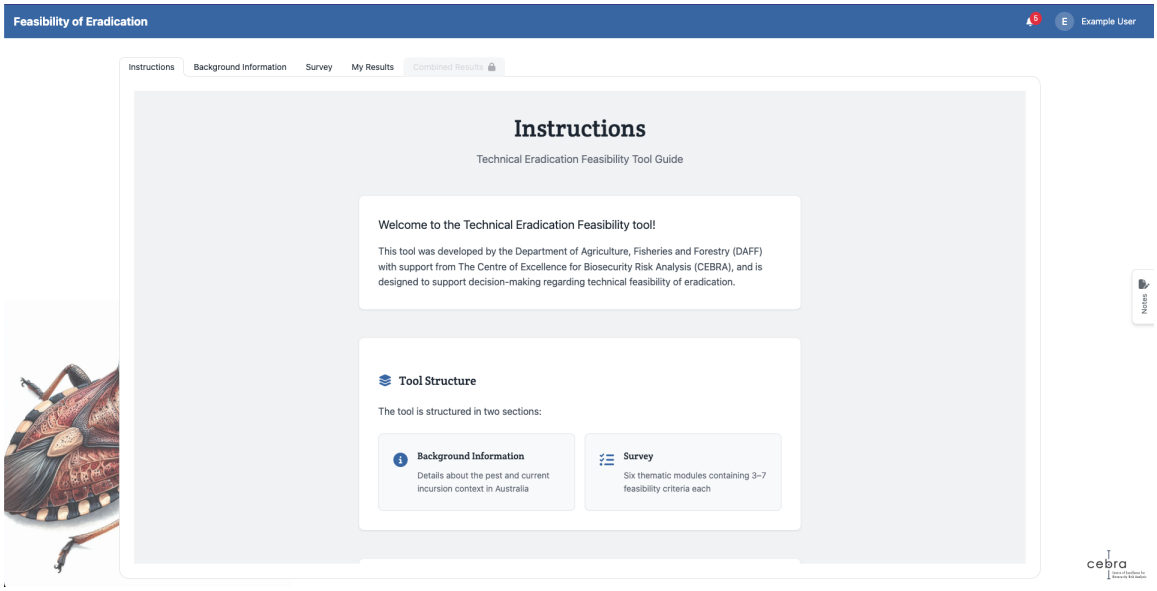

Figure 5.5.: Instructions tab with guidance and response options.

5.2.3.2. Background Information Tab

The Background Information tab displays contextual information about the hazard or subject of the survey (Fig. 5.6). It includes relevant resources, scientific references, and links to supporting documents, providing information and context around the current incursion for which technical feasibility of eradication is evaluated. Ideally, these resources will include:

1. The objective of using the tool at this time/point of the incursion. This objective may be different every time the tool is used, even for a single pest incursion.

2. What the pest under consideration is and its characteristics, e.g. its worldwide distribution, any past incursions into Australia, key known aspects of its biology/ecology, dispersal ability, and known hosts.

3. Details, to the best of the emergency response team's ability, of the proposed or agreed response strategy and eradication method, including control and surveillance. As agreed during the workshop, the tool will be limited to the evaluation of a single eradication scenario, at least for now.

4. Any other relevant pieces of information for the evaluation of technical feasibility at this point in time that may act as 'tipping points' in the decision process, or that represent imminent threats or overall limitations for eradication success. Examples include: 'is it fire season?', 'are there known locations close to a national park?', 'are there particular society expectations?', or 'are there known resource limitations or legal constrains?'.

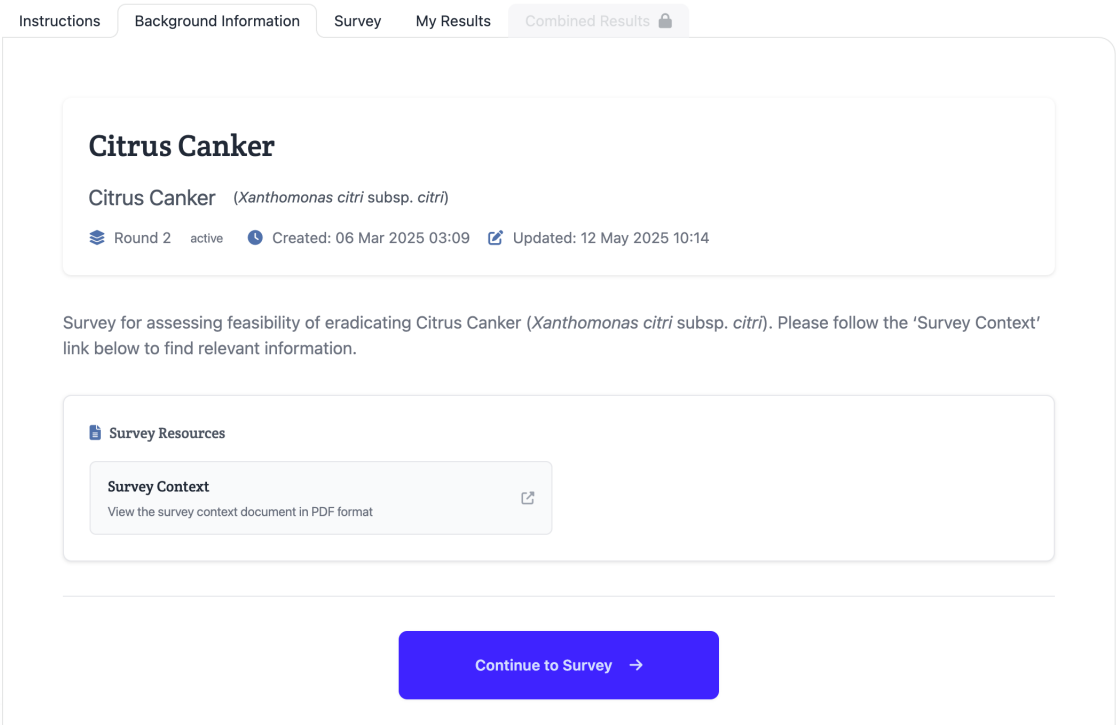

Figure 5.6.: Background Information tab with hazard context and resources. In this example, the key information is contained within the linked "Survey Context" PDF, which opens in a new browser tab.

5.2.3.3. Survey Tab

The Survey tab is the main assessment form (Fig. 5.7), where users answer structured questions representing feasibility criteria. Features include auto-save, progress tracking, and a real-time response summary sidebar that uses a traffic-light system to indicate the status of each response (Fig. 5.9).

The predefined survey contains 28 questions, divided in six thematic modules:

- Module 1: Identification and detection of the threat (7 questions)
- Module 2: Biology of the threat (4 questions)

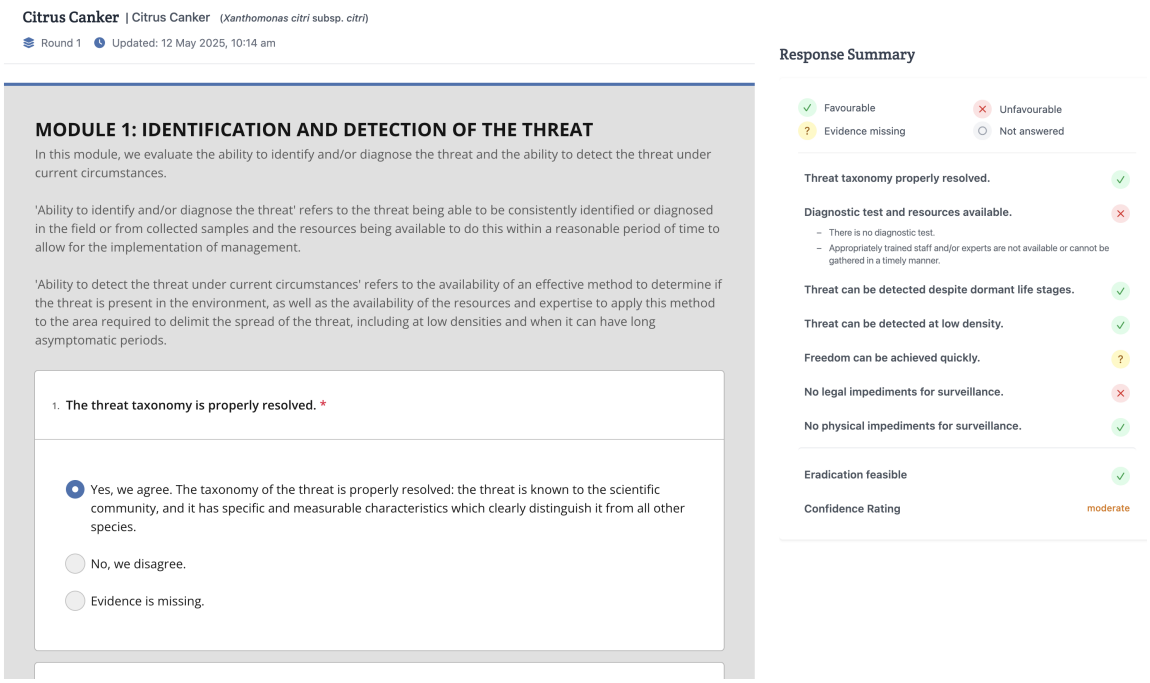

Figure 5.7.: Survey tab for completing assessment questions.

- Module 3: Current circumstances of infestation (4 questions)
- Module 4: Effectiveness of the control method (7 questions)
- Module 5: Acceptability of the control method (3 questions)
- Module 6: Ability to regulate threat entry pathway (3 questions)

The questions, or evaluation criteria, within each module are presented as statements (Fig. 5.8). Users are asked to either: (i) agree with the statement, (ii) disagree with the statement, or (iii) state that evidence to evaluate the statement is missing. To do that, users need to choose one of the following three options:

a. *Yes, we agree.*
b. *No, we disagree.*
c. *Evidence is missing.*

The evaluation criteria are always framed in a manner that agreeing with them is supportive of eradication being technically feasible. Therefore, *'Yes, we agree'* implies that evidence supports eradication feasibility, *'No, we disagree'* implies that evidence does not support eradication feasibility, and *'Evidence is missing'* implies that there is not enough evidence to evaluate that criterion.

For some evaluation criteria, disagreeing with the statement (option **b.** *'No, we disagree'*) prompts a series of predefined options for the user to choose from in line with their underlying reason/s for disagreement (Fig. 5.8). The last one of the predefined options is always *'Other'*, which reveals a free text space for users to specify reasons beyond the predefined options.

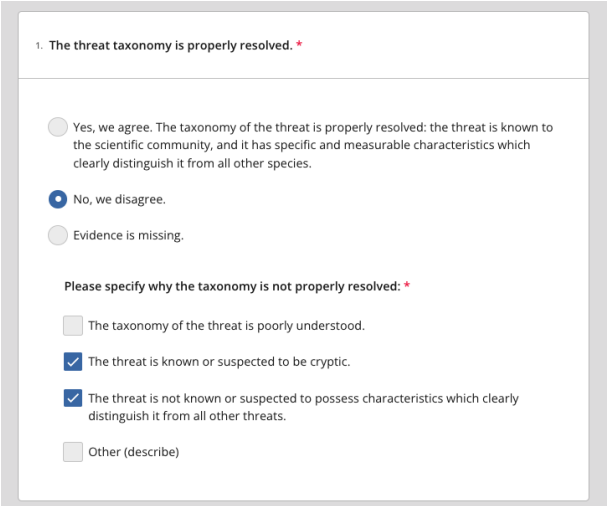

Figure 5.8.: An example survey question with conditional sub-questions when selecting "No".

The evaluation criteria presented in each module, along with the built-in reasons for disagreement, can be found in Appendix C.

Each thematic module of the tool is visually structured into two components. The first shows the feasibility criteria to be evaluated, while the second – the *response summary* – shows a real-time traffic light summary of the user's responses to the evaluation criteria within that module (Fig. 5.9), where each criteria is paired with either:

- a green tick, if the user has answered **a.** *'Yes, we agree'* to the criteria;
- a red cross, if the user has answered **b.** *'No, we disagree'* to the criteria (with the selected underlying reasons shown underneath); or
- a yellow question mark, if the user has answered **c.** *'Evidence is missing'* to the criteria

After the feasibility criteria within a module have been evaluated, users are asked to provide an overall assessment of eradication feasibility for that module (i.e., whether existing evidence for that module overall supports feasibility) and an estimate of how confident they are on that overall assessment, using a categorical scale (very low, low, moderate, high, very high).

5.2.3.4. Survey submission

Users can access and modify their responses as frequently as they wish until the survey closes at a date defined by the administrator. The latter can be can be a predefined closing time, or an ad hoc closure triggered by the administrator.

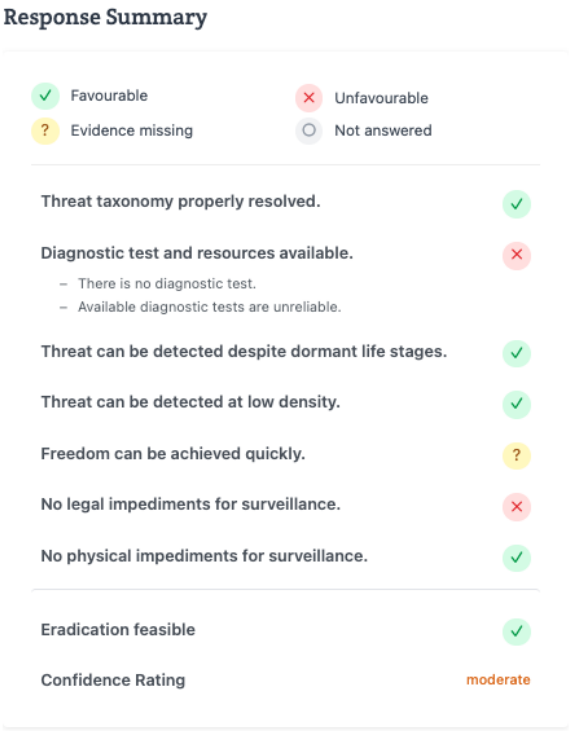

Figure 5.9.: Response summary panel showing a live representation of the user's responses.

5.2.4. Notes Drawer

The application features a notes drawer, accessible from the side of the survey interface (Fig. 5.10). This drawer allows users to record both private notes (visible only to themselves) and general notes (shared with other respondents). The notes drawer can be opened or closed at any time while completing the survey, making it easy to document thoughts, evidence, or questions as they arise.

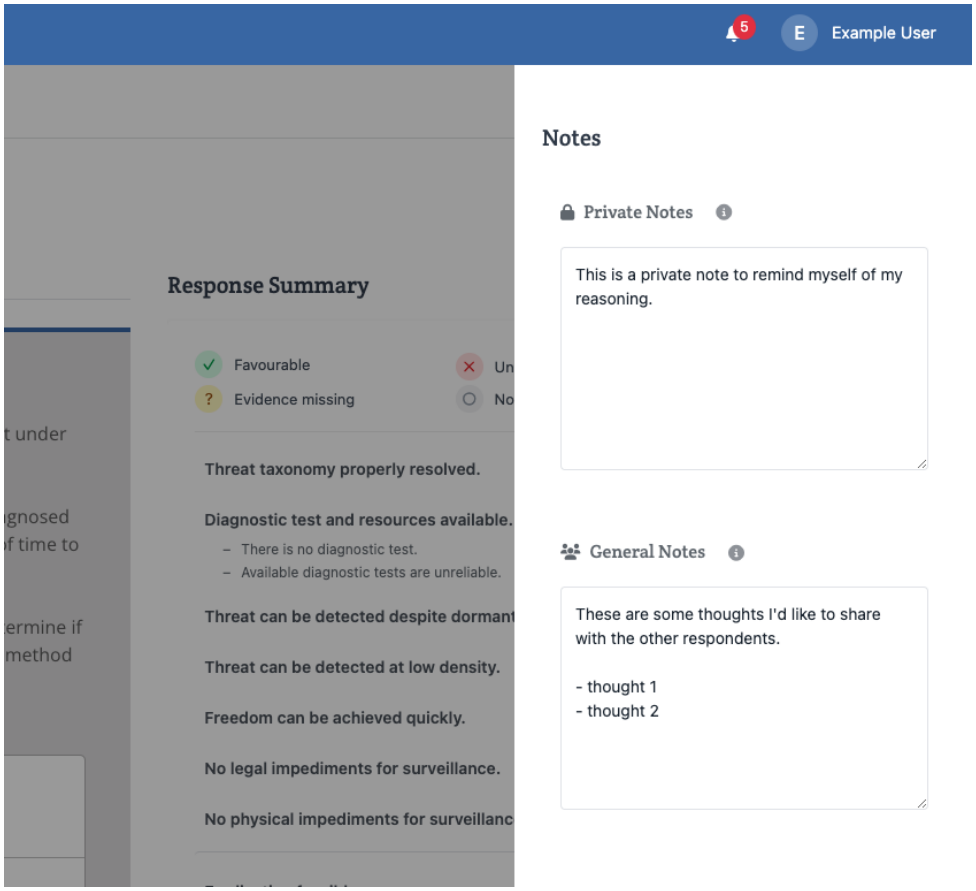

Figure 5.10.: Notes drawer for recording private and general notes during survey completion.

5.3. Outputs

5.3.1. Individual summary

The My Results tab provides a summary of the user's submitted responses, including visual indicators, notes, and the option to download a PDF report of their assessment (Fig. 5.11). This allows users to review their input and retain a record for future reference. This report is accessible once the user has submitted their responses.

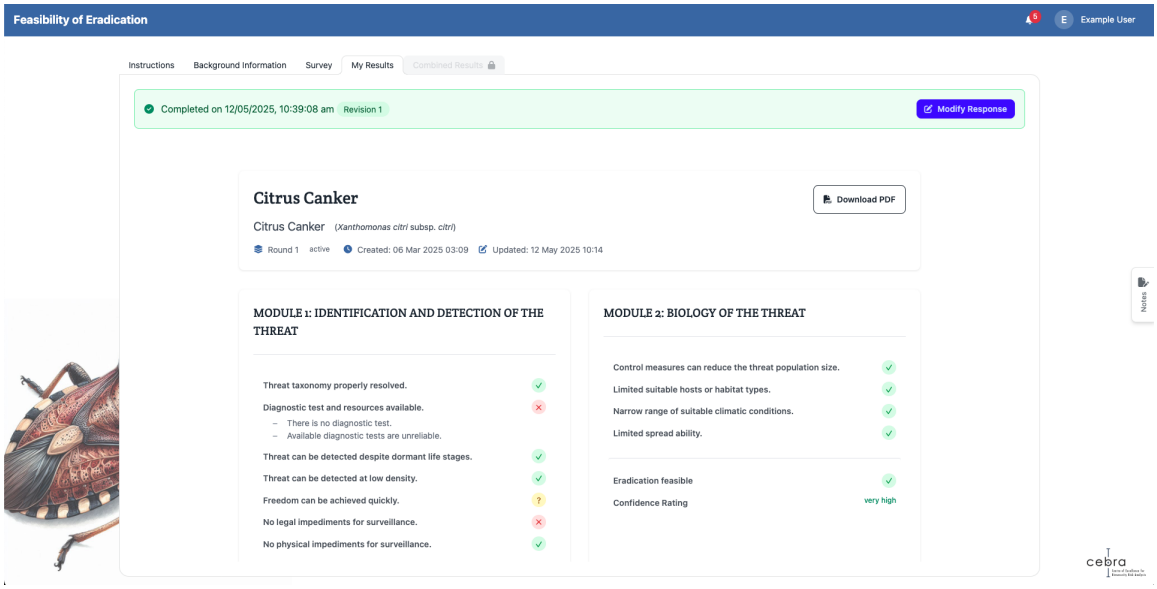

Figure 5.11.: My Results tab with summary and PDF export option.

5.3.2. Combined summary

In addition to the individual summary, the platform generates an aggregated summary of all respondents' submissions for the survey, enabling users to compare their responses with the group and gain insights from the collective assessment. This report is available on the Combined Results tab, and becomes available when the survey round has been closed.

The combined summary is structured into modules. For each module, the report presents two key outputs. The first is a summary of the overall assessment of feasibility that users provided for the module, with their expressed level of confidence. Figure 5.12 shows an example of this summary indicating respondents' overall assessment of the feasibility of eradication with respect to the theme presented in Module 1 (identification and detection of the threat); five respondents indicated that eradication was feasible (with varying levels of confidence), while one respondent was unsure. The second output is an overall, traffic light breakdown of the answers provided by the users for each evaluation criteria within the module (Fig. 5.13). This part highlights existing knowledge gaps and agreements/disagreements across users for individual

criteria: knowledge gaps are presented by yellow and inconsistencies among users are reflected as multiple colours assigned to the same criteria.

At the end of the combined summary report, shared notes are listed for reference and discussion.

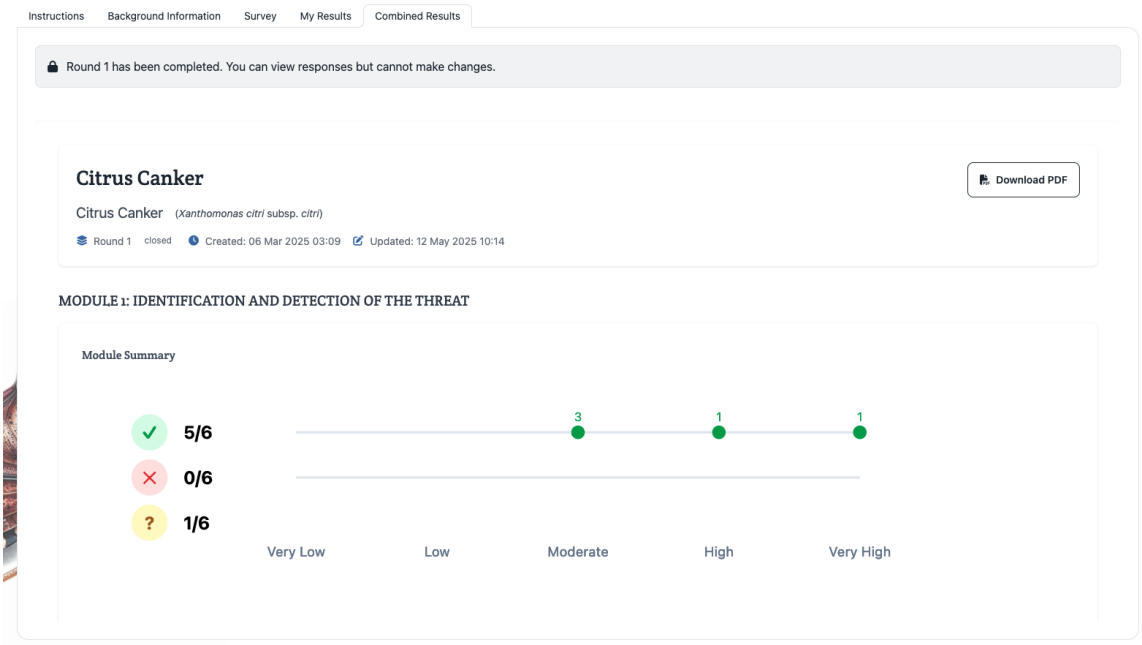

Figure 5.12.: Combined Results tab showing a summary of respondents' assessments for Module 1. Example responses are used for illustration.

