Threatened Species Recovery Hub

National Environmental Science Programme

Guidance for deriving 'Risk of Loss' estimates when evaluating biodiversity offset proposals under the EPBC Act

Report to the National Environmental Science Programme
Department of the Environment and Energy

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The University Of Queensland
AUSTRALIA

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Executive Summary

Biodiversity offsets under the EPBC Act

Biodiversity offsets aim to provide a measurable gain to compensate for impacts from development activities on biodiversity. In the context of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), offsets may be required as part of conditions of approval to compensate for residual impacts on Matters of National Environmental Significance (MNES) after avoidance and mitigation measures are taken. Offset actions can include restoration activities to increase the quality of habitat and ecological communities, threat abatement to benefit threatened species or maintain the condition of ecological communities, or securing the tenure status of a site to prevent its loss in the future. Such offset actions are described as 'direct offsets' in the EPBC Act Environmental Offsets Policy (the Offsets Policy). The Offsets Policy is accompanied by the Offsets Assessment Guide (the Guide), which gives effect to the requirement of the Offsets Policy. The Guide uses a balance sheet approach to estimate impacts and offsets for threatened species and ecological communities (but not other MNES).

The role of Risk of Loss in estimating offset benefit

The averted loss component of an offset is the protection of biodiversity that would, if it were not for the offset, be lost at some definable point in the future. Calculating the amount of averted loss achieved under an offset proposal therefore requires an evaluation of the likely outcome at the offset site both without the offset ('business as usual' scenario) and with the offset (for e.g., protection). Averted loss is included in the calculations of two components within the Guide: averted loss of *condition* using the 'quality' score and averted loss of area using the Risk of Loss (ROL) score. This report deals only with estimating the ROL score, which describes the likelihood that the proposed offset site will be lost completely due to anthropogenic impacts such as clearing.

The Guide requires ROL estimates to be included when assessing a direct offset proposal. If an offset proposal estimates a high ROL in the 'without offset' scenario, averting loss of area (an 'averted loss offset') will make a greater contribution to the total offset requirement than if a low ROL is estimated, thereby reducing the remaining offset benefits required. If the ROL is overestimated, it is likely that the full anticipated conservation gains will not occur, and impacts on the threatened species or ecological community will not be adequately compensated. This risks falling short of the Offsets Policy's principle of 'improving or maintaining the viability' of the target threatened species or ecological community. It is therefore crucial that evidence based, robust ROL estimates are derived and used in assessing offset proposals, to ensure that offsets effectively deliver an overall conservation outcome that improves or maintains the viability of the protected matter.

This report

1. Evaluates the advantages and disadvantages of commonly-used approaches to estimate ROL.
2. Places this evaluation in the context of likely outcomes for offset assessments and threatened species and ecological communities under the EPBC Act.
3. Provides guidance on how to calculate credible and robust ROL estimates under various situations.
4. Provides quantified background rates of loss of forest habitat between 2005 and 2014 for each Local Government Area across Australia, and the corresponding ROL estimate based on a 20 year 'foreseeable future' time horizon.

Findings

i. The guidance provided in this report supplements existing guidance contained in the *How to Use the Offsets Assessment Guide* by clearly identifying which factors should be used to calculate Risk of Loss (ROL).

ii. The clarifications we propose reduce the potential for ROL estimates to be overestimated by considering inappropriate influencing factors.

iii. Site-specific approaches to estimating ROL need to be treated with caution. Such approaches can result in indefensible ROL estimates of the 'business as usual' (without offset) scenario, and generate perverse incentives that undermine the effectiveness of offsets under the EPBC Act more broadly.

iv. Where ROL estimates are overstated, the perceived averted loss gain fails to be realised, compromising the 'improve or maintain' principle of the Offsets Policy.

v. Ensuring that ROL estimates are derived based on the 'best practice' guidance provided here will reduce this risk.

vi. The recommended process to calculate ROL estimates retains some limitations (predicting the future is never precise) but it reduces subjectivity, increases fairness, and provides a solid foundation for deriving defensible ROL estimates.

Recommendations

1. **That the decision trees provided in this report be used to guide calculations of ROL estimates** under both 'with offset' (Figure 3, & Table 2) and 'without offset' scenarios (Figure 4 & Table 3).
    a. That credible, robust evidence is provided to support ROL estimates. The robustness of evidence should increase as ROL estimates increase, or in situations where ROL estimates deviate from those recommended in the decision trees, or in Appendix 1.
2. **That greater confidence be placed in ROL estimates calculated following the approach provided in this report than those based on alternative approaches**, and that this greater certainty be reflected in the ROL component of the 'confidence in result' scores entered into the Offsets Assessment Guide.
3. **That consideration is given to whether a proposed offset site contains a threatened species or ecological community, the loss of which would trigger an offset requirement under either the EPBC Act, state/territory, or local government legislation.** This is important because should future development proposals trigger an offset requirement at the proposed offset site, these offset requirements by definition must neutralise the impact of these development pressures. Therefore, development pressures that would trigger an offset requirement under any legislation should not be incorporated into ROL estimates for the proposed offset site.
4. **That background rates of loss estimated from recent observed loss form the basis for ROL estimates.** This is because observed recent rates of loss provide a plausible and objective likelihood of future risk of loss.
5. **That recent background rates of loss based on generic forest deforestation data presented here be used as a proxy background rate of loss for other habitat types** (e.g. non-woody habitats or specific forest types) until such time as habitat specific data becomes available. Using the background rates of loss estimated from forest data is more robust than less objective estimates, but not ideal and should be replaced with habitat-relevant data when robust and reliable habitat-specific data becomes available.
    a. That effort is directed to deriving appropriate background rates of loss for specific ecological communities as reliable data becomes available. This is a priority for those ecological communities and for small Local Government Area (LGAs), LGAs with little woody vegetation remaining, or LGAs where there was no primary forest cover in 1972 and for which interim ROL estimates have been provided in this report.
    b. That a methodology similar to that used in this report to determine background rates of loss for forest habitats is followed when assessing background rates of loss for habitat or ecological communities not provided in this report (i.e. non-forested vegetation cover or habitat).
    c. That background rate of loss figures be refined to exclude loss driven by development that would have triggered an offset requirement, particularly in urban and peri-urban LGAs which are experiencing a high level of pressure from urbanisation. This would allow more accurate risk of loss estimates that accounts for losses that would be neutralised due to legally-required offsets.

Glossary

Averted loss is the estimated amount of expected future loss that is prevented due to the protection and maintenance of habitat. Averted loss within the Guide is calculated under a 'with offset' scenario and under a 'without offset' scenario for both condition (using the quality scores to indicate change in quality) and area (using the Risk of Loss scores to estimate the likelihood of complete loss such as from clearing).

Averted loss offsets secure the protection of a proposed offset site that is currently unprotected and would remain unprotected if it were not for the offset, to prevent its loss in the future. Protection is generally achieved by a change in tenure.

Continuing use rights under the continuing use exemption, assessment and approval under the EPBC Act is not required if:

- the action commenced before 16 July 2000; and
- the use of land, sea or seabed was lawful; and
- the action has continued in the same location without enlargement, expansion or intensification.

Counterfactual the counterfactual describes the alternative scenario where a proposed action does not occur ('business as usual'). The difference between the outcome with the proposed action and the outcome without the proposed action (the counterfactual) is used to describe the benefit that can be attributable to the action. Here the counterfactual describes the Risk of Loss of a proposed offset site under a 'without offset' scenario and is compared to the 'with offset' scenario to estimate the benefit gained by averting loss due to the proposed offset.

the EPBC Act is the