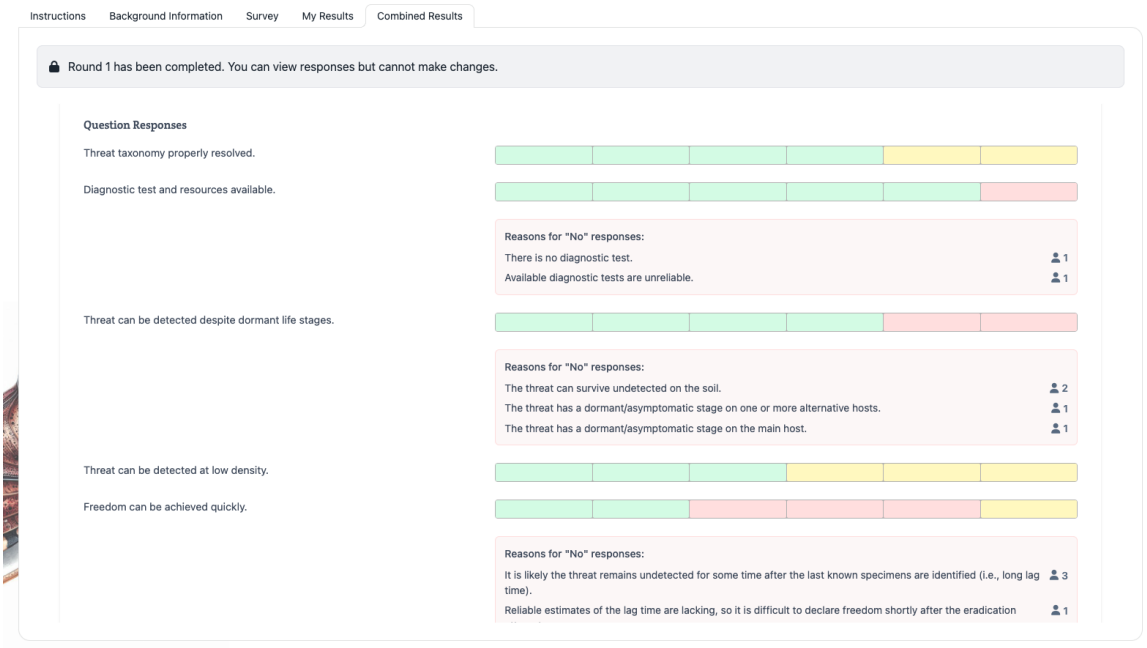

Figure 5.13.: Breakdown of each module into its questions, showing the frequency of "Yes", "No", and "Evidence Missing" responses for each question, along with any reasons motivating "No" responses.

5.3.3. PDF export

The My Results and Combined Results tabs each include a *Download PDF* button, allowing users to export either their individual summary or the aggregated group summary as a PDF report. This feature makes it easy to retain records, share findings, or include assessment outputs in external documentation. Example reports are given in Appendix D.1 (individual) and Appendix D.2 (combined).

5.4. Iterative use of the tool

The tool enables the iterative evaluation of eradication feasibility at various stages of a pest incursion, allowing the emergency response to be adjusted as new information emerges or the incursion context evolves. For consecutive assessments of eradication feasibility, a new survey is created and the corresponding card on the user's survey dashboard is updated to indicate that a new round is available (Fig. 5.14). The responses provided by the user during the previous survey are highlighted on this survey (Fig 5.15). The free text boxes to add notes, both the *'Private notes'* and the *'General notes'*, are reset to an empty state.

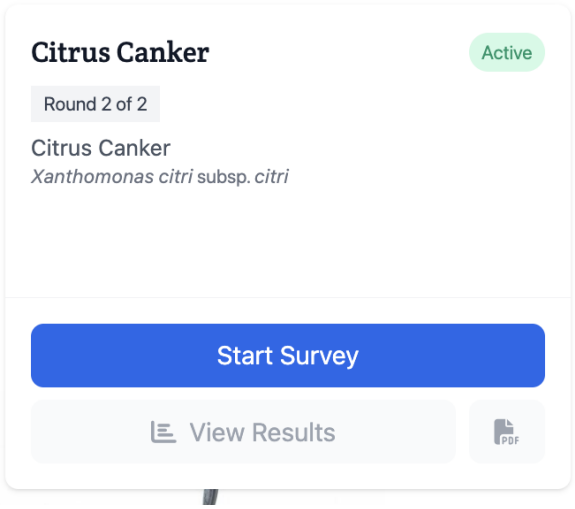

Figure 5.14.: An individual survey card on the user dashboard, showing a Citrus Canker survey in Round 2 of 2.

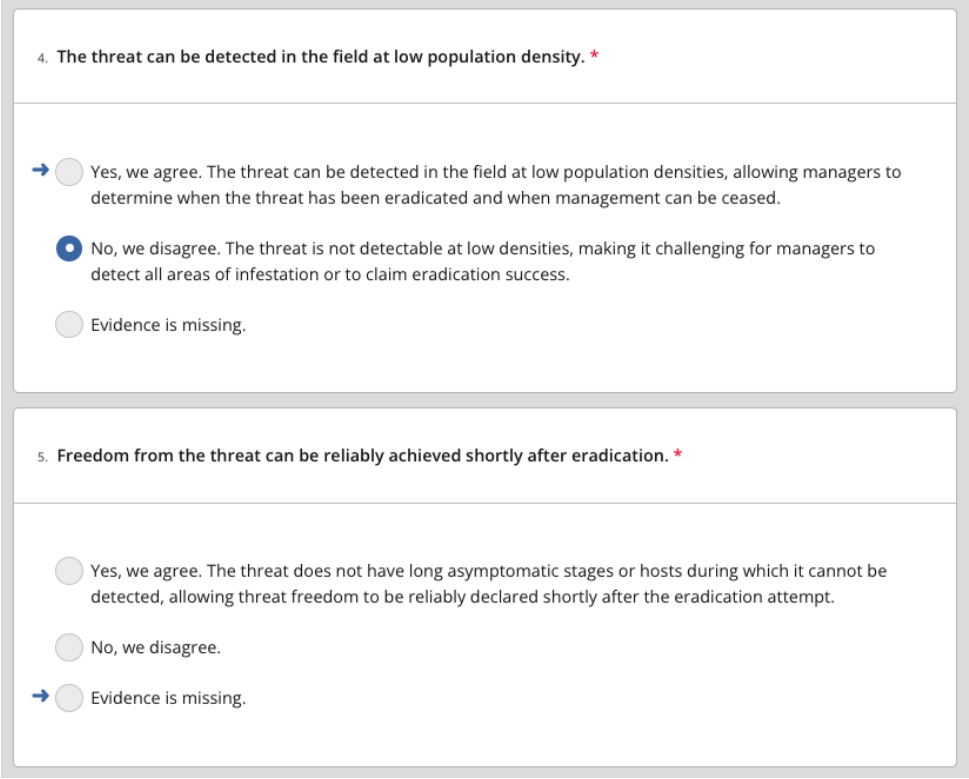

Figure 5.15.: Arrow indicators highlighting responses submitted by the user in the previous round.

5.5. Administration Interface

The platform includes an administration interface that enables authorised users to manage surveys, user accounts, invitations, and system activity. Administrators can create and configure new surveys, assign user access, monitor participation, and review audit logs, all through an intuitive web-based dashboard. The main administrative functions are described below.

5.5.1. User Management

Administrators can view, edit, and deactivate user accounts. The user management panel allows searching for users, updating user roles (e.g., "admin" vs. default "user"), and managing account status (see Fig. 5.16).

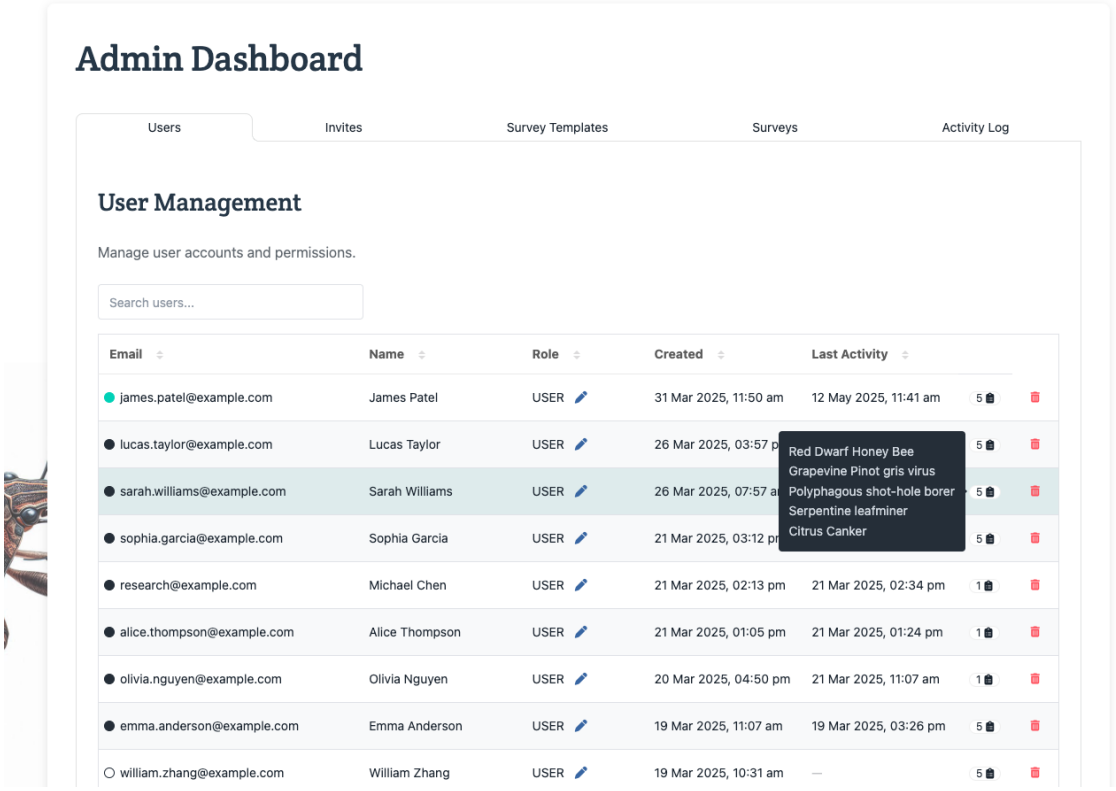

Figure 5.16.: User management interface showing anonymised user accounts. The rightmost column displays tooltips indicating which surveys each user is pre-approved to access. Example names and email addresses are used for illustration.

5.5.2. User Invitation

New users can be invited to the platform via email. Administrators can send invitation links, assign roles, pre-approve survey access, and track the status of pending invitations (see Fig. 5.17). Invitations have a default validity of 14 days (modifiable on tool deployment), and upon expiry the invite token can be refreshed via the Invites dashboard.

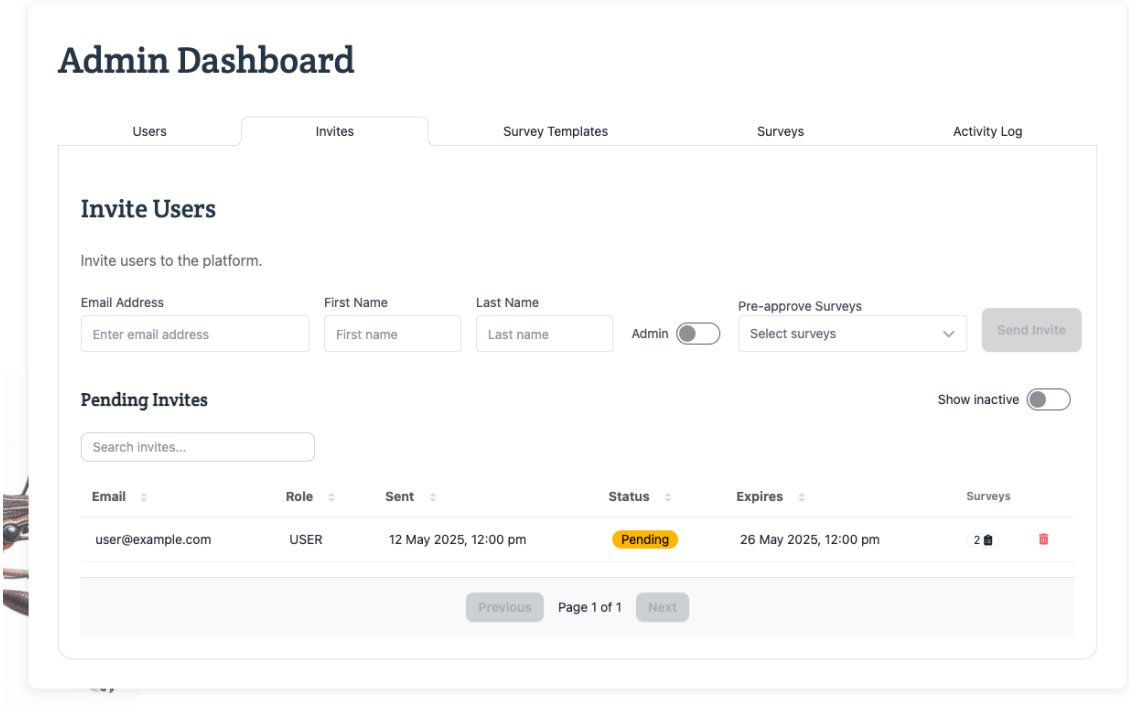

Figure 5.17.: User invitation interface for sending and tracking invitations.

5.5.3. Survey Creation and Management

The Survey tab provides administrators with a comprehensive interface for overseeing all surveys in the system (see Fig. 5.18). The main features and controls are as follows:

- **Survey List:** All surveys are displayed as cards, each summarising the survey's name, associated hazard (including scientific name), a brief description, and key metadata such as creation and update dates, current round, number of responses, and participant count.
- **Survey Status and Rounds:** Each survey card shows its current status (e.g., Draft, Active, Closed, Archived) and the status of the current round (e.g., In Progress, Completed). Administrators can start, close, or reopen rounds directly from the card, and initiate new rounds as needed.
- **Quick Actions:** Administrators can preview the survey as participants would see it, edit survey details, or archive surveys. The preview function opens a modal with an interactive, read-only version of the survey.
- **Survey Creation:** A prominent button allows administrators to create new surveys, launching a form where they can specify the survey template, hazard, description, resources, and user access (Fig. 5.19).
- **Filtering and Archiving:** Surveys can be filtered to show or hide archived items, making it easy to focus on active or historical surveys as needed.
- **Participant and Response Tracking:** Each card displays the number of participants and responses for the current round, supporting real-time monitoring of survey engagement.

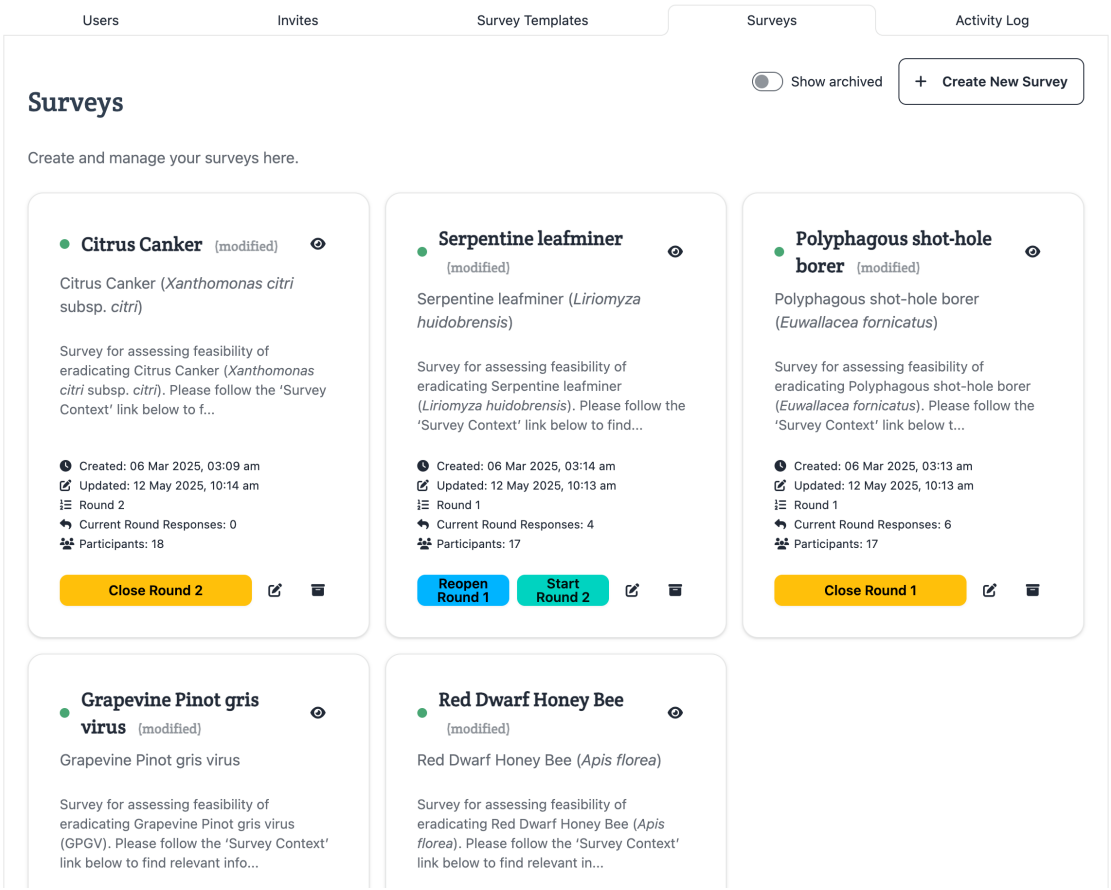

Figure 5.18.: Survey management interface. Administrators can view, create, edit, and manage surveys, including starting and closing rounds, tracking participation, and previewing survey content.

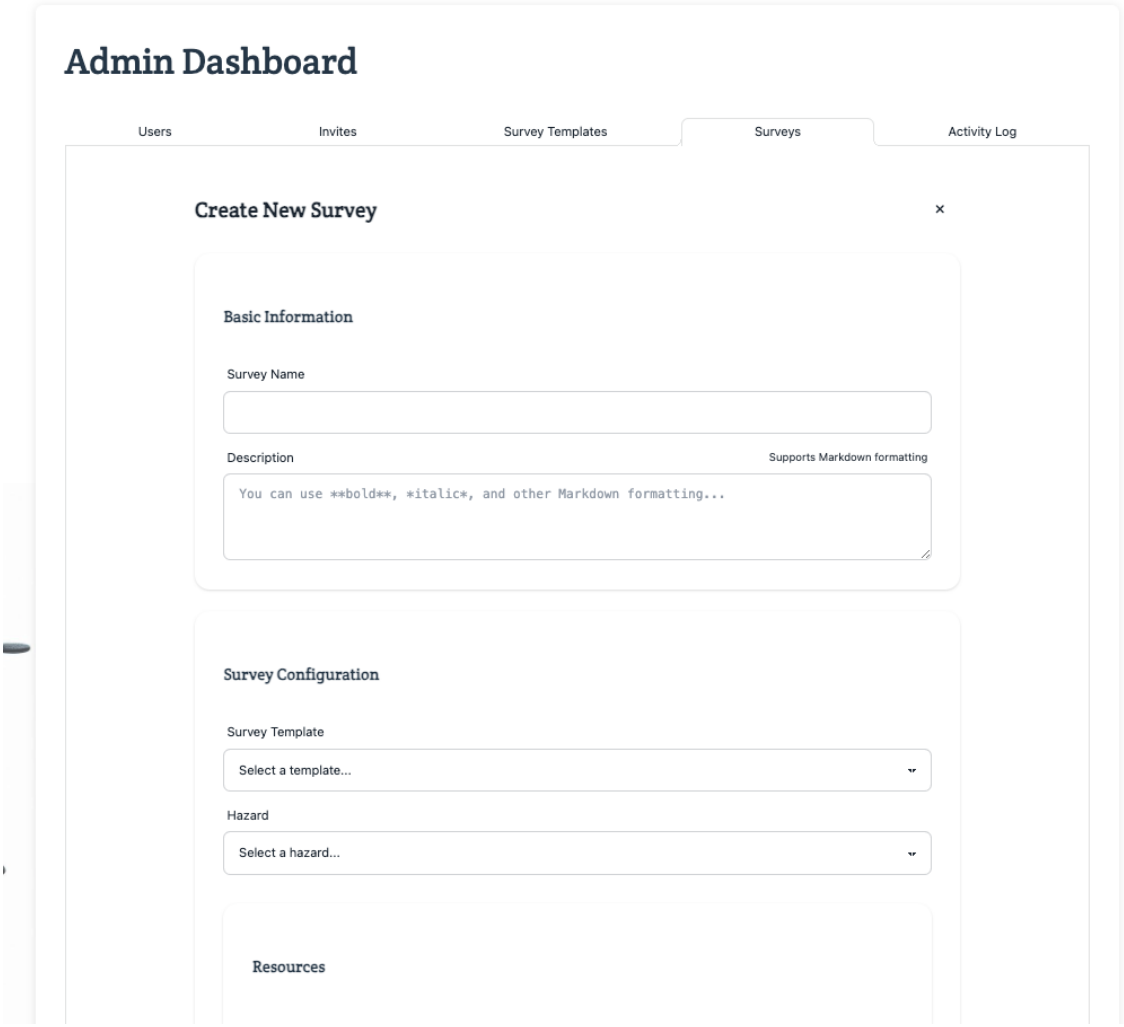

Figure 5.19.: Survey creation interface.

5.5.4. Activity Log

The activity log provides a record of key actions performed within the system, such as user logins, survey submissions, and administrative changes. This log supports auditability and helps administrators monitor system usage and security (see Fig. 5.20).

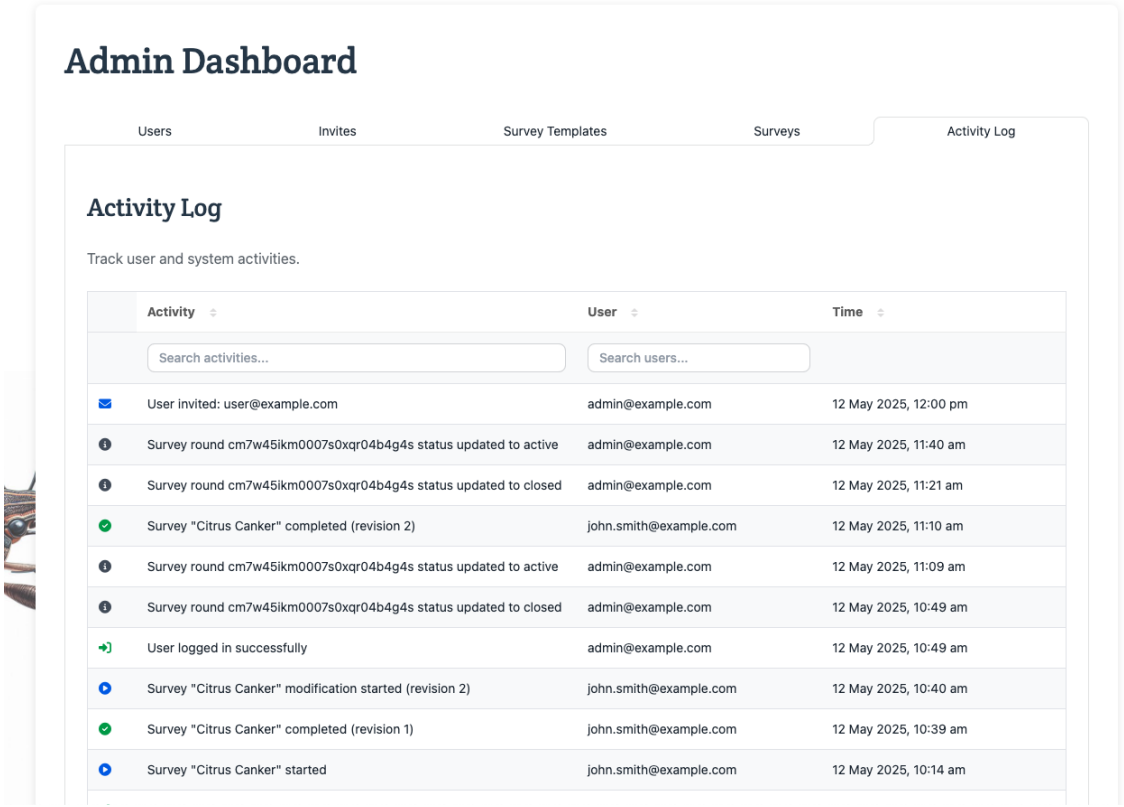

Figure 5.20.: Activity log showing recent actions and system events.

5.6. Extensibility

The modular design of the survey system allows users to easily modify and customise the set of questions within the technical feasibility of eradication context, ensuring that the assessment process can be tailored to specific hazards, scenarios, or evolving methodologies. Administrators can adapt the default survey template or create entirely new templates to suit the unique requirements of each assessment round.

Beyond this core use case, the platform's flexibility extends to a wide range of other applications. Administrators can import, design, and deploy their own survey templates for any subject area, provided the questions follow the structured traffic light response system of "Yes", "No", or "Evidence Missing". This approach ensures consistency in data collection and analysis, while allowing survey designers to address a diverse array of topics – from biosecurity and risk management to policy analysis

and stakeholder engagement. The intuitive template management interface enables rapid deployment of new surveys, and the ability to reuse or modify existing templates streamlines the process for recurring or evolving assessment programs.

By decoupling the survey structure from the underlying application logic, the platform ensures that organisations can respond quickly to changing requirements, regulatory updates, or emerging threats, without the need for software redevelopment. This adaptability makes the system a robust solution for any context where transparent, auditable, and collaborative decision-making is required.

In practice, this means the platform can support a wide variety of survey-driven workflows, such as preparedness assessments, prioritisation exercises, or other decision-making contexts. New templates can be introduced to improve the clarity of language, include additional evaluation criteria, or offer alternative survey structures, all while maintaining compatibility with the platform's core traffic light response system. This extensibility ensures that the tool remains relevant and valuable as organisational needs and assessment methodologies evolve.

5.7. Technical aspects

Access to the tool requires user authentication. With the exception of the public landing and login page, all parts of the application – including the APIs, frontend, and database – are restricted and not open to the public. New users are invited by administrators via email and must follow a secure link to set up their password. Once registered, users log in with their email and password to access the platform's features.

While hosting was not a deliverable for the present project, we temporarily deployed the tool to a DigitalOcean virtual machine (running Ubuntu 24.10, with 2 GB memory, 2 CPUs, and a 25 GB disk) for the purposes of the case studies (Chapter 6). However, the application is designed for flexible deployment and can be hosted on a range of Linux-based environments, including cloud virtual machines (e.g., AWS, Google Cloud, etc.) or on-premises infrastructure managed by the organisation itself. This self-hosting approach is particularly suitable for organisations with specific data governance or security requirements. In addition, integration with established platforms such as Biosecurity Commons offers a particularly promising avenue, enabling interoperability with other biosecurity tools and resources. For a discussion of hosting options, see Section 8.2.

Deployment is streamlined using automated scripts that handle server setup, application build, and environment configuration. The recommended environment includes Node.js, PM2 for process management, and a reverse proxy such as Nginx or Caddy for SSL/TLS termination. Full deployment instructions and requirements are provided in the Deployment Guide (Appendix E).

For a detailed description of the application's architecture, technology stack, security features, and data management approach, please refer to the Technical Overview (Appendix F).

6. Case studies & user feedback

Stakeholders were invited to trial the Feasibility of Eradication tool prototype via five hypothetical cases studies (Table 6.1). Each case study focused on a pest or disease for which incursions have recently been detected and eradication responses have been deployed in Australia. Each case studies was trialled by 4–7 stakeholders, including government and industry representatives.

Table 6.1.: Case studies used for stakeholders to trial the Feasibility of Eradication tool prototype.

Case study	Threat	Context	No. responses [gov:industry]
1.	Citrus canker [*Xanthomonas citri* subsp. *citri*]	Based on May 2018 incursion in Darwin, NT.	5 [4:1]
2.	Grapevine Pinot gris virus [*Trichovirus* spp.]	Based on December 2016 incursion in Angaston, SA.	5 [4:1]
3.	Polyphagous shot-hole borer [*Euwallacea fornicatus*]	Based on September 2021 incursion in East Fremantle, WA.	7 [5:2]
4.	Red dwarf honey bee, [*Apis florea*]	Based on August 2023 incursion in Dampier, WA.	6 [4:2]
5.	Serpentine leafminer, [*Liriomyza huidobrensis*]	Based on November 2020 incursion in Rossmore, NSW.	4 [3:1]

Stakeholders were invited to complete the survey based on the assumption that the evaluation was taking place at the early stage of the emergency response (i.e., shortly after the initial detection of the incursion). Upon survey closure, users were provided access to both their individual and the compiled summary outputs. Feedback was then gathered regarding their overall experience with the prototype, its content, the summary outputs, and potential areas for improvement or further development.

Users provided highly positive feedback on their experience trialling the prototype. Overall, they agreed that:

- The instructions for using the tool were clear and helpful;
- The tool was intuitive and easy to navigate;
- The time required to complete the survey was reasonable;
- The evaluation criteria within each module were clear and comprehensive;

- The combination of predefined options and free text fields allowed sufficient flexibility to evaluate a range of case studies effectively;
- The ability to add both personal and group notes was a valuable feature; and
- The traffic light summaries – both individual and aggregated (across participants) – were clear, informative, and useful for interpretation.

Users expressed strong enthusiasm for the improvements introduced by the prototype and its potential for further development in the context of emergency response. Comments included:

> 💬 *"Great job - this will be a very useful tool."*

> 💬 *"Keen to see how the project continues to develop. Congrats on creating what is already looking like an incredibly useful tool."*

Feedback also included suggestions for minor improvements and potential future enhancements to the tool, as outlined below.

- Some of the evaluation criteria may benefit from minor revisions to improve clarity and reduce the potential for subjective interpretation. Feedback primarily related to the use of vague or ambiguous language in certain criteria, which made objective assessment challenging (e.g., the term "extraordinary effort"). One user noted that incorporating quantitative measures – such as the 'number of infected premises over time and area' – instead of qualitative descriptors, could help enhance objectivity in specific instances.

  A user also highlighted that there is scope to introduce additional criteria within some modules. For example, the current tool does not adequately assess the capacity of different agencies to respond effectively to an emergency.

  Finally, some users highlighted the need to revise certain evaluation criteria to ensure wider applicability across different types of plant pests. In particular, criteria were reportedly more difficult to interpret when assessing plant diseases compared to insect pests. This was partially evident in the increased use of free-text responses during Case Study No. 2 ('Grapevine Pinot gris virus'), compared to other case studies.

  > 🔗 **Not integrated:** *CEBRA did not hold discussions with all relevant stakeholders to improve language accuracy, or include criteria not originally present as part of the DAFF/CCEPP Microsoft Excel tool. This aspect was out of the scope of the current project.*
  >
  > The prototype allows the tool manager to easily modify the number, nature and language of the criteria currently covered in the survey by creating new templates in the backend of the prototype. See Chapter 8 for more information about the use of new templates within the tool.

- In some cases, users expressed difficulty in evaluating a module or criterion for which they lacked the required expertise or background, alluding to the need for specialist input.

  Not integrated.

  Adding functionality to the prototype to limit user access to specific questions or modules, in line with their expertise, is presented as a potential extension (see Chapter 8).

- Users suggested that presenting summaries categorised by user groups (e.g., government vs. industry) or by institution could support discussions at CCEPP – particularly by helping identify if a specific party views an issue as a barrier to eradication.

  Not integrated.

  As a future extension of the tool (see Chapter 8) users could be assigned to pre-defined user groups and summary outputs provided at the level of each group.

- One of the users suggested that the overall assessment of eradication feasibility for each module should be produced automatically based on the responses provided to the individual questions within that module across users – as opposed to the users being asked to provide an overall assessment of the module, along with (but independently from) the individual criteria evaluated within the module). The same principle could be applied to produce an overall feasibility assessment, by aggregating responses across modules and users. This is a way to provide guidance and remove subjectivity around how to interpret the summary outputs to make a final stance on feasibility of eradication.

  Not integrated.

  The overall consensus among stakeholders who took part in the workshop 4 was that the tool should be designed to support discussions among stakeholders so they ultimately are responsible to make a decision on the feasibility of eradication. The automated aggregation of responses would have required reaching an agreement and defining clear rules on how the different criteria and/or modules within the prototype should be weighted according to some priorities. This was out of the scope of this project.

  See Chapter 8 for a possible extension of the prototype tool to include a structured evaluation of eradication feasibility criteria that could support stopping rules for decision-making.

7. User Guide: Feasibility of Eradication tool prototype

This chapter provides step-by-step instructions for both administrators and users on how to create and participate in surveys using the Feasibility of Eradication Assessment tool. The sections below complement Section 5.2, which provides several screenshots showing the various features and components of the tool.

7.1. Administrator Instructions

The following sections detail the steps for creating surveys and inviting users. While these tasks can be completed in any order, creating the survey before inviting users offers a key advantage: during the invitation process, you can pre-approve user access to specific surveys, ensuring they have immediate access to relevant assessments upon their first login. This streamlines the onboarding process and allows users to begin participating as soon as they complete their registration.

For detailed instructions on deploying and configuring the application, please refer to the deployment guide in Appendix E.

7.1.1. Creating a New Survey

1. From the admin dashboard, navigate to the *Surveys* tab.
2. Click the *Create New Survey* button.
3. Complete the survey creation form:
    - **Survey Name**: Enter a descriptive name for the survey (Fig. 7.1). This will appear throughout the app, e.g., on survey cards, within the survey itself, and in outputs such as PDF reports.
    - **Description**: Provide a brief overview of the survey's purpose. This will appear on the survey card (abbreviated if necessary) and in the Background tab of the survey. The input field supports Markdown syntax[1].

[1]See https://www.markdownguide.org/basic-syntax/ for an overview of Markdown syntax.

- **Survey Template**: Select a predefined survey template, which defines the set and structure of questions presented in the survey (Fig. 7.2). The tool provides a built-in example – *Eradication Feasibility Assessment* – with the structure given in Appendix C. Additional templates can be defined (e.g., using the built-in template as a guide, available in the `templates` directory of the project repository) and then imported for use in the tool.

- **Hazard**: Select the hazard to be considered in the survey. Hazards are stored in the database upon creation; you can either select one you've defined previously, or select + *Add New Hazard* to define a new hazard. The latter will prompt a modal input form (Fig. 7.3) requesting:

  - Name: name of the hazard (required).

  - Scientific name (optional): the scientific name of the hazard, used in survey cards and outputs.

  - Description (optional): a description of the hazard.

  - Reference URLs (optional): links to hazard-specific information.

- **Survey Status**: Define the initial status, scheduled closing time, and number of rounds for the survey (Fig. 7.4).

  - Current Status: the initial status of the survey (e.g., *Draft*, *Active*) (Fig. 7.4). If *Draft* is selected, the survey will not be accessible to invited respondents until the status is changed to *Active*.

  - Scheduled Closing Date (optional): use the date-time picker to select a date and time at which to automatically close the initial round.

  - Number of Survey Rounds: define the number of survey rounds that will be conducted.

- **Additional Content**: Optionally define additional introductory text and/or instructions for the survey, and upload a survey context PDF. These will appear in the *Background* tab of the survey (Fig. 7.5).

- **User Access**: Select users to add to the survey. Upon activating the survey (i.e., by selecting *Active* as the current status, above, or clicking *Start Survey* on the survey card after creating the survey), the chosen users will receive a notification that they can view and access the survey via their user dashboard. This access list can later be modified by editing the survey.

4. Click *Save Survey* to finalise.

Figure 7.1.: Survey name and description fields in the survey creation interface.

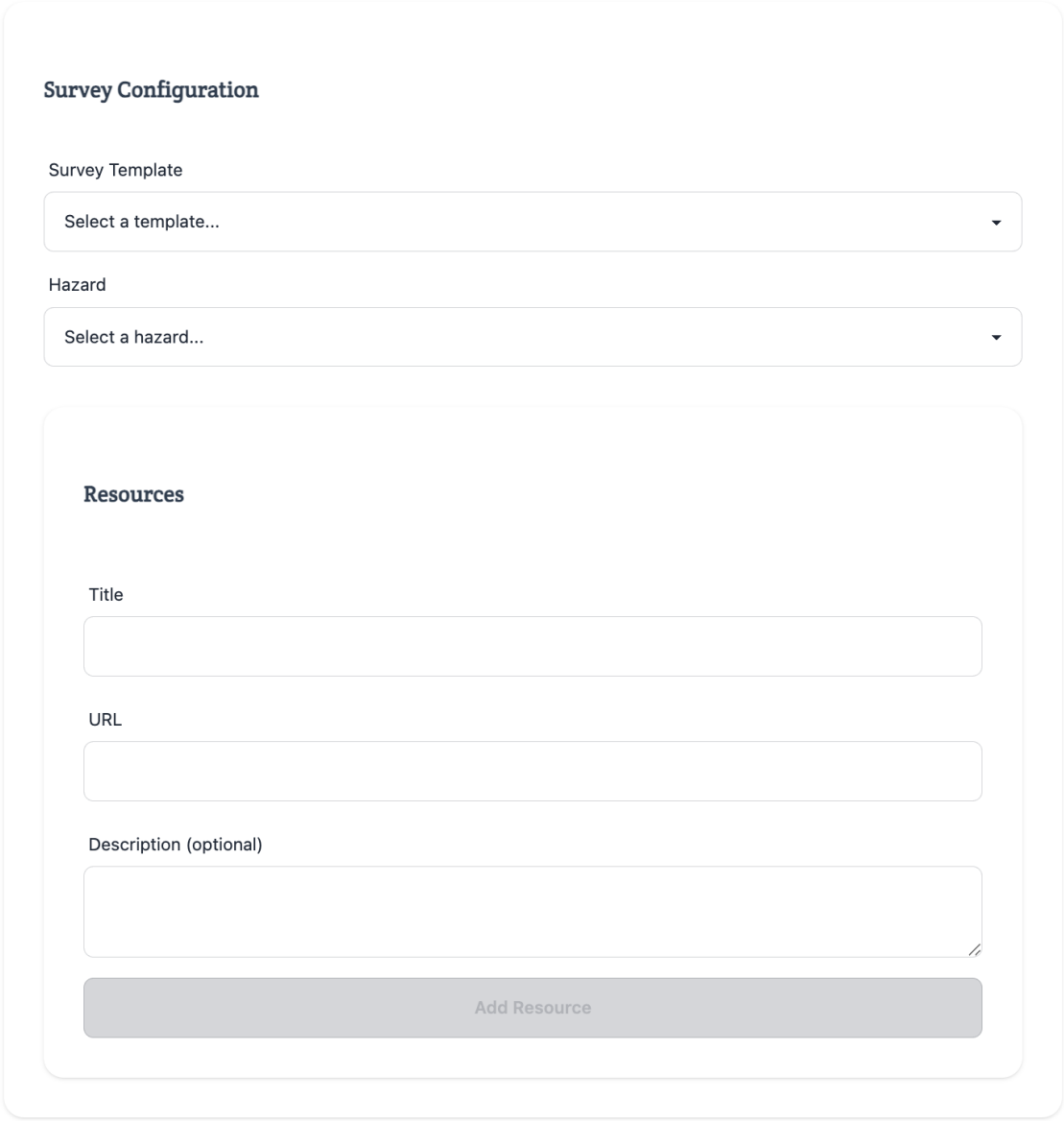

Figure 7.2.: The survey creator allows you to select the survey template and the focal pest, and add one or more web-based resources/references.

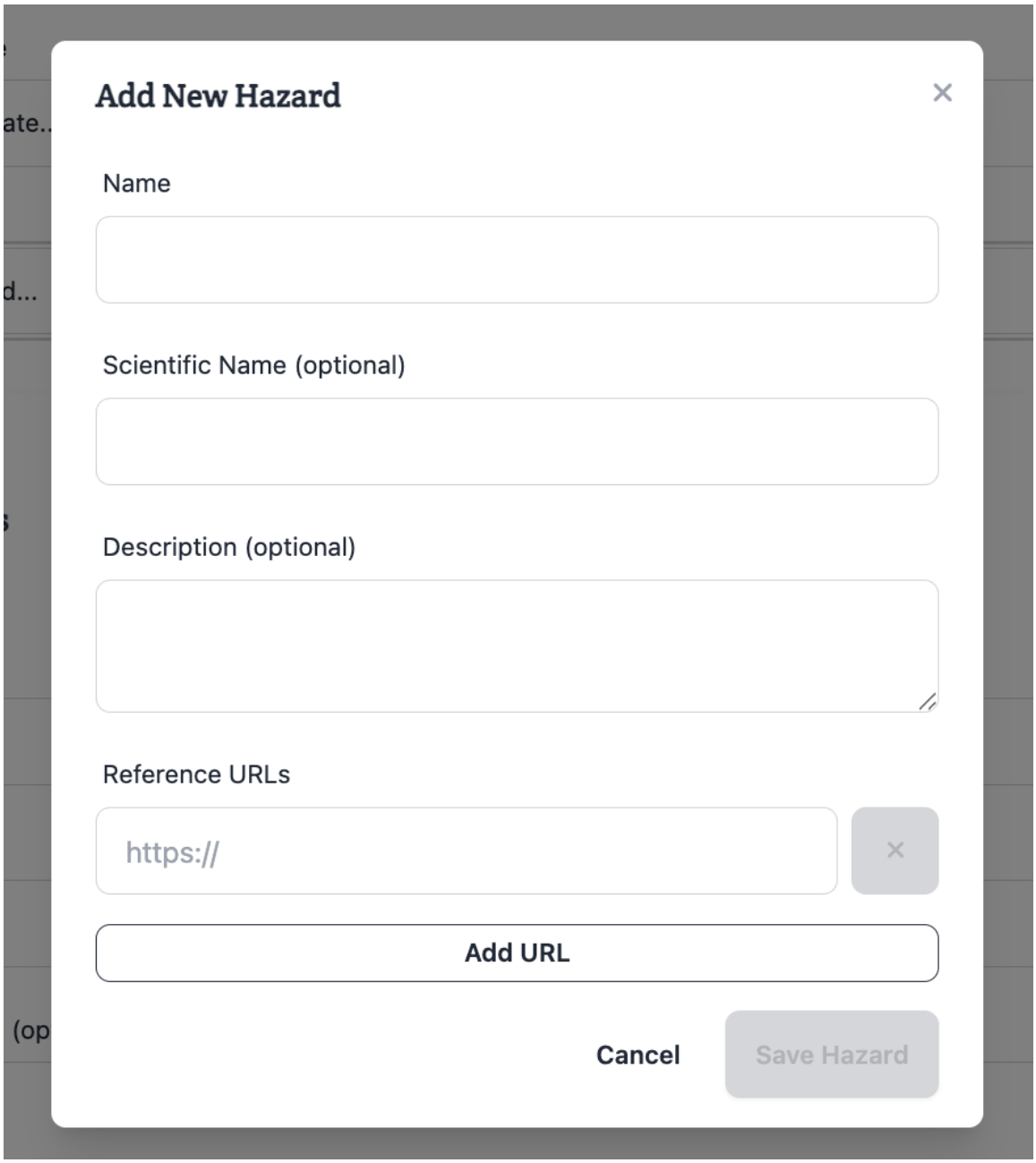

Figure 7.3.: Define a new hazard through the *Add New Hazard* input form.

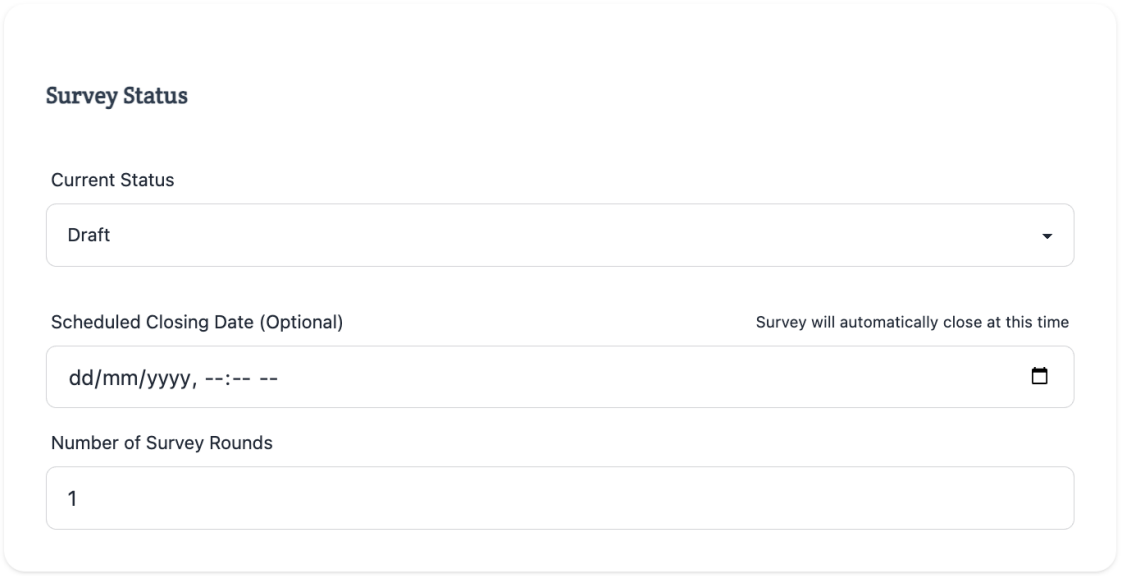

Figure 7.4.: Define the initial survey status, closing date, and number of rounds.

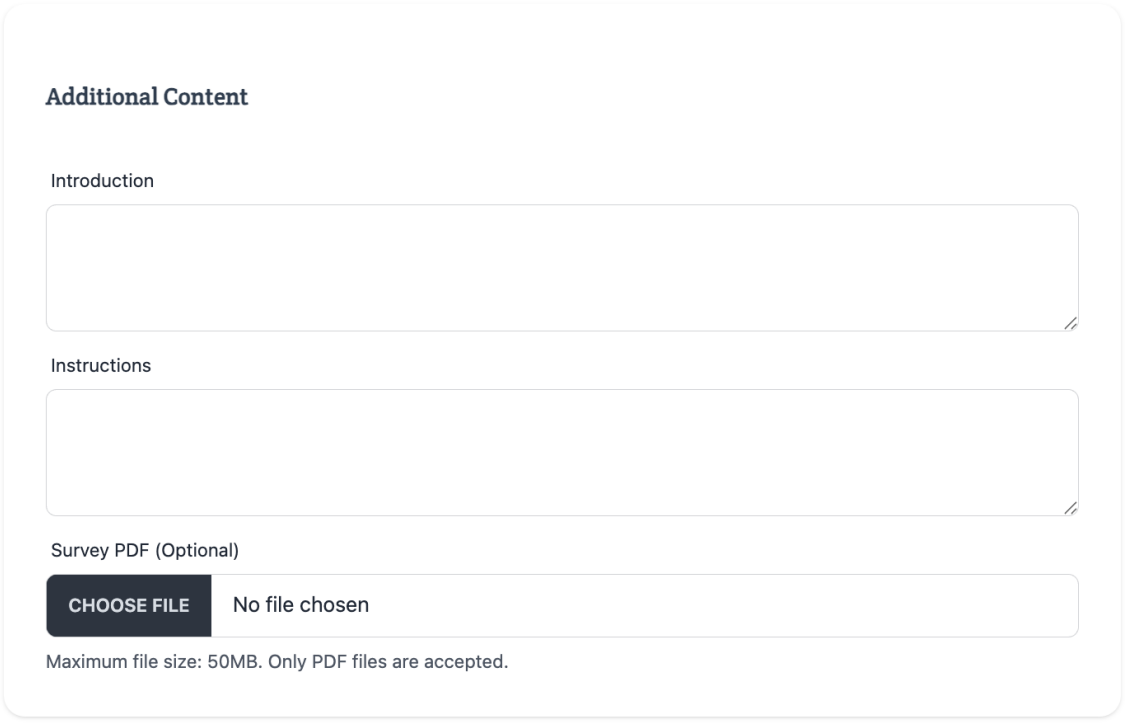

Figure 7.5.: Add survey-specific introductory text and instructions, and upload a PDF file providing the survey background/context.

7.1.2. Inviting Users

Users are added to the system via a magic link sent to them by email. To invite a user, perform the following steps:

1. Log in to the app using your administrator credentials, and navigate to the Admin Dashboard by clicking your username in the top-right corner of the window and selecting *Admin Dashboard*.
2. Navigate to the *Invites* tab (Fig. 7.6).
3. In the invitation form:
    - Enter the email address of the user you wish to invite.
    - Optionally enter their first and last names, to be used in the invitation email as well as in the user dashboard greeting and survey outputs.
    - Select whether the user should have administrator privileges by toggling the *Admin* switch on or off. A prominent warning is shown if the Admin role is selected.
    - Optionally select one or more surveys for which the user will be pre-approved (Fig. 7.7).
4. Click *Send Invite* to send the invitation email.

Note: Invitation links are valid for 14 days. If an invitation expires, you can refresh the token through the Invites dashboard.

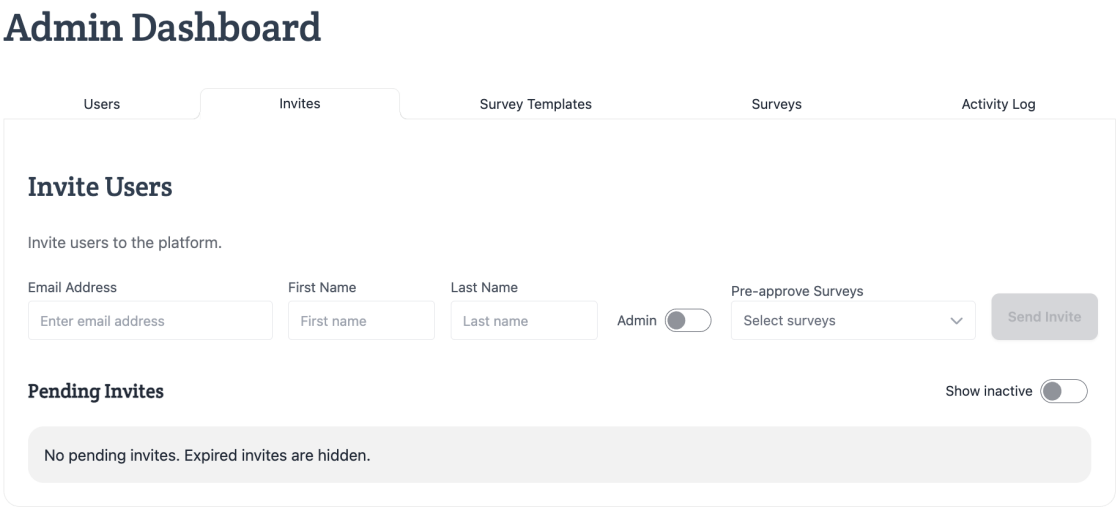

Figure 7.6.: The Invites interface for inviting new users.

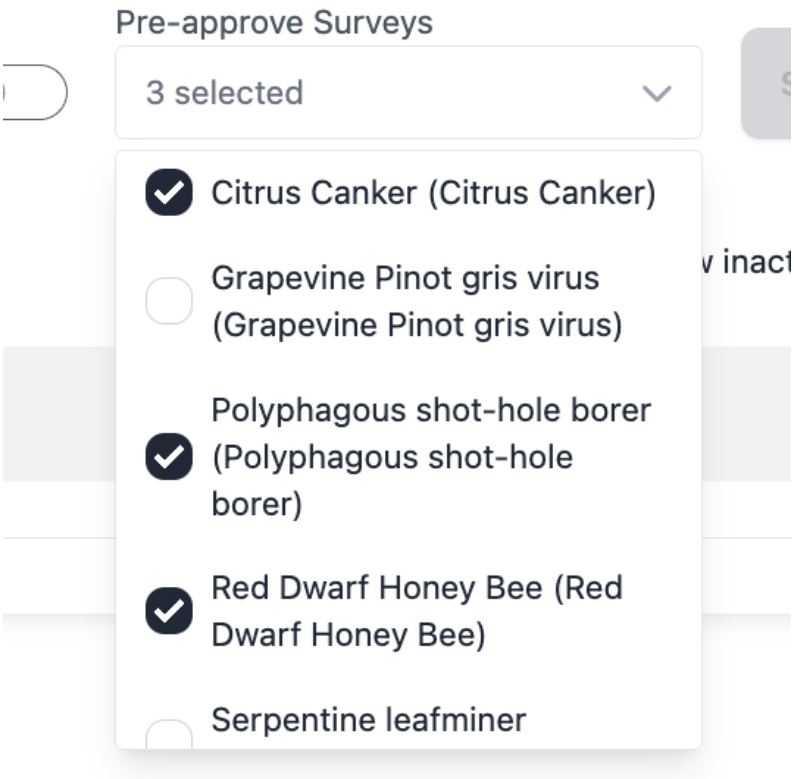

Figure 7.7.: Preapprove access to specific surveys.

7.1.3. Managing Survey Rounds

Surveys in the system are organised into rounds, allowing for iterative assessment and consensus-building. Each survey can have multiple rounds, with administrators controlling the progression between rounds. The survey dashboard presents each survey as a card that displays key information including creation date, last update, current round number, number of participants, and response counts. Available actions on each survey card dynamically update based on the survey's current status.

A survey can be in one of several states:

- **Draft**: When first created, awaiting the start of Round 1
- **Active**: Currently accepting responses in an ongoing round
- **Round Closed**: A round has been completed but not yet progressed to the next
- **Closed**: The survey has concluded

1. From the Survey Management dashboard, administrators can:
    - Monitor real-time participation rates for each round
    - View detailed response counts and completion status

- Track survey progress through different rounds
- Access quick actions appropriate to the survey's current state

2. To start a new round:
    - Locate the relevant survey card
    - Click *Start Survey* for Round 1 or *Start Round X* for subsequent rounds
    - Confirm the action via the browser prompt
    - Optionally edit the survey via the Edit button to configure round-specific settings (e.g., update the background material, or adjust the scheduled closing date/time).
3. To close a round:
    - Locate the relevant survey card
    - Click *Close Round*
    - Confirm closure via the browser prompt
4. Managing existing rounds:
    - Rounds can be reopened if additional responses are needed or if closed prematurely
    - Previous round data remains accessible for reference
    - Participant access can be modified between rounds
    - Progress through rounds is clearly indicated on the survey card

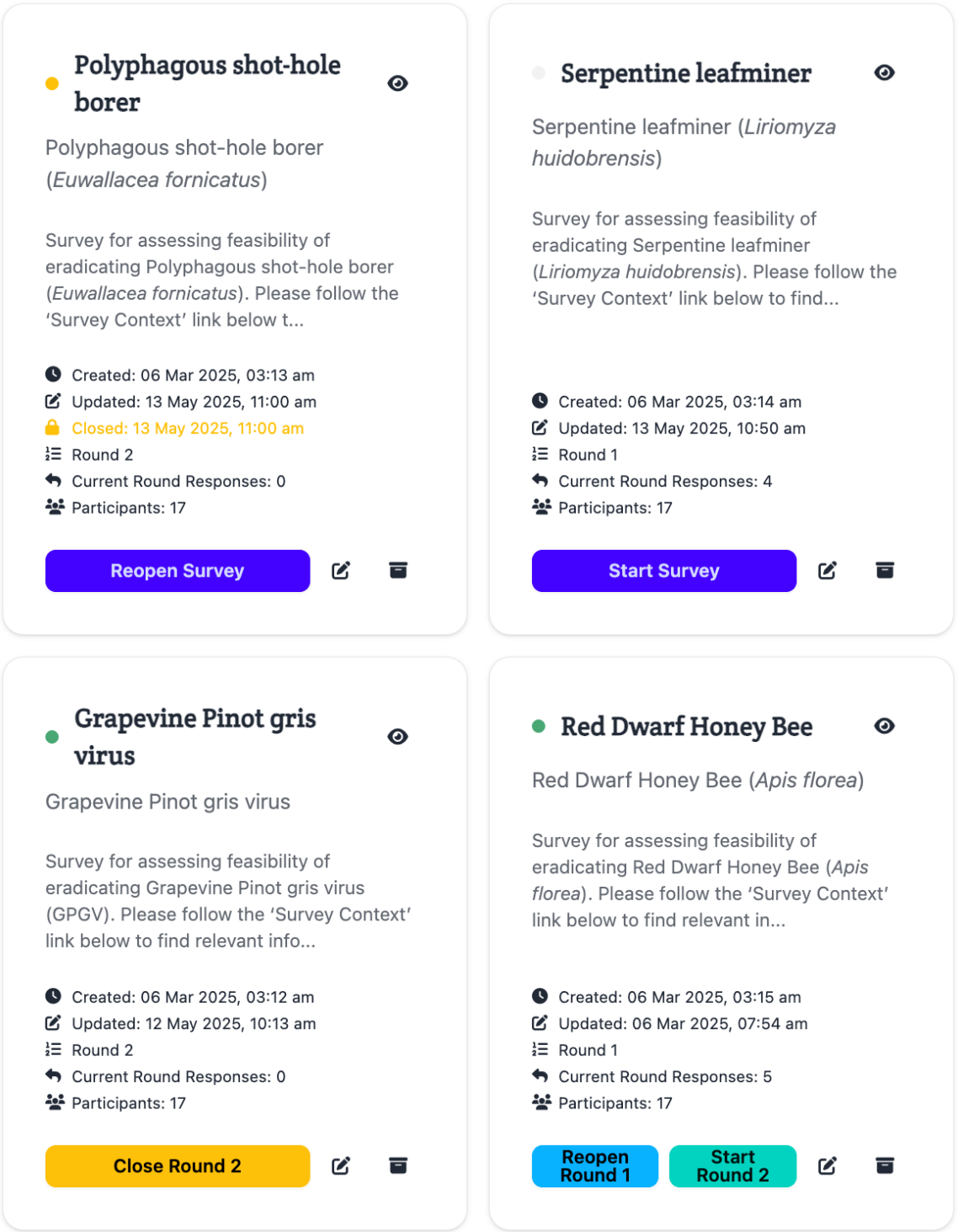

Figure 7.8.: Survey cards in the admin Survey dashboard, showing quick action buttons corresponding to their current status. The cards display key information including creation date, last update, current round number, participant count, and response statistics. Different action buttons (e.g., *Start Survey*, *Close Round 2*, *Start Round 2*, etc.) appear based on each survey's current state.

7.2. User Instructions

This section provides step-by-step guidance for users participating in feasibility assessment surveys. The instructions cover the entire user journey, from initial access through to participating in multiple survey rounds. Each major component of the application – including the user dashboard, survey interface, and results views – is designed to be intuitive and user-friendly. For detailed screenshots and explanations of these components, please refer to Section 5.2.

The assessment process is structured to promote thorough evaluation and meaningful collaboration. Users progress through clearly defined stages: accessing the system, starting surveys, completing assessments, reviewing results, and participating in subsequent rounds when needed. Each stage is supported by purpose-built interfaces that guide users through the required tasks while maintaining focus on the assessment objectives.

7.2.1. Initial Access

1. Check your email for the invitation link
2. Click the link in the invitation email
3. Set up your password (Fig. 7.9)
4. Log in to access your dashboard

7.2.2. Starting a Survey

1. From your dashboard, locate the survey card corresponding to the survey you wish to complete.
2. Click *Start Survey* or *Continue Editing* if previously started
3. Review the survey structure:
    - Instructions tab
    - Background Information tab
    - Survey tab
    - Results tabs (available after submission)

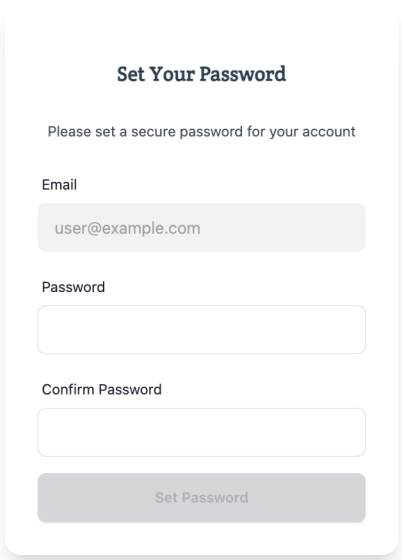

Figure 7.9.: Interface for a user to set their password when first registering to use the tool.

7.2.3. Completing the Survey

1. Begin with the Instructions tab to understand the assessment process
2. Review the Background Information tab:
    - Read provided context documents
    - Note any specific considerations for the assessment
3. Navigate to the Survey tab:
    - Work through each module systematically
    - For each criterion, select one of:
        - *Yes, we agree*
        - *No, we disagree* (provide specific reasons if prompted)
        - *Evidence is missing*
    - Add notes as needed using the notes drawer (accessible from the side panel at the right edge of the window). These notes persist across the course of the survey

- Your progress is automatically saved as you progress through the survey

4. Before submission:
    - If desired, review your responses using the response summary panel, paging through the modules with the controls at the bottom of the survey.
    - Finalise your notes

7.2.4. Viewing Results

1. After submission, access your individual results:
    - Navigate to the *My Results* tab
    - Review your assessment summary
    - Download your individual PDF report if needed
2. Once the survey round is closed:
    - Access the *Combined Results* tab
    - View aggregated responses from all participants
    - Examine the traffic light summaries for each module
    - Review shared notes and comments
    - Download the combined PDF report if needed

7.2.5. Participating in Subsequent Rounds

1. When a new round begins:
    - You will receive a notification
    - The survey card on your dashboard will update accordingly
    - Previous responses will be highlighted for reference (see Fig. 5.15)
2. Complete the new round:
    - Consider any updated information or changed circumstances
    - Review your previous responses (indicated by arrows)
    - Adjust your assessment as needed

- Add new notes to document changes in your evaluation

7.3. Tips for Effective Participation

- Make use of the Notes feature while completing the survey to document your reasoning
- Use private notes for personal observations and general notes for points you want to share with other participants
- Review the traffic light summary regularly to track your progress and overall assessment
- If you need to step away, your progress is automatically saved and you can continue later

8. Next steps

8.1. Extensions and opportunities for improvement

1. Add functionality to **compare multiple eradication strategies** within the tool. Currently, the platform is designed to assess the feasibility of a single eradication strategy at a time. By enabling users to define and compare multiple strategies side-by-side within the same survey, the tool could facilitate more nuanced decision-making. This would allow stakeholders to evaluate the relative strengths, weaknesses, and feasibility of alternative approaches, supporting more informed and transparent decision-making.

2. **Target different modules at different expert groups**. For example, users from government and industry may have different expertise and may be better suited to evaluate different criteria. Introducing role-based access or module assignment would allow the survey to be tailored to the specific knowledge and responsibilities of each participant group. This targeted approach could improve the quality of responses, reduce respondent burden, and ensure that each aspect of the assessment is reviewed by the most qualified individuals.

3. **Enable collaboration between multiple users**, such as experts from the same organisation. In addition to general collaboration, allowing users to work together on a single survey, the platform could support the delegation of access, allowing a user to assign responsibility for specific modules or sections of a survey to other users. This would facilitate distributed expertise, streamline workflow, and ensure that each part of the assessment is completed by the most appropriate individuals.

4. Develop functionality to **aggregate responses separately for different user groups or institutions** (e.g., industry vs. non-industry respondents). This would enable more granular analysis of the data, revealing how perspectives differ between stakeholder groups. Such functionality could support subgroup reporting, highlight consensus or divergence among different sectors, and inform targeted communication or follow-up actions. The platform could provide filters or separate summary views for each group, enhancing the interpretability and utility of the results.

5. Integrate a way to **compare changes in the responses that a single user provides across subsequent rounds of a survey**. While the platform currently includes a diff tool that allows users to view changes between their own revisions within a single survey round, this functionality could be extended to enable comparison of responses across different rounds, providing deeper insight into how individual perspectives evolve over time.

6. **Enhance support for multiple survey templates and new use cases.** See Section 5.6 for a discussion of how the platform supports multiple survey templates and can be extended to new use cases beyond eradication feasibility, including preparedness, prioritisation, and more. Implementation of an **interactive template creator** would streamline the process of creating new templates from scratch, or modifying existing templates to suit specific needs.

7. **Provide an overall assessment of eradication feasibility within the tool.** This could be achieved by adding an extra question at the end of the survey, aggregating responses using a pre-agreed weighting system, or integrating a structured approach with stopping rules for staged evaluation. An overall assessment would help synthesise the detailed module-level findings into a single, actionable outcome, making it easier for decision-makers to interpret the results and take appropriate action.

8. **Leverage the platform as a data repository.** Over time, data on how criteria are assessed across different case studies will accumulate, supporting research and evaluation of how early discussions and decisions relate to eradication outcomes. By providing tools for data export, visualisation, and meta-analysis, the platform could become a valuable resource for ongoing learning, evaluation, and evidence-based policy development.

9. **Explore flexible hosting options for the application.** See Section 8.2 for a discussion on this topic.

8.2. Opportunities for hosting the platform

There are several flexible options available for hosting the Feasibility of Eradication Assessment tool, allowing administrators to select the approach that best fits their technical requirements and security policies.

A common and cost-effective solution is to deploy the application on a Linux-based virtual machine (VM) using a cloud service provider. Providers such as Amazon Web Services (AWS EC2)[1], Google Cloud Compute Engine[2], and Microsoft Azure[3] all offer robust infrastructure for hosting Node.js applications. For this proof of concept, we deployed the tool on DigitalOcean[4] infrastructure. This approach allows for rapid de-

[1] https://aws.amazon.com/ec2
[2] https://cloud.google.com/compute
[3] https://azure.microsoft.com
[4] https://digitalocean.com

ployment, scalability, and straightforward maintenance, with the ability to configure resources and security settings according to organisational needs. The platform can also be containerised using Docker[5] where supported, further simplifying deployment and portability across different environments.

Alternatively, the platform can be self-hosted within the infrastructure of a government department or research institution, or relevant non-profit organisation (e.g., DAFF, Plant Health Australia). This option may be preferred where data sovereignty, internal security policies, or integration with existing IT systems are paramount. Self-hosting enables direct control over server configuration, access management, and compliance with organisational standards, but may require additional IT support and ongoing maintenance.

A further opportunity is to incorporate the application into the Biosecurity Commons platform[6] as a dedicated eradication feasibility assessment workflow. Integration with Biosecurity Commons would enable seamless interoperability with other biosecurity data tools and resources, provide a familiar environment for users in the sector, and leverage the platform's established infrastructure and support services. This approach could facilitate broader adoption and collaboration across the biosecurity community, while reducing the technical burden on individual organisations.

Each of these hosting models offers distinct advantages, and the choice will depend on factors such as organisational capacity, data governance requirements, and the desired level of integration with other systems.

[5] https://docker.com
[6] https://biosecuritycommons.org.au

Acknowledgements

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A. Review of Feasibility of Eradication decision-support tools in Australia

Two tools have been developed in Australia to inform decisions around eradication feasibility during emergency response. The first one, jointly developed by the Australian Department of Agriculture, Fisheries and Forestry (DAFF) and the Consultative Committee on Emergency Plant Pests (CCEPP), is a Microsoft Excel spreadsheet focused on eradication of plant pest and diseases. The second one, developed by the Centre for Invasive Species Solutions (CISS), is a web-based platform that focuses on eradication of vertebrate species. Here, we provide a comprehensive evaluation of each of these tools, including:

- their main capabilities (i.e. outputs) and how they work (i.e. what assumptions they make);
- their strengths and weaknesses; and
- whether they are fit-for-purpose for informing eradication feasibility during an incursion response in Australia – as required by the multiple biosecurity response deeds and agreements in place, but with particular emphasis on the Emergency Plant Pest Response Deed and the list of criteria presented in PLANTPLAN (Table 2.1).

A.1. DAFF/CCEPP Microsoft Excel tool

A.1.1. Main capabilities and assumptions of the DAFF/CCEPP Microsoft Excel tool

The DAFF/CCEPP Microsoft Excel tool was developed by the Department of Agriculture, Fisheries and Forestry (DAFF) as an initiative of the Consultative Committee on Emergency Plant Pests (CCEPP). This tool is designed to assist decision-makers to evaluate available evidence (or lack thereof) and develop a documented argument for the stance of eradication.

This decision tool is implemented using Microsoft Excel spreadsheets. It works by asking representatives from each jurisdiction and impacted industry to provide answers to 76 unique questions, organised into 7 decision-trees focused on:

1. Ability to identify/diagnose pest
2. Able to detect pest in current circumstances
3. Species biology leaves pest susceptible to eradication
4. Current circumstances of infestation leave pest susceptible to eradication
5. Control method effective
6. Effective control methods supported
7. Ability to close pest pathway

The decision criteria are presented as a set of qualitative questions, for which each party selects the statement (out of a few pre-defined options) that more closely aligns with their understanding of existing evidence and attributes associated with the incursion under consideration (Fig. A.1). The criteria span the areas of socio-political feasibility (e.g. public support for control methods), technical feasibility (e.g. pest detectability at low population levels, effectiveness of control/treatment methods), and economic feasibility (e.g. benefits vs. costs of eradication). These criteria are presented in a semi-structured tree, that visually shows the interdependencies within each of the seven main criteria sections. The responses to the criteria are independent from each other, meaning that the responses to lower-rank questions (to the right of the tree; Fig. A.1) do not formally condition the responses to higher-rank questions (to the left of the tree). The tool does not require a response to all the criteria.

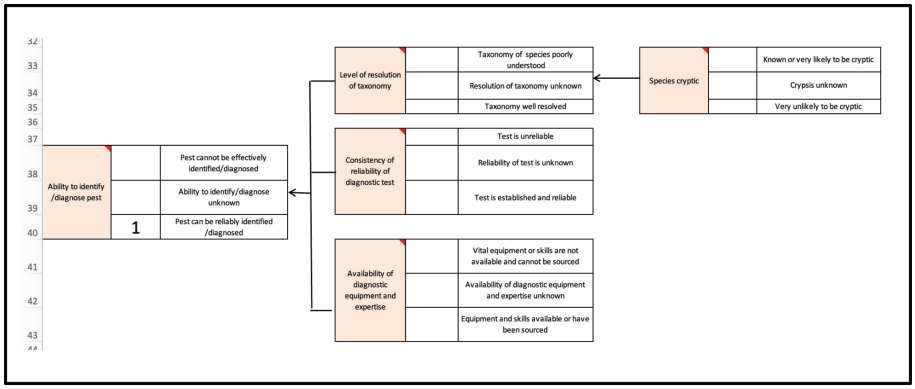


Figure A.1.: Screenshot of one of the main sections of the DAFF/CCEPP Microsoft Excel tool, showing the structure and nature of the decision criteria. Criteria are meant to be filled up following their rank position, from lower-rank criteria (on the right side) to higher-rank criteria (on the left side).

The information supplied by each respondent is compiled at the top of their individual spreadsheet using a colour-coded summary of the evidence (Fig. A.2). This summary diagram contains different colours and shades indicating whether: (i) the evidence for a criteria suggests that the pest is likely to be eradicable, (ii) the evidence for a criteria suggests that feasible eradication is unlikely, or (iii) there is some degree of uncertainty around the evidence supporting the role of a criteria in eradication feasibility. As part of this summary diagram, parties are prompted to indicate their overall level of confidence for each of the seven main decision criteria (Fig. A.2, bottom row), by selecting the category – from very high to very low – that most closely aligns with their evidence.

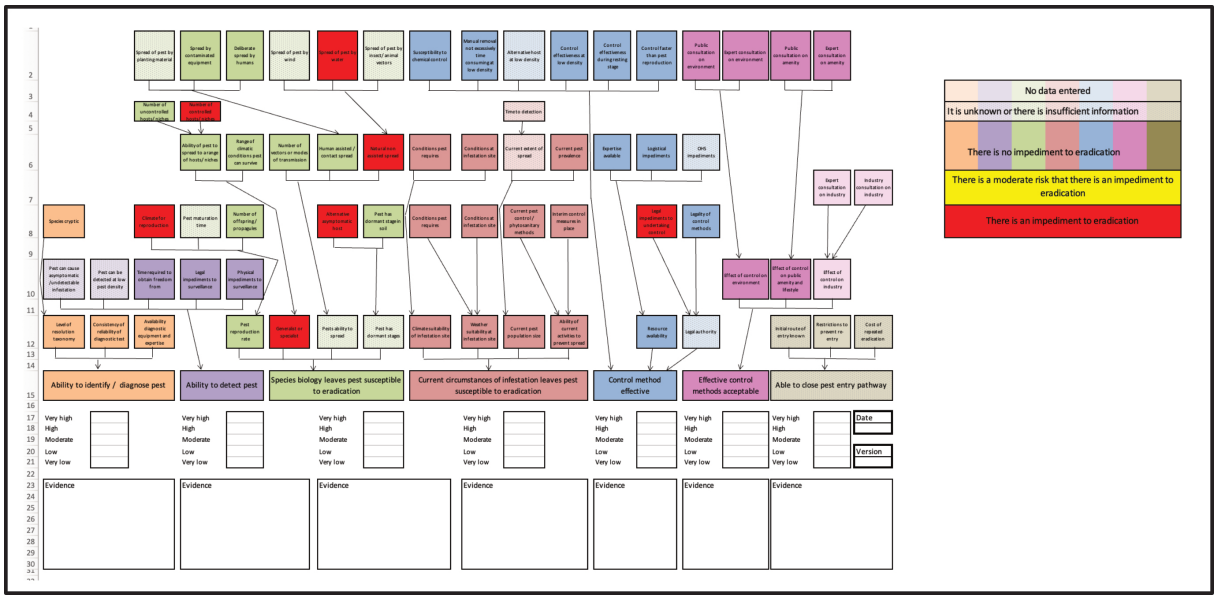


Figure A.2.: Screenshot of a hypothetical summary of the evidence provided by a single party involved in decision-making via the DAFF/CCEPP Microsoft Excel tool. Note the colour legend on the right side of the summary – each of the 76 criteria will show a particular colour/shade depending on whether the evidence supports their role in eradication feasibility.

Individual stakeholders submit their spreadsheet to a designated compiler. The compiler pastes them into a master document that summarises the information under the 'compiler' tab. Again, a colour-coded summary is generated, this time showing the compiled evidence from all the stakeholders at once. The meaning behind the different colours and shades in this summary (Fig. A.3) is similar to the individual summary (Fig. A.2), with some additional categories showing those criteria for which a difference of opinion among stakeholders exists. Disagreements among stakeholders can arise from two main sources:

- Conflicting evidence: Some stakeholders may have data that support eradication feasibility, while others have contradictory information.
- Varying levels of uncertainty: Some stakeholders might express uncertainty about specific criteria, preventing them from making a definitive decision on eradication feasibility, while others feel more confident.

The DAFF/CCEPP Microsoft Excel tool is designed to assess the level of consensus across stakeholders. This helps to identify and focus the discussion on those specific points of contention among different parties and determine why there are differences of opinion (i.e., where all or some parties feel that there is insufficient information or evidence to come to a conclusion about feasibility of eradication).

Stakeholders can use the tool iteratively until an eradication decision is made. Each version of the model is saved from every meeting or iteration, documenting how new information or changing circumstances impact eradication feasibility decisions. These versions provide a detailed record of the decision-making process, useful for reporting, stakeholders communication, and demonstrating sound decision-making.

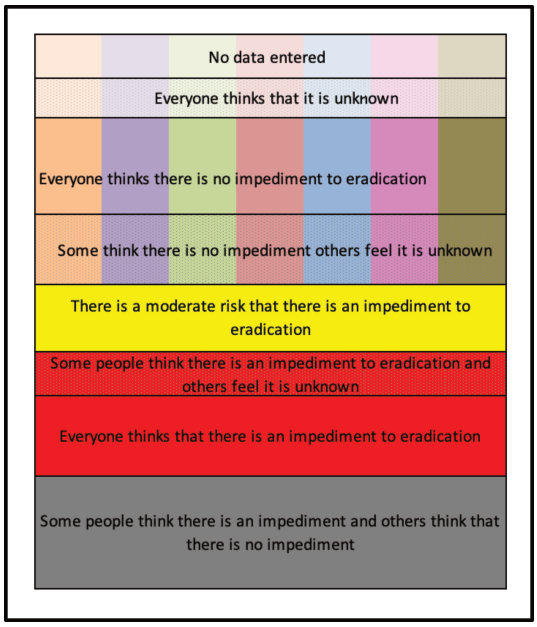


Figure A.3.: Legend of the summary output provided by the DAFF/CCEPP Microsoft Excel tool by combining the answers provided by multiple users. Note it contains a few extra colours/patterns compared to the summary produced from a single user (Fig. A.2).

It is important to recognise that the DAFF/CCEPP Microsoft Excel tool was specifically developed as a response-ready decision-support tool, based on the multiple feasibility criteria in PLANTPLAN (Table 2.1), and designed to engage multiple stakeholders. As such, it provides a summary of the evidence that experts consider relevant for a particular scenario, which can then be used by decision-makers to reach an agreement regarding feasibility of eradication during an incursion. The tool can play an important role at the initial steps of management response, i.e. prior to the actual management of the pest, by facilitating and narrowing discussions among multiple stakeholders. However, it does not provide information regarding the optimal management strategy, or a formal process to follow as eradication progresses. It is also for the decision-makers to establish whether the seven main decision criteria presented in the tool hold equal weight into the final decision, or whether some of them are more critical in a particular incursion scenario. Finally, the decision-makers have full discretion in interpreting the summary figure, and in concluding which levels of uncertainty and/or disagreement (Fig. A.3) are ultimately acceptable for the eradication to be considered feasible overall.

A.1.2. Strengths of the DAFF/CCEPP Microsoft Excel tool

- **Structured, comprehensive, and aligned with PLANTPLAN evaluation criteria**

  The DAFF/CCEPP tool is based on a comprehensive and structured vision of eradication feasibility, and closely aligns to the key feasibility criteria proposed in PLANTPLAN (Table 2.1). It evaluates multiple aspects spanning socio-political, technical and economic feasibility, and as such, it is expected to provide well-

rounded support to decision-makers tasked with biosecurity emergency response by identifying both technical and non-technical barriers to eradication.

The feasibility criteria presented in the DAFF/CCEPP Microsoft Excel tool are visually organised in a tree-like structure, which gives the users a thorough understanding of the links and relations among the different aspects that need to be simultaneously considered, i.e., how the evidence to evaluate lower-rank criteria will affect the evaluation of higher-rank criteria. At the same time, the 76 criteria are organised into seven main sections, which breaks the evaluation into smaller, easier-to-handle aspects of eradication feasibility. The final decision regarding feasibility can then be based in the seven main decision criteria (Fig. A.2, bottom row), once consensus on these has been reached across the involved stakeholders.

- **Easy to use**

  Evaluation of the criteria is relatively straightforward. For most of the criteria, the user is asked to choose one of a few pre-defined, qualitative categories (e.g. low, high, unknown). The questions require users to lean into their previous experience and knowledge, but they do not require any quantitative estimates. DAFF/CCEPP has put great effort into the criteria showing a consistent directionality across their pre-defined response categories (Fig. A.1; for each criteria, the first, top response category reflects a lack of feasibility, while the last, bottom response category reflects feasibility). In addition, the colour-coded system used for the summary outputs makes it easy to interpret whether overall the users think there is support for eradication feasibility, or whether the overall evidence suggests otherwise (Fig. A.3).

- **Identification of uncertainty and knowledge gaps**

  This tool is excellent at identifying uncertainties and disagreements during the process of evaluating feasibility of eradication. First, for every individual criteria, the tool provides users with the opportunity to acknowledge that there is not enough evidence to answer a question, or that they are not sure how to interpret the evidence. Second, for the seven main decision criteria (Fig. A.2, bottom row), users are explicitly asked to provide a qualitative estimate of their level of confidence in their response, ranging from very high to very low. Third, the colour-coded output of the tool identifies which individual criteria, including the seven main criteria, the users consistently have not provided an answer for, or they have provided answers that disagree with each other. As such, the tool can identify knowledge gaps regarding the pest or control method that are evaluated, as well as differences in how stakeholders understand or interpret existing evidence (Fig. A.3). Knowledge gaps mean more research is likely needed to have a better understanding of how a criteria may support or hinder eradication success. Disagreements, on the other hand, call for a discussion among the stakeholders involved in the evaluation to share their experiences and points of view in the hopes they can ultimately reach a consensus.

- **Designed to collate input from multiple stakeholders and facilitate discussion**

  Following expectations described in several Australian biosecurity emergency response agreements, including the Emergency Plant Pest Response Deed (PHA, 2025), the DAFF/CCEPP Microsoft Excel tool is designed to compile feedback from a diverse group of stakeholders and affected parties, including the Australian Government, state and territory governments, and industry signatories. And it does so in a structured, transparent and replicable manner, providing accountability and transparency to all parties involved in shared decision-making. The DAFF/CCEPP Microsoft Excel tool can be used in an iterative way to provide a trail of proof and evidence regarding eradication feasibility decisions.

  What's more, the tool can equally be used by a single decision-maker to evaluate a very simple pest incursion scenario, or by one or multiple stakeholders to discuss theoretical scenarios of incursion. In fact, the tool has been used in the past to identify knowledge gaps in theoretical exercises, with great success (for an example, see *Exercise Fastidious Report* by Plant Health Australia).

- **Potential to be used to evaluate several groups of invasive species**

  Even though the list of evaluation criteria presented in the DAFF/CCEPP tool is tightly tailored to plant pest species – particularly insects and other invertebrates – its qualitative and flexible nature means it has potential to be applied to decisions of eradication feasibility beyond this group of species to plant diseases, pathogen complexes, and likely environmental weeds. The use of standardised protocols within and across groups of pests is the cornerstone of critical evaluation of eradication initiatives success, by allowing transparent and objective assessments of the emergency contexts and decisions that were conductive of eradication success.

A.1.3. Weaknesses of the DAFF/CCEPP Microsoft Excel tool

- **Large number of evaluation criteria, and some redundancy**

  The tool contains 76 evaluation criteria. Not only providing answers for that many criteria seems like an arduous exercise, but also the fact that all the criteria are presented in a single spreadsheet can easily be perceived as daunting and overwhelming by the person tasked with filling up the assessment. In addition, even though the summary figure (Fig. A.2) summarises all the responses in a single output, it does not condense the information in a way that it can be quickly or easily interpreted. The colour-coding summary output created by the tool (Fig. A.2) is quite involved, as it includes all the 76 criteria. However, the focus of decision-makers when using the output is very likely the bottom line of this figure, which shows just the seven main decision criteria involved in eradication feasibility. To what degree decision-makers need to pay close attention to disagreements on lower-rank criteria, as opposed to just the main seven criteria, is unclear. This raises questions about availability vs. usability of information.

On one hand, some information may be easily available, and experts may agree on it; however, that does not necessarily translate into a straightforward decision regarding eradication feasibility. On the other hand, experts may disagree on specific lower-rank criteria, while agreeing on the overall main criteria. For example, they may agree that pest identification would be challenging, however, they disagree on the underlying reason (some may refer to the species being cryptic while others may refer to a lack of expertise). To what extent that disagreement should be discussed is for stakeholders to decide.

- **Lack of clarity around control/surveillance methods and overall strategy**

  The tool has not a dedicated space where the proposed eradication strategy that is being evaluated is clearly described, even though multiple questions in the tool focus on evaluating different aspects of the control and surveillance methods. Consequently, the evaluation process faces the risk of different users answering these questions while having different eradication strategies in mind. If individual users are thinking of different control methods, their responses to the evaluation criteria won't necessarily be comparable. This applies to technical aspects of the eradication as much as it applies to social, legal and economic considerations of feasibility.

  Even if a clear eradication plan is presented *a priori* to the stakeholders taking part in the evaluation, the tool only allows the evaluation of a single management alternative. There is no opportunity to compare the costs and the effectiveness of different management options simultaneously, which may risk overlooking some possibly feasible eradication alternatives.

- **Qualitative assessments heavily rely on subjectivity**

  All the criteria evaluated in this tool are qualitative questions that heavily rely on the users' previous experience, abstract knowledge and gut-feeling. While experts' pest knowledge and experience in incursion response is invaluable to make sound decisions regarding feasibility of eradication, qualitative assessments make it challenging to separate objective evidence from the subjective values, opinions and expectations of the diverse stakeholders involved. The users also provide qualitative estimates of their level of confidence – very high, high, moderate, low, very low – for the seven main decision criteria (Fig. A.2, bottom row) supporting feasibility of eradication, which is difficult to interpret and summarise into a single estimate of uncertainty. In addition, the fact that most responses are qualitative and that each criteria is answered independently from others (despite the tree-like structure of the tool implying a cascading effect from lower- to higher-rank criteria) may lead to inconsistencies between criteria at different rank levels. It is unclear whether these inconsistencies may cause serious issues, or on the contrary, may provide users with the opportunity to give an overall response to the highest-rank criteria even when objective evidence for them or the lower-rank criteria does not exist.

- **Vague language**

  The language used across the tool is rather vague, which can lead to different users interpreting the same term or idea in different ways. For example, 'maturation time' is classified as short or long, 'reproduction rate' is classified as low/-moderate or high, and 'spread distance' is allowed to be short to intermediate or long. There is no further clarification of what these terms mean for a particular type of organism. Key concepts used to describe some criteria, such as 'low population levels', are not defined either. If experts interpret a given criteria in different ways, their assessments are again not necessarily equivalent.

  Beyond that, the criteria representing the economic aspects of eradication feasibility are only few, and very vague in their language: e.g. 'costs of multiple eradication efforts outweigh benefits'. Answering this criteria alone may need a relatively involved quantitative assessment of economic impacts and benefits.

- **Not openly available**

  While those stakeholders directly contacted by the federal government (who is ultimate responsible of the evaluations) will have the ability to provide feedback, it is unclear how other interested parties (e.g. industry) potentially affected by an incursion can break into the decision process if not directly contacted.

  On top of that, this tool still requires a good amount of manual handling of the individual responses by the designated compiler.

- **Likely inadequate to be used to evaluate animal disease incursions**

  While the tool seems to have potential to be applied to different groups of species (e.g. plant pests and diseases, weeds), the degree to which it would provide an adequate framework to evaluate the feasibility of eradication for animal disease incursions is unknown. Responses to animal diseases incursions need to be ignited particularly quickly, and follow a highly regulated process as described in the guidelines for Emergency Animal Disease Response Plans (AHA, 2020), which were developed based on the directives given in the Australian Veterinary Emergency Plan (AHA, 2023a) and the Emergency Animal Disease Response Agreement (AHA, 2023b). It seems that the tool would need to include extra criteria following these directives, for example related to vaccination regulations.

A.2. CISS web-based tool

A.2.1. Main capabilities and assumptions of the CISS web-based tool

The CISS web-based tool, called the Eradication Feasibility decision-support tool (Fig. A.4), was developed by the Centre for Invasive Species Solutions (CISS; Ramsey *et al.*, 2022). This R Shiny App, openly available at *https://landcare.shinyapps.io/EradSim*, is designed to quantitatively assess eradication feasibility via simulations of the pest population dynamics given some biological parameters, information on the control method/s, and economic costs of surveillance and control. In particular, the tool allows decision-makers to simulate various combinations of control measures to determine which one is most likely to achieve the desired level of pest population reduction for the minimum cost, given the pest biology and its expected population dynamics.

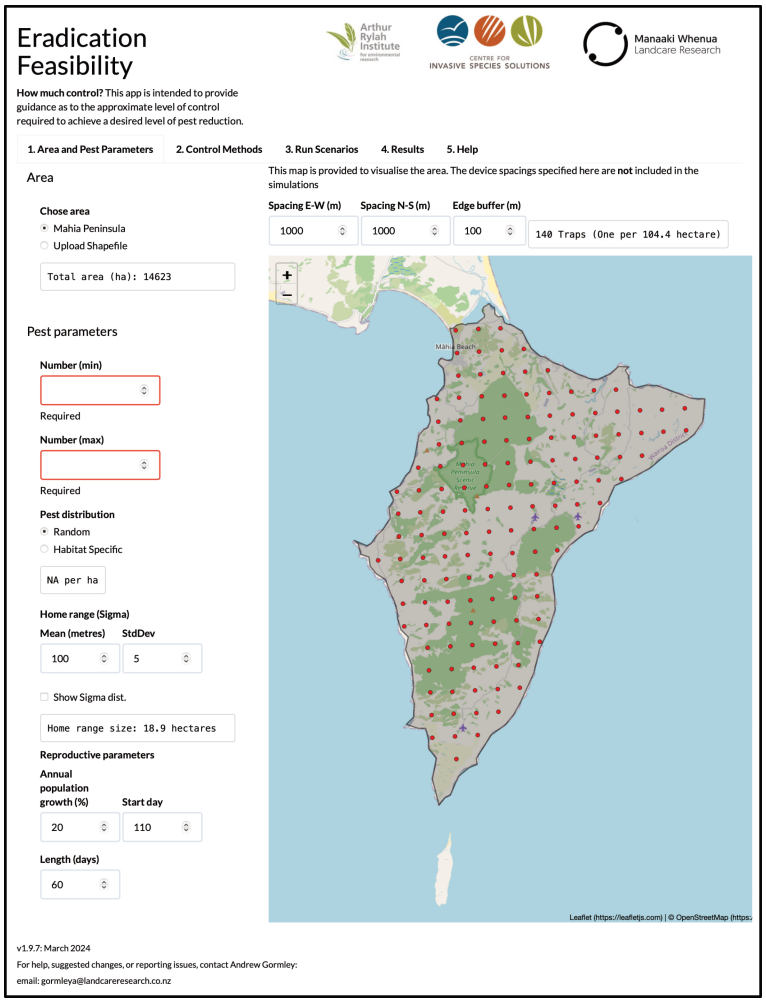


Figure A.4.: Screenshot of the front end of the Eradication Feasibility decision-support tool, developed by the Centre of Invasive Species Solutions and hosted at *https://landcare.shinyapps.io/EradSim/*.

The Eradication Feasibility decision-support tool was developed as part of a larger project putting forward several tools to provide objective support for decisions within the incursion response framework – namely, eradication feasibility assessment, eradication progress assessment, and pest absence assessment (Fig. A.5). While the Eradication Feasibility decision-support tool aims to support decisions regarding eradication feasibility, another two tools (Eradication Progress decision-support tool and Proof of Absence decision-support tool) were developed to help decision-makers during the following stages of emergency response. This review focuses exclusively on the Eradication Feasibility decision-support tool.

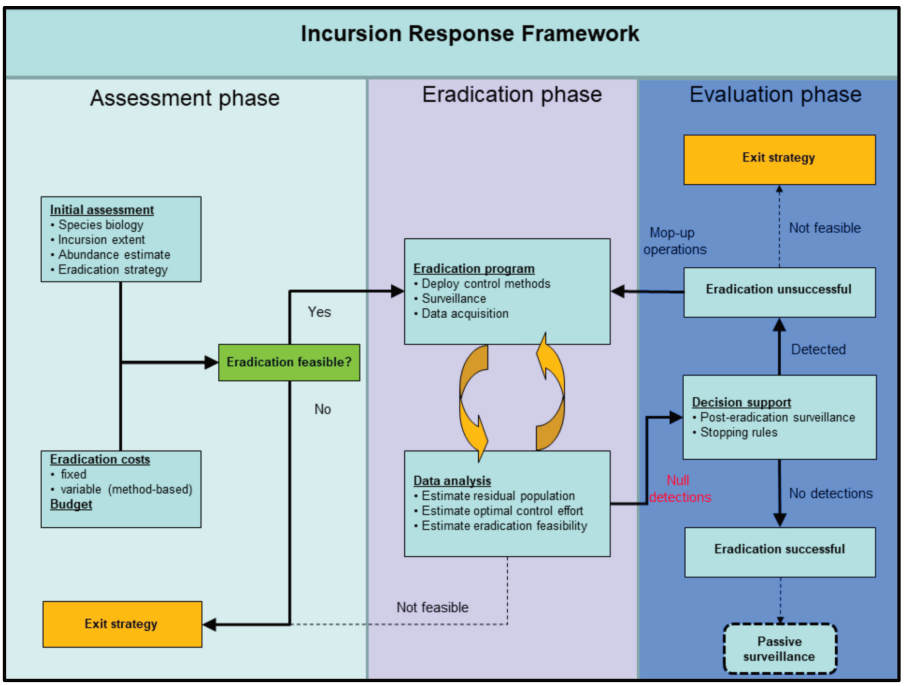


Figure A.5.: Structured framework used by the Centre for Invasive Species Solutions (CISS) to guide decisions around pest incursion response. Several decision-support tools were developed to provide support for the three phases presented in this framework; assessment phase (i.e., is eradication feasible?), eradication phase (i.e., is eradication progressing adequately?) and evaluation phase (i.e., has eradication being successful?). Each phase represents a discrete stage in the management of an incursion and has its own set of questions, activities or knowledge requirements. The Eradication Feasibility decision-support tool was developed to support the assessment phase. *Source: Ramsey et al. (2022).*

Drafting a strategy regarding how and when to proceed with eradication is key for managers tasked with deciding whether eradication is a feasible option. In doing so, managers need to evaluate the efficacy and cost-effectiveness of different control strategies for achieving eradication. The Eradication Feasibility tool allows managers to do so based on spatially explicit models that simulate the removal of individuals from a pest population under one or more control regimes. These models are then used to determine whether the level of effort required to achieve eradication is feasible.

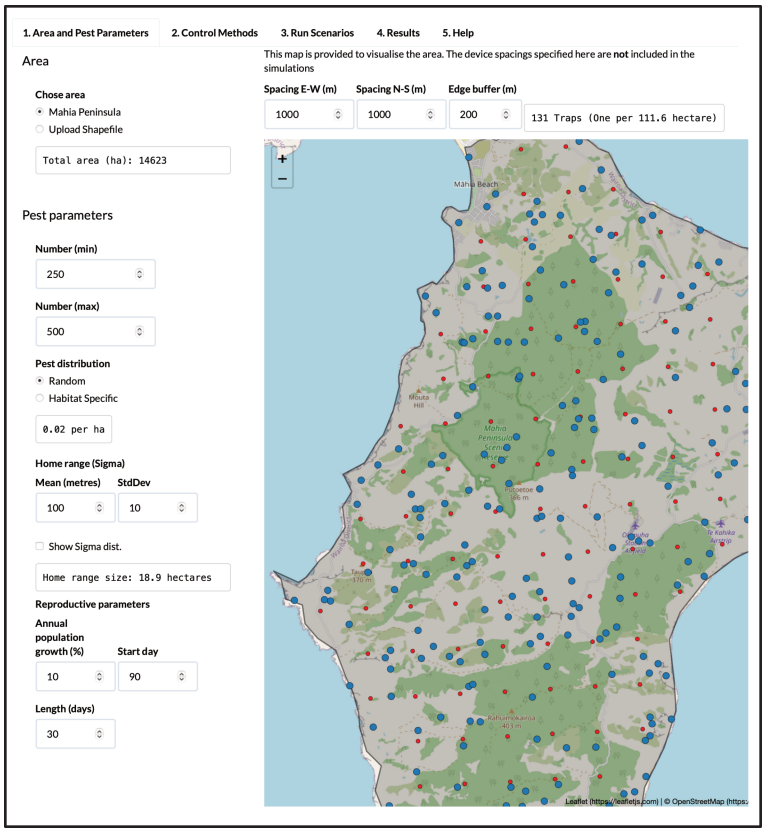


Figure A.6.: Screenshot of 'Step 1 - Area and Pest Parameters' of the Eradication Feasibility decision-support tool. Blue dots represent the pest individuals (n = 250-500), which for this example have been randomly placed across a hypothetical landscape and assigned a home range of approx. 19ha. Red dots represent the spatial layout of the control points (e.g. traps, baits).

The Eradication Feasibility decision-support tool focuses solely on whether the removal rate of the pest is high enough to eliminate the population, and assumes that other factors (e.g., pest detectability at low densities, eradication vs. sustained control benefits, or socio-political support for eradication) are conducive to eradication without further consideration. More specifically, the tool was designed to address the following decisions: (i) what is the likelihood that the eradication response will fail?; and (ii) what are the most cost-effective removal and surveillance strategies?

To answer these questions, managers need to provide information on the pest biology, its abundance and suspected spatial distribution, as well as information on the control method/s. To initiate the simulations the area under examination needs to be defined by uploading a shapefile of the regional boundary (Fig. A.6, Area) and defining a starting pest population of a specified size and density (Fig. A.6, Pest parameters). Pest individuals can be placed randomly in the landscape, or alternatively around the species' preferred habitat (via a raster of relative abundance by habitat for the pest). The species movement or dispersal dynamics across the landscape are approximated by defining their home range, which is assumed to be circular. The pest's annual population growth needs to be described too by providing several reproductive parameters. All these parameters, which can be derived from the literature, preliminary monitoring data or expert opinion, are meant to represent not only known aspects of the pest

biology, but also the conditions of the current incursion under evaluation.

Next, information regarding the effectiveness (and potentially the cost) of the control method/s needs to be inputted into the tool. Eradication feasibility can be assessed on purely technical terms, based on the properties of the proposed pest-removal methods, or on bioeconomic terms, to determine whether eradication can be achieved for a fixed budget.

The user can construct one or more eradication scenarios by specifying one or multiple concurrent control methods. The tool offers four in-built control methods: trapping, bait stations, hunting, and aerial poisoning (Fig. A.7). While removal devices, such as traps or bait stations, are represented by georeferenced point locations within the area of interest, hunter or dog tracks can be incorporated by discretising the movement tracks into points at a set distance interval. The choice of which control methods to consider will depend on factors such as the habitat where the pest species occurs.

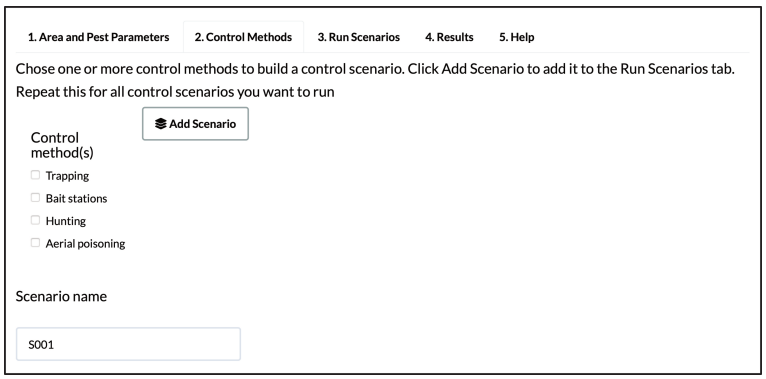


Figure A.7.: Screenshot of 'Step 2 – Control Methods' of the Eradication Feasibility decision-support tool. The tool provides four control methods: trapping, bait stations, hunting, or aerial poisoning. These methods can be independently or simultaneously assessed in the simulations.

Each control method has several parameters that must be specified for the simulations to run (Fig. A.8). For trapping and baiting methods, the density of traps/stations is determined by their spatial positioning in the landscape, which is defined by the N-S and E-W spacing parameters. The interaction between the removal traps or baiting stations and the pest individuals depends on two parameters; the probability the species will be captured/baited by a trap/station placed at the centre of their home range – defined by g_0 – and the overlap between the traps/stations and the species home range – defined by *StdDev*. The effectiveness in pest trapping or killing is further defined by a combination of multiple parameters, such as the daily catch rate, the duration of deployment, and the trap/station checking interval. Finally, information related to the costs of the trapping/baiting regimen can also be provided, e.g. the number of traps/stations to be checked per day, the daily rate for a field technician, and the fixed cost per trap/station.

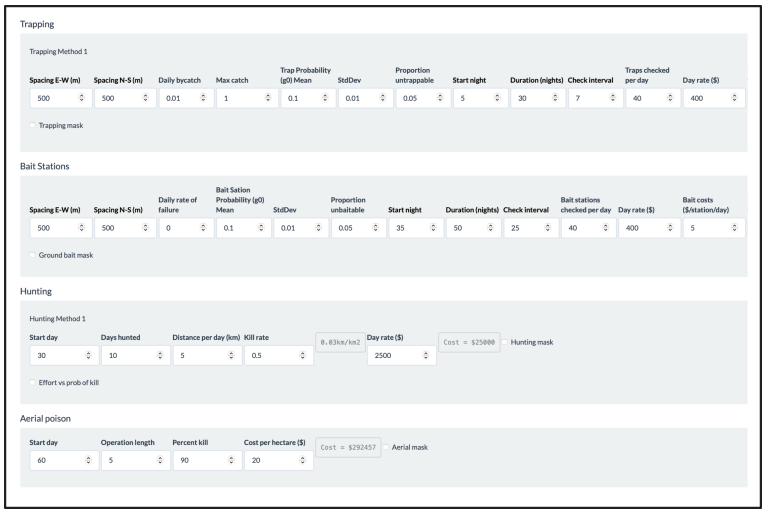
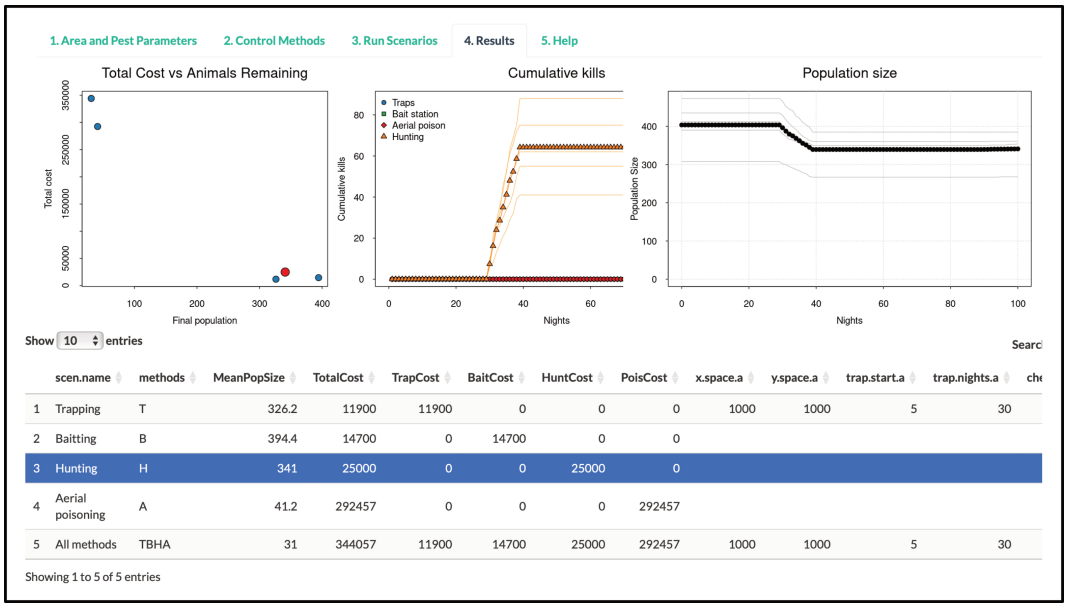


Figure A.8.: Screenshot showing the multiple parameters to be specified under each control method for 'Step 2 – Control Methods' of the Eradication Feasibility decision-support tool.

For hunting and aerial poisoning, the daily probability of an individual being killed needs to be specified; either by defining the distance covered by a hunter per day and the kill rate (i.e. *removal rate*), or by providing the killing percentage for the area. The length of the control operation and the associated costs also need to be specified. For all four control methods, a raster (*mask*) file can be added to the tool to limit the areas where control occurs.

Figure A.9.: Screenshot of 'Step 3 – Run Scenarios' of the Eradication Feasibility decision-support tool. For this example, five alternative scenarios have been defined: one scenario for each individual control method (trapping, baiting, hunting, and aerial poisoning) and one scenario where all of them are simultaneously considered. Note the full table with all the simulation parameters is not shown.



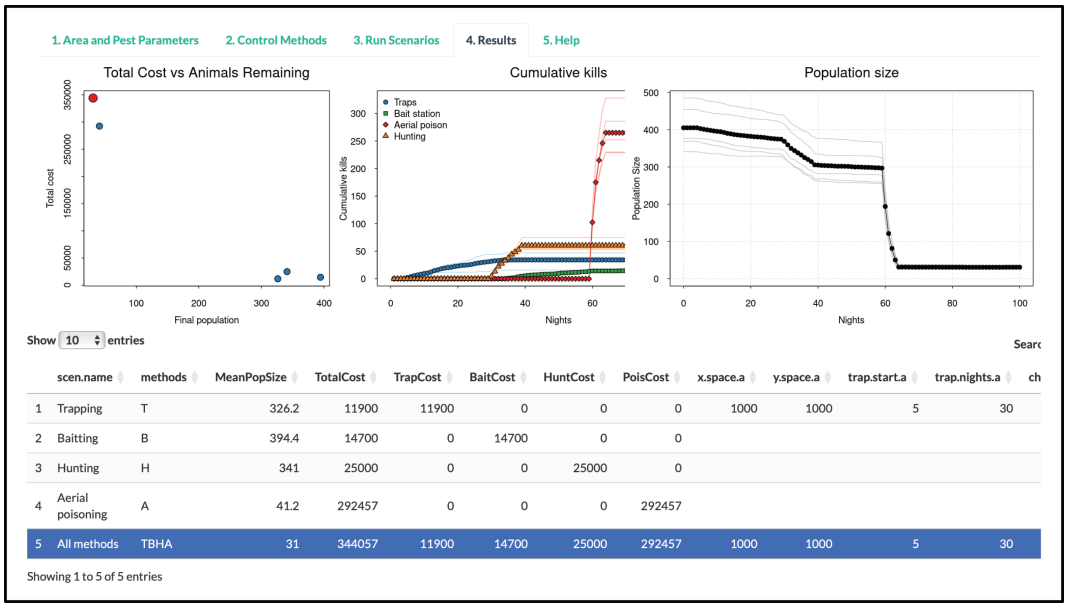
	scen.name	methods	MeanPopSize	TotalCost	TrapCost	BaitCost	HuntCost	PoisCost	x.space.a	y.space.a	trap.start.a	trap.nights.a	che
1	Trapping	T	326.2	11900	11900	0	0	0	1000	1000	5	30	
2	Baitting	B	394.4	14700	0	14700	0	0					
3	Hunting	H	341	25000	0	0	25000	0					
4	Aerial poisoning	A	41.2	292457	0	0	0	292457					
5	All methods	TBHA	31	344057	11900	14700	25000	292457	1000	1000	5	30	

Showing 1 to 5 of 5 entries

Figure A.10.: Screenshot of 'Step 4 – Results' of the Eradication Feasibility decision-support tool, highlighting the outputs of a scenario where hunting is the only control method considered to eradicate a hypothetical pest. While, for this hypothetical exercise, this scenario represents one of the most affordable management options for eradication (first plot, red dot representing this scenario), hunting alone does not achieve a large reduction of the pest population (third plot), with the number of cumulative kills reaching a plateau over time (second plot). This is likely a sign that the control method has stopped working or is not effective at this population size. Note the full table with all the simulation parameters is not shown.

Values for most of the input parameters are likely to differ between pest species, habitats, and control methods, or due to additional factors such as season, population density or individual behaviour.

Once all the parameters have been specified and the user-defined scenarios are built, the simulations must be run for a specific time length (number of days of management) and number of iterations (Fig. A.9). Based on the simulations, the tool generates a series of quantitative outputs for each scenario (Figs. A.10, A.11), including the ratio between total cost and killing efficacy (i.e. mean number of pest individuals remaining in the landscape at the end of the control campaign), the estimated mean number of cumulative kills, and the mean reduction of the pest population size over time. The user can visualise and interpret the outputs from several scenarios at once, and quickly conclude which (if any) of the scenarios resulted in the expected control efficacy within the required budget. Even though the Eradication Feasibility decision-support tool is not intended to provide accurate predictions of residual pest population size, it shows the relative efficacy of each scenario and offers managers insights into the pest-removal process. It also allows for sensitivity testing, providing a way to examine how management outcomes may change depending on the value of specific parameters, which is particularly useful when substantial uncertainty is suspected around one or more parameters used in the simulations.



	scen.name	methods	MeanPopSize	TotalCost	TrapCost	BaitCost	HuntCost	PoisCost	x.space.a	y.space.a	trap.start.a	trap.nights.a	ch
1	Trapping	T	326.2	11900	11900	0	0	0	1000	1000	5	30	
2	Baitting	B	394.4	14700	0	14700	0	0					
3	Hunting	H	341	25000	0	0	25000	0					
4	Aerial poisoning	A	41.2	292457	0	0	0	292457					
5	All methods	TBHA	31	344057	11900	14700	25000	292457	1000	1000	5	30	

Showing 1 to 5 of 5 entries

Figure A.11.: Screenshot of 'Step 4 – Results' of the Eradication Feasibility decision-support tool, highlighting the outputs of a scenario where all control methods are simultaneously considered to eradicate a hypothetical pest. In this hypothetical exercise, this scenario represents the most expensive management alternative (first plot, red dot representing this scenario); however, it also achieves the largest reduction in pest population size (third plot). As with the previous example (Fig. A.10), the concurrent control methods seem to reach a plateau in the cumulative number of kills (second plot), which may indicate low effectiveness of control at low pest density. Note the full table with all the simulation parameters is not shown.

As with the DAFF/CCEPP Microsoft Excel tool, the Eradication Feasibility decision-support tool has the potential to guide decisions regarding feasibility of eradication by answering questions about cost-effectiveness of eradication operations. However, the tool does not guarantee the success of any given eradication strategy. It is for the decision-makers to use this tool and its outputs to make an informed decision regarding feasibility of eradication for a particular pest incursion.

A.2.2. Strengths of the CISS web-based tool

- **Quantitative, objective and action-oriented**

  The Eradication Feasibility decision-support tool is a strong quantitative tool, based on objective estimates related to the species biology and the control methods. It was designed to provide a clear picture of the pest population dynamics given a set of potential management strategies, along with an estimation of the economic cost of each of those management alternatives. Comparing different strategies for pest control can be very insightful for managers tasked with making a decision regarding feasibility of eradication, given that budgets are often limited. It is highly likely that, for any given incursion, decision-makers will be contemplating multiple possible options regarding both the control method/s

and the surveillance method/s. Limiting themselves to a single option, without proper consideration of how feasible the alternatives may be, is a missed opportunity to make wise and cost-effective decision.

- **Clear, informative outputs**

  This tool creates easy-to-understand visual summaries, and provides a clear picture of the cost-benefits associated with different management strategies.

- **Uncertainty is incorporated into the outputs**

  The tool outputs incorporate uncertainty around the population size estimates (but note that costs are fixed; Figs. A.10, A.11). The outputs are produced through a simulation exercise, based on the information provided by the user regarding the pest biology and the efficacy of the control method/s. The simulations can, based on user's preferences, be run multiple times and for as long as necessary (Fig. A.9, Iterations per scenario and Simulation length). In this sense, the tool does not only support incursion emergency response, it can also be used to evaluate theoretical scenarios of incursion and management, which may be key to develop proactive eradication plans before an incursion occurs.

  Providing quantitative parameter estimates related to costs, control efficacy and population dynamics force experts to rely on evidence, rather than their 'gut feeling', and be critical about their values and expectations. Simulations based on quantitative data are, therefore, an excellent method to evaluate the risk around one or multiple eradication scenarios in an objective way.

- **Part of a larger pipeline supporting adaptive management for eradication initiatives**

  The Eradication Feasibility decision-support tool, especially when used along its two sister tools (Fig. A.5, Eradication Progress decision-support tool and Proof of Absence decision-support tool), supports an evidence-based approach for managing pest eradication in a cost-effective way. These tools follow a logical, staged framework (Fig. A.5) to provide near real-time analysis of data that can be used to support decision-making, including refining the control strategy, all the way from the initial pest incursion to complete pest eradication.

- **Openly available**

  The tool is user-friendly and freely available online via its web-based platform. It is tailored for end users and designed as a point-and-click graphical user interface (Fig. A.4). These attributes are likely to increase the tool uptake among stakeholders.

A.2.3. Weaknesses of the CISS web-based tool

- **Key aspects of eradication feasibility are missing**

  The Eradication Feasibility decision-support tool lacks consideration of aspects beyond the pest population dynamic, the control method efficacy and the economic costs. It does not contemplate factors such as the social acceptance or the possible legal impediments for control. Even for those aspects included in the tool, it presents an oversimplified picture of eradication. For example, the tool assumes that the ability to remove the pest is constant regardless of the pest population size. There is no consideration of how likely new incursions may be, given the entry pathway and the possibility (or not) to regulate it. And it does not allow to incorporate dispersal or migration events to describe the pest population dynamic. This latter issue gets circumvented by defining a home range for the pest individuals, which is a good approximation for pests that are vertebrate animals, but unlikely to be representative for other groups. Other type of pests, such as weeds or invertebrates, may require their dispersal ability (via natural and human-mediated vectors) to get factored into their population dynamics for an eradication campaign not to overlook secondary establishment. While increasing the level of biological and operational complexity in the tool would be an option, it would come at the cost of increased difficulty for users and may require further support of quantitative ecologists and the addition of further parameter estimates.

- **Tightly tailored to vertebrate pest incursions**

  Although the developers of the Eradication Feasibility decision-support tool state that the software could be applied generally to any invasive pest eradication response, the general set-up to describe the species demography (Fig. A.6) and the choice of control methods offered in the tool (Fig. A.7; trapping, baiting, hunting, and aerial poisoning) are clearly tailored to vertebrate species. These aspects limit the transferability of the tool to other groups of invasive species, including invertebrate pests, weeds and diseases.

- **Requires detailed information/estimates**

  The simulation of the management scenarios requires a considerable amount of detailed information. For each control method, users are asked to input multiple parameters to quantify the effectiveness to remove pest individuals, the associated costs, and several other logistic aspects (Fig. A.8). Information of this nature is more often than not lacking for pests, and it is particularly rare during the initial incursion response. Therefore, it remains unclear to what degree the Eradication Feasibility decision-support tool has the ability to support decision-making for pest incursions, especially for completely novel pests. The simulations would require using expert knowledge to approximate the estimates and using sensitivity analysis to check the impact of uncertainty.

- **Unable to incorporate input from multiple stakeholders simultaneously**

  Notwithstanding the requirements of the multiple agreements on biosecurity response in Australia (Commonwealth, 2021; AHA, 2023b; PHA, 2025), the tool does not allow to incorporate feedback from several users simultaneously. It does not allow the use of a series of different estimates for each parameter, nor does it allow to provide uncertainty around parameter estimates. Therefore, if multiple experts were involved in decision-making but they disagreed regarding the parameter estimates, they would need to reach an agreement prior to running the simulations (e.g. use the mean value), or they could run parallel simulations and compare the outputs (i.e. sensitivity analysis).

- **Medium- and long-term maintenance**

  The web-based nature of the tool means that it requires ongoing maintenance and curation, both of which rely on sustained funding being available. Currently, the tool is hosted within the Manaaki Whenua Landcare Research institute, which may or may not be a long-term option for maintenance improvements and generally ensuring the functionality of the tool is up to date.

B. Stakeholder engagement

Stakeholders engaged during this project are listed in Table B.1. Invitations to attend the workshop (Chapter 4) were extended across 16 federal, state, and territory government representatives, six industry representatives and a not-for-profit organisation representative (Plant Health Australia). Due to several apologies, the group of participants who ultimately attended the workshop included three academics (CEBRA staff who run the workshop), ten government representatives, one industry representative, and one representative from Plant Health Australia. Invitations to trial the Eradication Feasibility prototype tool via case studies (Chapter 6) were extended across 15 federal, state, and territory government representatives; five industry representatives; and one representative from Plant Health Australia. Out of these 21 stakeholders, 15 participated in the case studies, including nine government representatives, the five industry representatives and the representative from Plant Health Australia.

Table B.1.: Stakeholders invited to attend the workshop organised by CEBRA on October 2024 and/or trial the Eradication Feasibility prototype tool. **DAFF** = Department of Agriculture, Fisheries and Forestry (Australian Government); **AG VIC** = Agriculture Victoria - Department of Energy, Environment and Climate Action (Victorian Government); **DPI NSW** = Department of Primary Industries (New South Wales Government); **DPI QLD** = Department of Primary Industries (Queensland Government); **DNRE TAS** = Department of Natural Resources and Environment (Tasmanian Government); **DPIRD WA** = Department of Primary Industries and Regional Development (Western Australia Government); **PIRSA**= Department of Primary Industries and Regions (South Australia Government); **DAF NT** = Department of Agriculture and Fisheries (Northern Territory Government); **PHA** = Plant Health Australia; **AFPA** = Australian Forest Products Association; **AGW** = Australian Grape and Wine; **AHBIC** = Australian Honey Bee Industry Council; **AOA** = Australian Olive Association Ltd.; **GIA** = Greenlife Industry Australia; **CA** = Citrus Australia.

Stakeholder	Organisation	Gov/ Industry	Attended workshop?	Trialled prototype?
Susie Collins	DAFF	G	Yes	Yes
Liesl Taylor	DAFF	G	Yes	Yes
Brendon Reading	DAFF	G	Yes	Yes
Melissa Dodd	DAFF	G	Yes	No
Suzy Perry	DPI QLD	G	Yes	No
Brett Jackson	DPI QLD	G	Yes	No
Susanna Driessen	DNRE TAS	G	Yes	No
Stephen Dibley	AG VIC	G	Yes	No
Chris Pittock	AG VIC	G	Yes	Yes
Antonette Walford	AG VIC	G	No	Yes
Elisse Nogarotto	AG VIC	G	No	Yes
Mee-Yung Shin	AG VIC	G	No	Yes
Cynthia Kefaloukos	AG VIC	G	No	Yes
Shane Hetherington	DPI NSW	G	Yes	No
Chris Anderson	DPI NSW	G	No	Yes
David Cousins	DPIRD WA	G	No	Yes
Nick Secomb	PIRSA	G	No	Yes
Sally Heaton	DAF NT	G	No	Yes
Rachel Mann	PHA	G	Yes	No
Lily McDonald	PHA	G	No	Yes
Jessica Lye	CA	I	Yes	Yes
Paco Tovar	AFPA	I	No	Yes
Anna Hooper	AGW	I	No	Yes
Danny Le Feuvre	AHBIC	I	No	Yes
John McDonald	GIA	I	No	Yes

C. Eradication Feasibility prototype tool: survey questions

MODULE 1: IDENTIFICATION AND DETECTION OF THE THREAT
In this module, we evaluate the ability to identify and/or diagnose the threat and the ability to detect the threat under current circumstances.
'Ability to identify and/or diagnose the threat' refers to the threat being able to be consistently identified or diagnosed in the field or from collected samples and the resources being available to do this within a reasonable period of time to allow for the implementation of management.
'Ability to detect the threat under current circumstances' refers to the availability of an effective method to determine if the threat is present in the environment, as well as the availability of the resources and expertise to apply this method to the area required to delimit the spread of the threat, including at low densities and when it can have long asymptomatic periods.

1. The threat taxonomy is properly resolved.

   a. Yes, we agree. The taxonomy of the threat is properly resolved: the threat is known to the scientific community, and it has specific and measurable characteristics which clearly distinguish it from all other species.

   b. No, we disagree.

   - The taxonomy of the threat is poorly understood.
   - The threat is known or suspected to be cryptic.
   - The threat is not known or suspected to possess characteristics which clearly distinguish it from all other threats.
   - Other.

   c. Evidence is missing.

2. A consistent and reliable diagnostic test for the threat, as well as any equipment and expertise needed to identify/diagnose the threat, is available or can be sourced in a timely manner.

   a. Yes, we agree. An established and reliable test (that can consistently identify the threat positively from all other species and from the absence of the threat) can be implemented in a timely manner. Equipment and expertise needed to identify/diagnose the threat is also available or can be sourced in a timely manner.

   b. No, we disagree.

   - There is no diagnostic test.
   - Available diagnostic tests are unreliable.
   - The diagnostic test cannot be sourced or implemented in a timely manner.
   - Vital equipment is lacking and cannot be sourced in a timely manner.
   - Appropriately trained staff and/or experts are not available or cannot be gathered in a timely manner.
   - Other.

   c. Evidence is missing.

3. The threat can still be detected despite a possible dormant life stage (i.e. stages during which the threat is inactive or asymptomatic) in its main host, an alternative host, or the soil.

   a. Yes, we agree. The threat has no dormant stage, it has a short dormant stage, or it has a long dormant stage but it can still be detected and controlled.

   b. No, we disagree.

   - The threat has a dormant/asymptomatic stage on the main host.
   - The threat has a dormant/asymptomatic stage on one or more alternative hosts.
   - The threat can survive undetected on the soil.
   - Other.

   c. Evidence is missing.

4. The threat can be detected in the field at low population density.

   a. Yes, we agree. The threat can be detected in the field at low population densities, allowing managers to determine when the threat has been eradicated and when management can be ceased.

   b. No, we disagree. The threat is not detectable at low densities, making it challenging for managers to detect all areas of infestation or to claim eradication success.

   c. Evidence is missing.

5. Freedom from the threat can be reliably achieved shortly after eradication.

   a. Yes, we agree. The threat does not have long asymptomatic stages or hosts during which it cannot be detected, allowing threat freedom to be reliably declared shortly after the eradication attempt.

   b. No, we disagree.

   - It is likely the threat remains undetected for some time after the last known specimens are identified (i.e., long lag time).
   - Reliable estimates of the lag time are lacking, so it is difficult to declare freedom shortly after the eradication attempt.
   - Other.

   c. Evidence is missing.

6. No legal impediments to surveillance exist, or they can be circumvented.

   a. Yes, we agree. Authority is in place for all land tenures. There are no laws, regulations or other legal orders that prevent surveillance officers from accessing and carrying out surveillance on all land suspected to be infested.

   b. No, we disagree. There are legal impediments to access for surveillance, and they cannot be easily circumvented.

   c. Evidence is missing.

7. No physical impediments for surveillance exist, or they can be circumvented.

   a. Yes, we agree. No physical impediments for surveillance exist. There are no environmental or landscape characteristics that prevent access to suspected infested land or that pose health and safety risks which cannot be mitigated effectively.

   b. No, we disagree.

   - Environmental or landscape characteristics prevent access to suspected infested land.
   - Environmental or landscape characteristics pose health and safety risks that cannot be mitigated.
   - Other.

   c. Evidence is missing.

MODULE 2: BIOLOGY OF THE THREAT

In this module, we evaluate the susceptibility of the threat to eradication given its biology. The threat is considered susceptible to eradication if its life history and biological characteristics do not render known management techniques ineffective or result in a reproductive rate that exceeds the ability to apply management to the threat.

8. The threat reproduction rate is slow enough that control measures can reduce the population size.

   a. Yes, we agree. The reproduction rate of the threat is such that control methods can reduce the population size in a timely manner.

   b. No, we disagree.

   - The climate is suitable for reproduction and can lead to an elevated reproductive rate of the threat, e.g. the incursion site has a tropical climate, or the incursion happens at the beginning of the spring/summer months.
   - The threat maturation time is short, which can quickly lead to an increase in the pest population size.
   - The fecundity of the threat (number of offspring or propagules) is high, which can quickly lead to an increase in the threat population size.
   - Other.

   c. Evidence is missing.

9. The threat can survive and reproduce only in one or a few suitable hosts or habitat types – i.e. threat is a host/habitat specialist.

   a. Yes, we agree. The threat has between one and five known suitable hosts/habitats present in the infestation region, and all or most of them are controlled hosts/habitats.

   b. No, we disagree. The threat has at least six suitable hosts/habitats present in the infestation region, including several uncontrolled ones – i.e. the threat is a host/niche generalist.

   c. Evidence is missing.

10. The threat can survive and reproduce only in a narrow range of suitable climatic conditions within the potential area of infestation – i.e. threat is a climate specialist.

    a. Yes, we agree. There is a narrow range of suitable climatic conditions in the potential area of infestation where the threat can survive.

    b. No, we disagree. There is a broad range of suitable climatic conditions in the potential area of infestation where the threat can survive – i.e. threat is a climate generalist.

    c. Evidence is missing.

11. The threat's ability to spread is limited enough that control measures can prevent its spread.

    a. Yes, we agree. The threat has poor ability to spread (either naturally or with human assistance) and/or to reach new hosts. Alternatively, the threat can spread intermediate/long distance, but these processes can be mitigated through management.

    b. No, we disagree.

    - The threat is likely to be spread accidentally by humans (e.g., in infested plant material, contaminated equipment) over intermediate/long distances, in ways that cannot be easily mitigated.
    - The threat is deliberately spread by humans over medium/long distances, in ways that cannot be easily mitigated.
    - The threat spreads medium/long distance by natural processes (e.g. wind dispersal, water movement, animal vectors) that cannot be controlled.
    - Other.

    c. Evidence is missing.

MODULE 3: CURRENT CIRCUMSTANCES OF INFESTATION

In this module, we evaluate whether the environmental conditions or the size, location and intensity of the current infestation leave the threat susceptible to eradication. Current circumstances leave the threat susceptible to eradication if the extent of the management that would be required to manage the threat is practical and likely to be effective.

12. Considering the current area of infestation, the local climate is not suitable for threat survival and reproduction.

    a. Yes, we agree. The local climate at the current infestation site is not believed to be suitable for threat survival and reproduction.

    b. No, we disagree. The local climate at the current infestation site, including its seasonal variation, matches the suitable climatic conditions for threat reproduction and survival.

    c. Evidence is missing.

13. The weather at the infestation site is not suitable for threat survival and reproduction.

    a. Yes, we agree. The weather conditions (rainfall, temperature and humidity) expected at the infestation site in the coming weeks/months are beyond the tolerable range for threat survival and reproduction, so its population growth and spread will be restricted.

    b. No, we disagree. The weather conditions (rainfall, temperature and humidity) expected at the infestation site in the coming weeks/months are within the tolerable range of conditions for threat reproduction and spread.

    c. Evidence is missing.

14. Pest management activities already exist that are preventing or significantly slowing the reproduction and spread of the current threat.

    a. Yes, we agree. Existing management at the infestation site - either in the form of pest control and phytosanitary methods aimed at other threats, or as interim control measures in place since the detection of the current threat – are likely to be successful in limiting the growth and spread of the current threat.

    b. No, we disagree.

    - There are no pre-existing pest management activities in place with potential to slow the reproduction or movement of the threat.
    - There are some interim measures in place or control methods aimed at other threats at the infestation site, but they have had limited success in slowing the reproduction or movement of the current threat.
    - Other.

    c. Evidence is missing.

15. The threat population size is small enough, i.e. few individuals spread across a small area, to make control effort manageable.

    a. Yes, we agree. The threat has a low population size and a restricted extent, which permits effective control.

    b. No, we disagree.

    - The threat's current population size is too large for effective control.
    - The threat population extent is known or expected (e.g. due to extended time since introduction) to be too broad for effective control.
    - Other.

    c. Evidence is missing.

MODULE 4: EFFECTIVENESS OF THE CONTROL METHOD

In this module, we evaluate the effectiveness of the proposed control method. An eradication method is deemed effective when it is legal, kills or removes the threat - including at low threat densities, when the threat is on alternative hosts, or in dormant/asymptotic life stages - and there are suitable resources available to undertake the control method on the scale required for the current infestation.

16. The control method, or combination of methods, is effective at killing or removing the threat - i.e. all individuals are susceptible - across all densities, life stages, and suitable hosts/habitats.

    a. Yes, we agree. The control method is known to be effective under all circumstances outlined above.

    b. No, we disagree.

    - Some individuals of the threat are not susceptible to the control method.
    - The control method loses effectiveness when the threat is at low density.
    - The control method is not effective when the threat is dormant.
    - The control method is not effective when the threat is on an alternative host/habitat.
    - Other.

    c. Evidence is missing.

17. The control method eliminates individuals of the threat faster than the threat can reproduce.

    a. Yes, we agree. The control rate is faster than the threat's reproductive rate.

    b. No, we disagree. The threat can reproduce and grow faster than the control method can eliminate individuals of the threat.

    c. Evidence is missing.

18. There are no legal impediments to implement the control method/s.

    a. Yes, we agree. There are no legal barriers preventing the control method from being implemented over the infested area, and any required permits are available or likely to be granted in a timely manner.

    b. No, we disagree.

    - The control method itself is not legal.
    - Permits required to implement the control (e.g. for chemicals) are missing and not expected to be issued in a timely manner.
    - There is no legal authority to enter all infested or potentially infested land, or to carry out the treatment on that land.
    - Other.

    c. Evidence is missing.

19. There are no occupational health and safety (OHS) impediments to implement the control method/s, or they can be circumvented.

    a. Yes, we agree. There are no occupational health and safety issues that can't be effectively mitigated and result in an unsafe workplace when implementing the control method.

    b. No, we disagree. There are some occupational health and safety impediments that prevent the implementation of the control method.

    c. Evidence is missing.

20. There are no logistic impediments to implement the control method/s, or they can be circumvented.

    a. Yes, we agree. There are no physical obstacles that prevent control methods from being implemented effectively throughout the suspected infestation area, or they can be easily circumvented.

    b. No, we disagree.

    - Terrain ruggedness prevents effective access to the infestation area.
    - Remoteness of the threat population, or parts of it, prevents effective access to the infestation area or implementation of control method.
    - Other.

    c. Evidence is missing.

21. Resources, expertise and technology are readily available to implement the control measures.

    a. Yes, we agree. The resources, expertise and technology needed to implement the control measures are available (in Australia) or can be obtained in a timely manner.

    b. No, we disagree.

    - Vital resources, including products and technology, to implement control measures are lacking, or they are available but not currently in Australia and not expected to be sourced in a timely manner.
    - There is an insufficient number of people who are trained or could quickly become effectively trained to implement the control method.
    - Other.

    c. Evidence is missing.

22. Given the nature of the current infestation, implementation of the control method is unlikely to require an extraordinary amount of effort, time or resources.

    a. Yes, we agree. Eradication attempts of the current threat are expected to involve a tolerable amount of effort, time and resources.

    b. No, we disagree. Eradication attempts of the threat are expected to be too time-consuming, resource-demanding, or generally involve too much effort.

    c. Evidence is missing.

MODULE 5: ACCEPTABILITY OF THE CONTROL METHOD

In this module, we evaluate the acceptance of the control methods. An eradication method is deemed acceptable when it does not have unacceptable impacts on the environment or the industry, or when it is unlikely to be perceived by the public to have impacts on their way of life.

23. The control measures have little or no impact on the environment, and have the endorsement of experts and the public.

    a. Yes, we agree. There are no known or predicted impacts of the control measures on the environment, environmental processes or threatened species that are greater than the predicted impact of the uncontrolled threat.

    b. No, we disagree.

    - Environmental impacts of the control method are likely to exceed those of the uncontrolled threat.
    - There is no general public endorsement of the control method due to environmental impacts.
    - There is no general consensus among experts that the control method is acceptable with respect to environmental impacts.
    - Other.

    c. Evidence is missing.

24. The control measures have little or no impact on public amenity and lifestyle, and have the endorsement of experts and the public.

    a. Yes, we agree. There are no known or predicted impacts of the control measures on public amenity and lifestyle, including cultural activities, that are greater that the predicted impact of the uncontrolled threat.

    b. No, we disagree.

    - Impacts of the control method on public amenity and lifestyle are likely to exceed those of the uncontrolled threat.
    - There is no general public endorsement of the control method due to impacts on public amenity and lifestyle.
    - There is no general consensus among experts that the control method is acceptable with respect to impacts on public amenity and lifestyle.
    - Other.

    c. Evidence is missing.

25. Regardless of the magnitude of their impact on the economy, the control measures have the endorsement of affected industries and economy experts.

    a. Yes, we agree. There are no known or predicted impacts of the control measures on the industry affected by the threat that are greater than the predicted impact of the uncontrolled threat.

    b. No, we disagree.

    - Economy experts have not been consulted.
    - Economy experts have been consulted and they believe the effect of control measures on industry to be greater than the effect of the uncontrolled threat.
    - Affected industries and associated businesses have not been consulted.
    - Impacted industry sectors and associated businesses have been consulted and the majority showed concerns regarding the control method, given its potential economic impacts, compared to the effect of the uncontrolled threat.
    - Other.

    c. Evidence is missing.

MODULE 6: ABILITY TO REGULATE THREAT ENTRY PATHWAY

In this module, we evaluate knowledge around threat entry pathways, and the potential to regulate these pathways. The potential to regulate entry pathways depends on being able to identify the main entry pathway/s with a high degree of certainty, and the resources needed for regulation (e.g. closure of pathways) being less than those needed to manage repeated incursions of the threat.

26. The initial route of entry for the threat is known.

    a. Yes, we agree. The initial pathway through which the threat entered the country is known.

    b. No, we disagree. The initial pathway through which the threat entered the country is unknown, or there is high uncertainty about it.

    c. Evidence is missing.

27. The threat entry pathway/s can be regulated to minimise re-entry of the threat into Australia.

    a. Yes, we agree. Regulations are currently in place to minimise the likelihood of the threat entering through its main entry pathways in the future, or these restrictions can be quickly put in place.

    b. No, we disagree.

    - The main entry pathway is unknown.
    - Effective regulation of the main entry pathway is not feasible.
    - There are multiple entry pathways that cannot be simultaneously regulated.
    - Entry of the threat into Australia happens via natural dispersal.
    - Other.

    c. Evidence is missing.

28. The cost of repeated eradication is acceptable.

    a. Yes, we agree. Costs associated with multiple eradication campaigns are lower than costs associated with pathway regulations and the economic impacts caused by the threat.

    b. No, we disagree. Costs associated with multiple eradication campaigns exceed costs associated with pathway regulations and the economic impacts caused by the threat.

    c. Evidence is missing.

D. Examples of outputs produced by the New Feasibility of Eradication tool prototype

D.1. Individual summary

Example Survey

Assessment Report

Hazard:	Example Hazard
Round:	1
Completed by:	Example User
Completed at:	12/05/2025, 1:10:26 am

How to Read This Report

Response Types

- Favourable (Yes) - The evidence supports a positive assessment
- Unfavourable (No) - The evidence indicates challenges or barriers
- Evidence missing - Insufficient information to make a determination

Module Structure

Each module begins with a donut chart showing response distribution

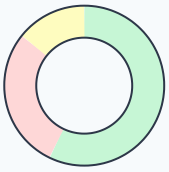
- An introduction explaining the module's purpose
- Detailed responses with supporting evidence
- A module assessment indicating feasibility and confidence

Notes and Evidence

Supporting evidence, general notes, and private notes are provided at the end of the report.

MODULE 1: IDENTIFICATION AND DETECTION OF THE THREAT

In this module, we evaluate the ability to identify and/or diagnose the threat and the ability to detect the threat under current circumstances. 'Ability to identify and/or diagnose the threat' refers to the threat being able to be consistently identified or diagnosed in the field or from collected samples and the resources being available to do this within a reasonable period of time to allow for the implementation of management. 'Ability to detect the threat under current circumstances' refers to the availability of an effective method to determine if the threat is present in the environment, as well as the availability of the resources and expertise to apply this method to the area required to delimit the spread of the threat, including at low densities and when it can have long asymptomatic periods.



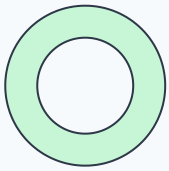
Feasible

Moderate confidence

- ✓ **Threat taxonomy properly resolved.**
- ✗ **Diagnostic test and resources available.**
  - There is no diagnostic test.
  - Available diagnostic tests are unreliable.
- ✓ **Threat can be detected despite dormant life stages.**
- ✓ **Threat can be detected at low density.**
- ? **Freedom can be achieved quickly.**
- ✗ **No legal impediments for surveillance.**
- ✓ **No physical impediments for surveillance.**

MODULE 2: BIOLOGY OF THE THREAT

In this module, we evaluate the susceptibility of the threat to eradication given its biology. The threat is considered susceptible to eradication if its life history and biological characteristics do not render known management techniques ineffective or result in a reproductive rate that exceeds the ability to apply management to the threat.



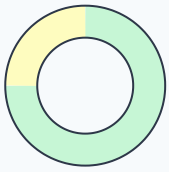
Feasible

Very High confidence

- **Control measures can reduce the threat population size.**
- **Limited suitable hosts or habitat types.**
- **Narrow range of suitable climatic conditions.**
- **Limited spread ability.**

MODULE 3: CURRENT CIRCUMSTANCES OF INFESTATION

In this module, we evaluate whether the environmental conditions or the size, location and intensity of the current infestation leave the threat susceptible to eradication. Current circumstances leave the threat susceptible to eradication if the extent of the management that would be required to manage the threat is practical and likely to be effective.



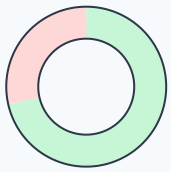
Feasible

High confidence

- **Local climatic conditions unsuitable.**
- **Weather unsuitable.**
- **Pest management activities currently in place.**
- **Threat population size is manageable.**

MODULE 4: EFFECTIVENESS OF THE CONTROL METHOD

In this module, we evaluate the effectiveness of the proposed control method. An eradication method is deemed effective when it is legal, kills or removes the threat - including at low threat densities, when the threat is on alternative hosts, or in dormant/asymptotic life stages - and there are suitable resources available to undertake the control method on the scale required for the current infestation.



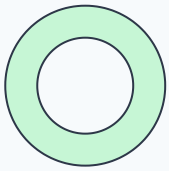
Not Feasible

Low confidence

- ✓ **Control method effective under all circumstances.**
- ✓ **Control method quicker than threat reproduction rate.**
- ✓ **No legal impediments for control.**
- ✗ **No OHS impediments for control.**
- ✗ **No logistic impediments for control.**
  - Terrain ruggedness prevents effective access to the infestation area.
- ✓ **Resources, expertise and technology available.**
- ✓ **Tolerable amount of effort, time and resources needed for control.**

MODULE 5: ACCEPTABILITY OF THE CONTROL METHOD

In this module, we evaluate the acceptance of the control methods. An eradication method is deemed acceptable when it does not have unacceptable impacts on the environment or the industry, or when it is unlikely to be perceived by the public to have impacts on their way of life.



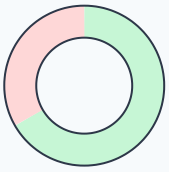
Feasible

Very High confidence

- **Control has no environmental impact and is endorsed by public and experts.**
- **Control has no impact on public amenity/lifestyle and is endorsed by public and experts.**
- **Control is endorsed by industry and economy experts.**

MODULE 6: ABILITY TO REGULATE THREAT ENTRY PATHWAY

In this module, we evaluate knowledge around threat entry pathways, and the potential to regulate these pathways. The potential to regulate entry pathways depends on being able to identify the main entry pathway/s with a high degree of certainty, and the resources needed for regulation (e.g. closure of pathways) being less than those needed to manage repeated incursions of the threat.



Feasible

Moderate confidence

- **Entry pathway known.**
- **Entry pathway can be regulated.**
  - Effective regulation of the main entry pathway is not feasible.
- **Cost of repeated eradication acceptable.**

Notes

Private Notes

This is a private note.

General Notes

This is a note that I'd like to share with other respondents.

D.2. Compiled summary

Example Survey

Combined Assessment Report

Hazard: Example Hazard

Round: 1

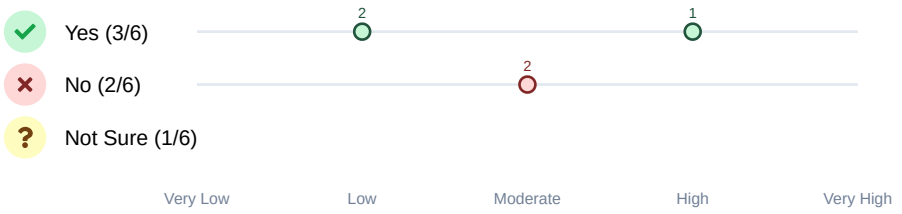
Number of Responses: 6

Generated: 12 May 2025, 11:21 am

How to Read This Report

Response Types and Confidence

For each module, respondents indicate whether they believe eradication of the hazard is feasible, based on the specific criteria being evaluated in that module.



- Yes - Respondents who believe eradication is feasible for this module's criteria, with dots showing their confidence levels. In the above example, 3 respondents answered Yes, 2 of whom had Low confidence, and 1 had High confidence.
- No - Respondents who believe eradication is not feasible based on this module's criteria, with dots showing their confidence levels. In the above example, 2 respondents answered No, and both reported Moderate confidence.
- Not Sure - Respondents who are uncertain about feasibility in the context of this module. In the above example, 1 respondent answered Not Sure. Confidence is not reported for this response.

Question Response Summary

For each question within a module, users' responses are shown as a series of coloured blocks. This visualisation enables users to quickly digest the data and identify disagreement amongst respondents, as well as any hurdles to eradication, by providing a clear and concise representation of responses:

The control method eliminates individuals of the threat faster than the threat can reproduce.

Yes No Not Sure

In this example, there is a split in opinion among respondents: two believe the control method is effective (Yes), two disagree (No), and one is uncertain (Not Sure). This pattern suggests there may be varying experiences with the control method or different interpretations of its effectiveness.

Module Structure

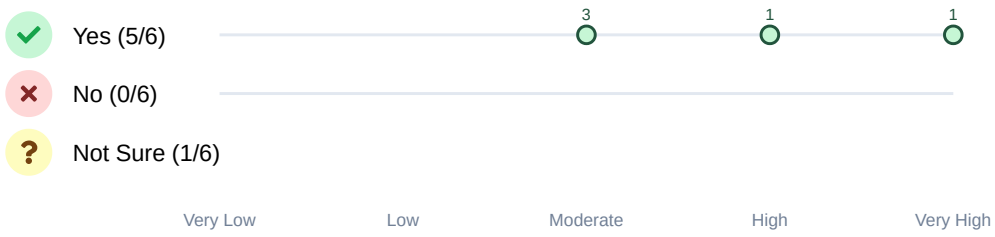
- Each module begins with an introductory section that explains its purpose and context
- This is followed by a feasibility assessment that displays the distribution of responses and their associated confidence levels
- Finally, a detailed breakdown shows responses for each individual question, allowing you to identify areas of agreement and disagreement

Supporting evidence and general notes, if provided by respondents, can be found at the end of this report.

MODULE 1: IDENTIFICATION AND DETECTION OF THE THREAT

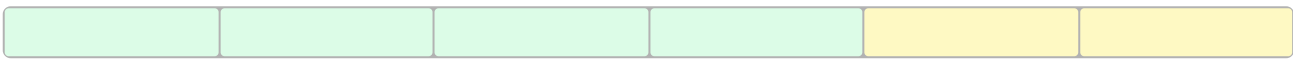
In this module, we evaluate the ability to identify and/or diagnose the threat and the ability to detect the threat under current circumstances. 'Ability to identify and/or diagnose the threat' refers to the threat being able to be consistently identified or diagnosed in the field or from collected samples and the resources being available to do this within a reasonable period of time to allow for the implementation of management. 'Ability to detect the threat under current circumstances' refers to the availability of an effective method to determine if the threat is present in the environment, as well as the availability of the resources and expertise to apply this method to the area required to delimit the spread of the threat, including at low densities and when it can have long asymptomatic periods.

Eradication feasibility and confidence

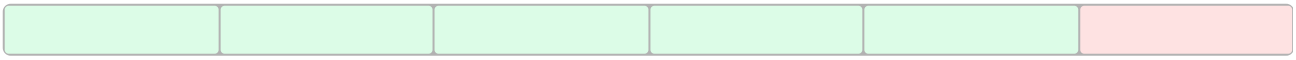


Response summary

Q1. The threat taxonomy is properly resolved.



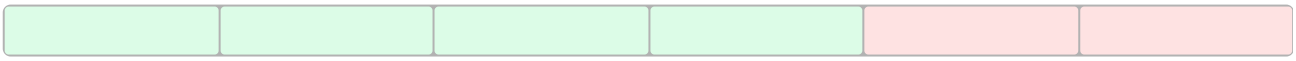
Q2. A consistent and reliable diagnostic test for the threat, as well as any equipment and expertise needed to identify/diagnose the threat, is available or can be sourced in a timely manner.



Reasons for "No" responses:

- There is no diagnostic test. 1
- Available diagnostic tests are unreliable. 1

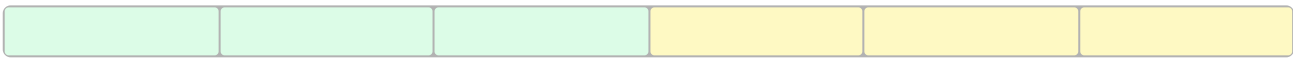
Q3. The threat can still be detected despite a possible dormant life stage (i.e. stages during which the threat is inactive or asymptomatic) in its main host, an alternative host, or the soil.



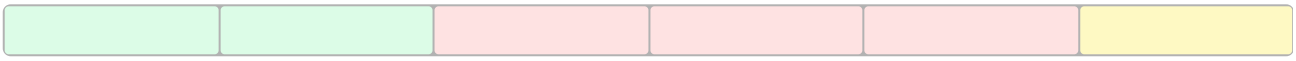
Reasons for "No" responses:

- The threat can survive undetected on the soil. 2
- The threat has a dormant/asymptomatic stage on one or more alternative hosts. 1
- The threat has a dormant/asymptomatic stage on the main host. 1

Q4. The threat can be detected in the field at low population density.



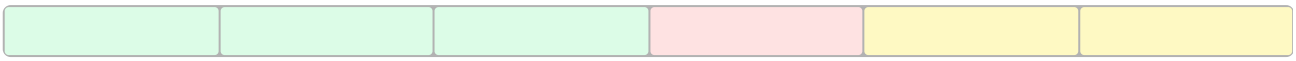
Q5. Freedom from the threat can be reliably achieved shortly after eradication.



Reasons for "No" responses:

- It is likely the threat remains undetected for some time after the last known specimens are identified (i.e., long lag time). 3
- Reliable estimates of the lag time are lacking, so it is difficult to declare freedom shortly after the eradication attempt. 1

Q6. No legal impediments to surveillance exist, or they can be circumvented.

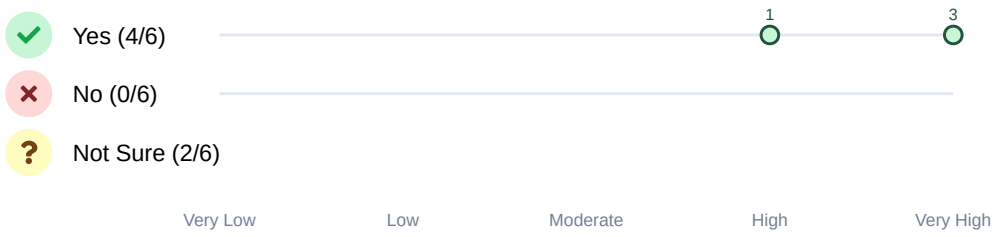


Q7. No physical impediments for surveillance exist, or they can be circumvented.

MODULE 2: BIOLOGY OF THE THREAT

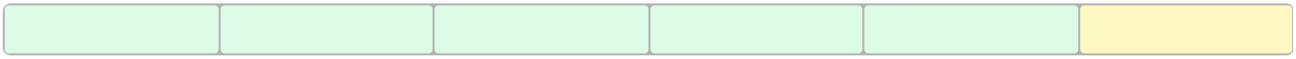
In this module, we evaluate the susceptibility of the threat to eradication given its biology. The threat is considered susceptible to eradication if its life history and biological characteristics do not render known management techniques ineffective or result in a reproductive rate that exceeds the ability to apply management to the threat.

Eradication feasibility and confidence

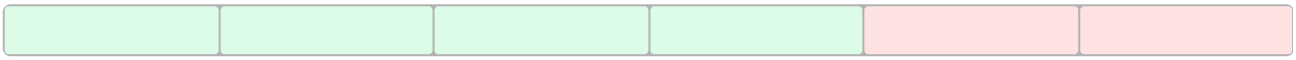


Response summary

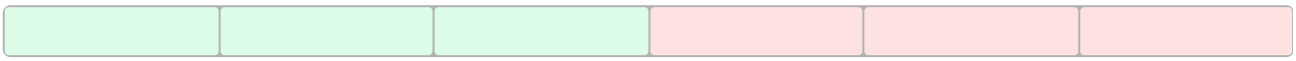
Q8. The threat reproduction rate is slow enough that control measures can reduce the population size.



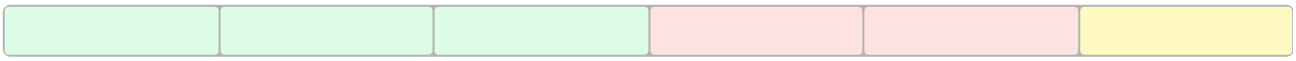
Q9. The threat can survive and reproduce only in one or a few suitable hosts or habitat types -- i.e. threat is a host/habitat specialist.



Q10. The threat can survive and reproduce only in a narrow range of suitable climatic conditions within the potential area of infestation -- i.e. threat is a climate specialist.



Q11. The threat's ability to spread is limited enough that control measures can prevent its spread.



Reasons for "No" responses:

– The threat is likely to be spread accidentally by humans (e.g., in infested plant material, contaminated equipment) over intermediate/long distances, in ways that cannot be easily mitigated. 2

– The threat spreads medium/long distance by natural processes (e.g. wind dispersal, water movement, animal vectors) that cannot be controlled. 2

MODULE 3: CURRENT CIRCUMSTANCES OF INFESTATION

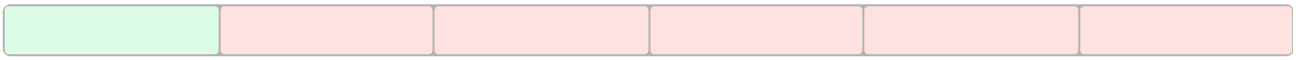
In this module, we evaluate whether the environmental conditions or the size, location and intensity of the current infestation leave the threat susceptible to eradication. Current circumstances leave the threat susceptible to eradication if the extent of the management that would be required to manage the threat is practical and likely to be effective.

Eradication feasibility and confidence

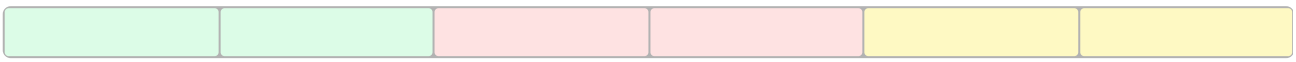
Response summary

Q12. Considering the current area of infestation, the local climate is not suitable for threat survival and reproduction.

Q13. The weather at the infestation site is not suitable for threat survival and reproduction.



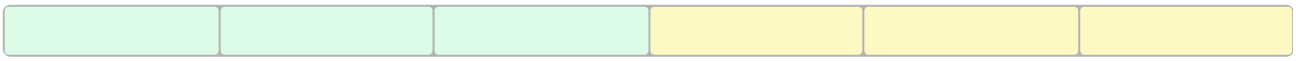
Q14. Pest management activities already exist that are preventing or significantly slowing the reproduction and spread of the current threat.



Reasons for "No" responses:

– There are some interim measures in place or control methods aimed at other threats at the infestation site, but they have had limited success in slowing the reproduction or movement of the current threat. 2

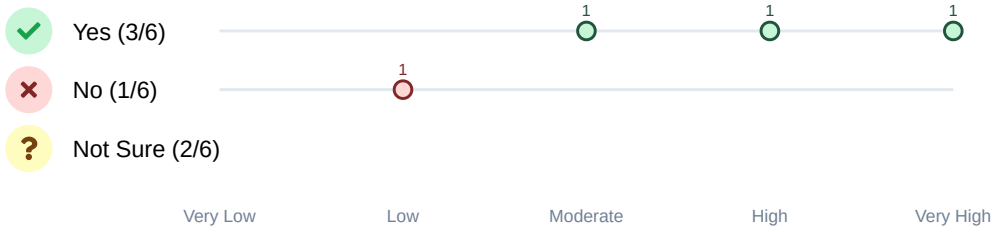
Q15. The threat population size is small enough, i.e. few individuals spread across a small area, to make control effort manageable.



MODULE 4: EFFECTIVENESS OF THE CONTROL METHOD

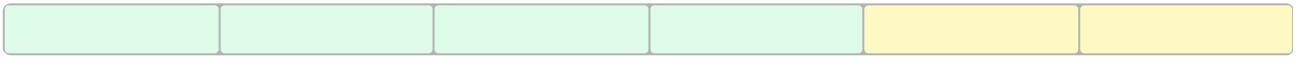
In this module, we evaluate the effectiveness of the proposed control method. An eradication method is deemed effective when it is legal, kills or removes the threat - including at low threat densities, when the threat is on alternative hosts, or in dormant/asymptotic life stages - and there are suitable resources available to undertake the control method on the scale required for the current infestation.

Eradication feasibility and confidence

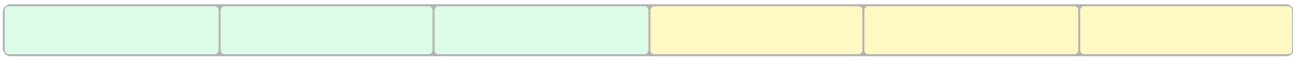


Response summary

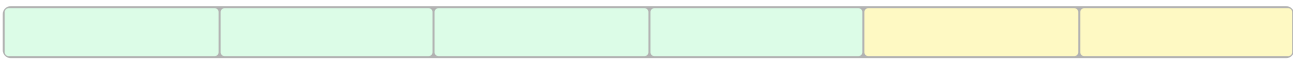
Q16. The control method, or combination of methods, is effective at killing or removing the threat - i.e. all individuals are susceptible - across all densities, life stages, and suitable hosts/habitats.



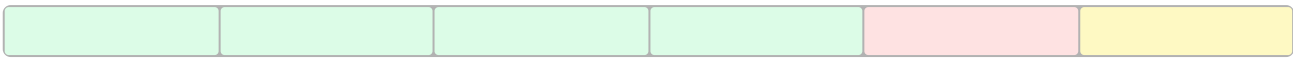
Q17. The control method eliminates individuals of the threat faster than the threat can reproduce.



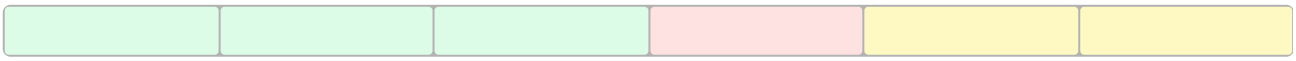
Q18. There are no legal impediments to implement the control method/s.



Q19. There are no occupational health and safety (OHS) impediments to implement the control method/s, or they can be circumvented.



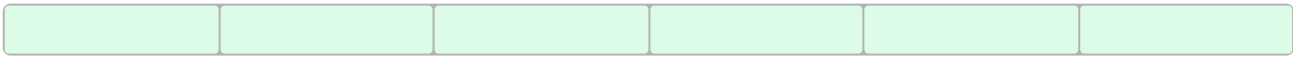
Q20. There are no logistic impediments to implement the control method/s, or they can be circumvented.



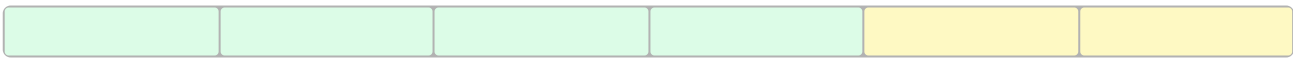
Reasons for "No" responses:

– Terrain ruggedness prevents effective access to the infestation area. 1

Q21. Resources, expertise and technology are readily available to implement the control measures.



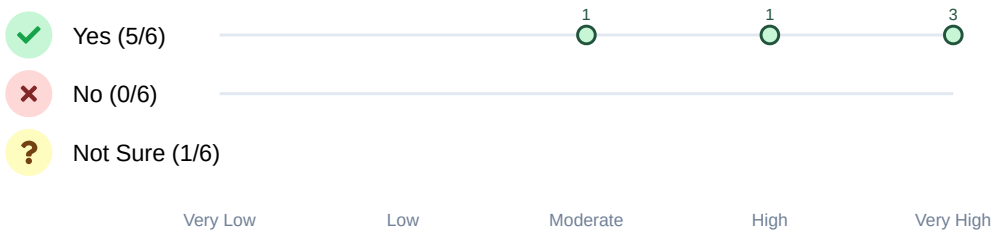
Q22. Given the nature of the current infestation, implementation of the control method is unlikely to require an extraordinary amount of effort, time or resources.



MODULE 5: ACCEPTABILITY OF THE CONTROL METHOD

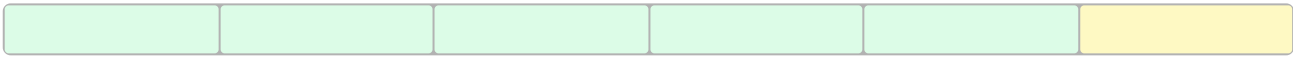
In this module, we evaluate the acceptance of the control methods. An eradication method is deemed acceptable when it does not have unacceptable impacts on the environment or the industry, or when it is unlikely to be perceived by the public to have impacts on their way of life.

Eradication feasibility and confidence

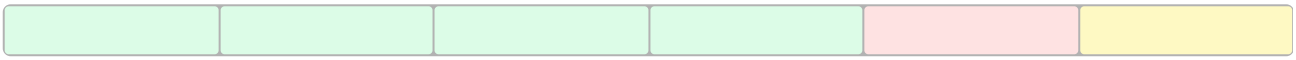


Response summary

Q23. The control measures have little or no impact on the environment, and have the endorsement of experts and the public.



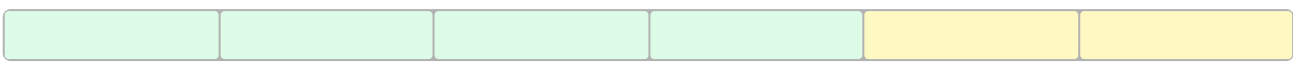
Q24. The control measures have little or no impact on public amenity and lifestyle, and have the endorsement of experts and the public.



Reasons for "No" responses:

– There is no general consensus among experts that the control method is acceptable with respect to impacts on public amenity and lifestyle. 1

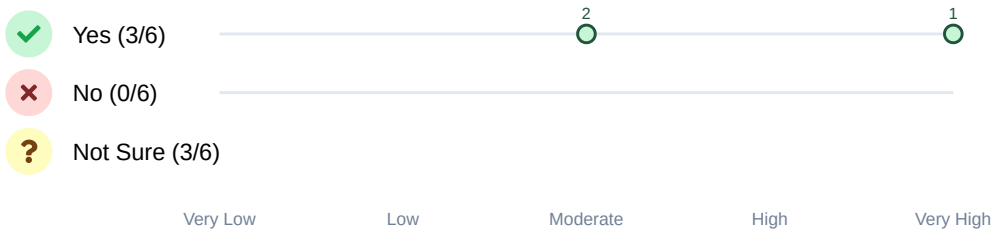
Q25. Regardless of the magnitude of their impact on the economy, the control measures have the endorsement of affected industries and economy experts.



MODULE 6: ABILITY TO REGULATE THREAT ENTRY PATHWAY

In this module, we evaluate knowledge around threat entry pathways, and the potential to regulate these pathways. The potential to regulate entry pathways depends on being able to identify the main entry pathway/s with a high degree of certainty, and the resources needed for regulation (e.g. closure of pathways) being less than those needed to manage repeated incursions of the threat.

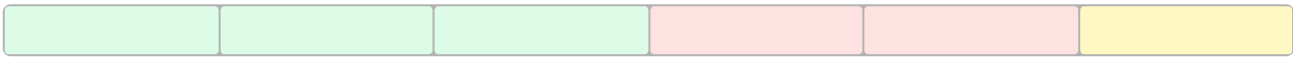
Eradication feasibility and confidence



Response summary

Q26. The initial route of entry for the threat is known.

Q27. The threat entry pathway/s can be regulated to minimise re-entry of the threat into Australia.

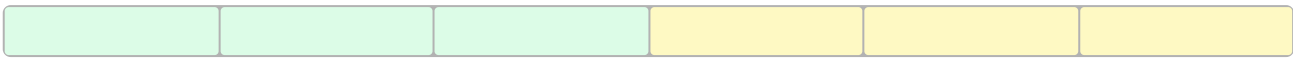


Reasons for "No" responses:

– Effective regulation of the main entry pathway is not feasible. 1

– The main entry pathway is unknown. 1

Q28. The cost of repeated eradication is acceptable.



Respondent Notes

This is a note that I'd like to share with other respondents.

Threat can survive in a narrow climate range, but that range is the whole potential infestation area.

E. Deployment Guide

This guide outlines the steps required to deploy the application on a new Ubuntu server. An up-to-date version of this guide will be maintained in the project repository[1].

E.1. Deployment Scripts

We provide two scripts to automate the deployment process:

- `setup.sh`: First-time server setup script that:
  - Installs system dependencies
  - Sets up directory structure
  - Configures permissions
  - Initialises the environment
  - Performs initial build and database setup
  - Configures SSL/HTTPS with Caddy (optional)
  - Sets up CSRF protection
- `build.sh`: Ongoing deployment script that:
  - Manages application updates
  - Handles backup/restore
  - Manages permissions
  - Controls PM2 processes
  - Supports both production and development environments

[1] https://gitlab.unimelb.edu.au/cebra/2024-2025-projects/24e-technical-feasibility-of-eradication.git

E.2. Initial Server Setup

1. Create a new Ubuntu server (e.g. droplet on DigitalOcean)
2. Set up SSH access and log in as root
3. Install git:

```
apt-get update
apt-get install -y git
```

4. Clone the repository:

```
# Create /var/www directory if it doesn't exist
mkdir -p /var/www
git clone -b docker https://gitlab.unimelb.edu.au/cebra
   /2024-2025-projects/24e-technical-feasibility-of-eradication.
   git /var/www/eradication
cd /var/www/eradication
```

5. Run the setup script:

```
./setup.sh
```

   The script will:

   - Prompt for your application URL
   - Install required system dependencies
   - Set up Node.js, pnpm, and PM2
   - Create necessary directories
   - Configure permissions
   - Set up the environment (you'll be prompted for configuration values)
   - Install dependencies and build the application
   - Initialise the database
   - Configure PM2 for process management
   - Set up SSL/HTTPS with Caddy (optional)
   - Configure CSRF protection based on SSL choice

6. After the setup completes, verify the installation:

```
# Check PM2 process status
runuser -u www-data -- pm2 status

# Check if the application is listening on port 3000
netstat -tulpn | grep 3000

# View application logs
runuser -u www-data -- pm2 logs
```

E.3. Subsequent Deployments

For all future updates, use the build script:

```
sudo ./build.sh eradication      # For production
sudo ./build.sh eradication-dev  # For development
```

The build script will:

- Stop the application
- Back up the current build
- Pull latest changes
- Rebuild the application
- Update permissions
- Restart the application

E.4. Important Notes

- The application runs under the www-data user for security
- All application files are contained within `/var/www/eradication`
- Data persistence:
  - Database: `/var/www/eradication/data/sqlite`
  - Uploads: `/var/www/eradication/data/uploads`
  - Logs: `/var/www/eradication/logs`
  - Backups: `/var/www/eradication/backups`

- The `ecosystem.config.cjs` file configures PM2 to run as www-data
- SSL/HTTPS is configured automatically during setup if chosen
- CSRF protection is automatically configured based on SSL choice

E.5. SSL/HTTPS Configuration

The setup script will automatically handle SSL/HTTPS configuration using Caddy if you choose to enable it. Caddy provides:

- Automatic SSL certificate management
- Automatic HTTPS redirection
- Simple reverse proxy configuration

If you need to modify the Caddy configuration after setup:

1. Edit `/etc/caddy/Caddyfile`
2. Reload Caddy: `systemctl reload caddy`

E.6. Troubleshooting

- Check application logs: `runuser -u www-data - pm2 logs`
- Check PM2 status: `runuser -u www-data - pm2 status`
- Check system logs: `journalctl -u pm2-www-data`
- Check Caddy logs: `journalctl -u caddy`

For more detailed logs, use the `-f` flag to follow the log output:

```
runuser -u www-data -- pm2 logs -f
```

F. Technical Overview

The Feasibility of Eradication Assessment application is a modern web-based platform designed to facilitate systematic evaluation of eradication feasibility for biosecurity hazards. The application implements a comprehensive survey system that enables experts to provide structured assessments while maintaining data integrity and user privacy.

The application is deployed as a Node.js service running under PM2 process management, with a SQLite database for data persistence. It is designed to run behind a reverse proxy (such as Nginx or Caddy) with SSL/TLS encryption. For detailed deployment instructions, including server setup, environment configuration, and security considerations, please refer to the Deployment Guide (Appendix E) in this report.

F.1. Architecture and Technology Stack

At its core, the application is built using SvelteKit, a modern web application framework that balances developer productivity and end-user performance. SvelteKit's component-based architecture enables rapid development while maintaining a clean, maintainable codebase. The framework's built-in routing and server-side rendering capabilities ensure fast page loads and optimal search engine optimisation.

Data persistence is handled through Prisma, a type-safe Object-Relational Mapping (ORM) tool that interfaces with a SQLite database backend. This combination provides robust data integrity while maintaining the flexibility needed for complex survey data structures. Prisma's schema-first approach ensures consistent data modeling and enables automated migration management, crucial for maintaining data consistency across deployments.

The frontend interface is crafted using Tailwind CSS, a utility-first CSS framework that allows for rapid styling while maintaining a consistent design language throughout the application. Custom components extend Tailwind's capabilities to create a cohesive user experience that adapts seamlessly across different device sizes and screen orientations.

For data visualisation, the application leverages the D3.js JavaScript library to create dynamic, interactive data representations. When displaying survey results and trends, this allows users to gain insight through various visual representations of the assessment data.

F.2. Security Architecture

Security is a fundamental consideration in the application design. The authentication system implements a session-based approach, providing a robust security model while maintaining a smooth user experience. Key security features include:

- Content Security Policy (CSP) headers that protect against cross-site scripting (XSS) attacks
- Rate limiting on authentication endpoints to prevent brute force attempts
- Automatic session timeout management with secure session storage
- Strong password requirements with modern hashing algorithms
- CSRF token validation for all state-changing requests

File uploads, which are crucial for supporting documentation in assessments, are carefully controlled through size restrictions and type validation. All uploaded files are securely stored with randomised names and appropriate access controls.

F.3. Logging and Monitoring

The application implements comprehensive logging through Winston, a versatile logging library that provides structured logging with multiple severity levels. Logs are automatically rotated on a weekly basis to maintain system performance and facilitate log analysis. The logging system captures various types of events:

- Authentication attempts and outcomes
- Critical system events and errors
- User actions and data modifications
- Performance metrics and system health indicators

This logging infrastructure is essential for system maintenance and audit purposes, providing administrators with the tools needed to monitor system health and investigate any issues that arise.

F.4. Data Management and Scalability

The application's data architecture is designed with scalability in mind. Database queries are optimised through careful index design and query planning. The system

implements efficient pagination for large data sets, ensuring responsive performance even as the volume of survey data grows.

The application uses a robust data management system to ensure data integrity and reliability:

- **Database**: SQLite database with Prisma ORM for data persistence
- **Backup System**: Automated daily backups with retention policy
- **Data Synchronisation**:
  - Auto-save functionality with debouncing
  - Draft responses saved automatically
  - Change tracking for response modifications
  - Conflict resolution for concurrent edits
- **UI State Management**:
  - Local storage for view preferences and navigation state
  - Survey progress tracking
  - Revision history navigation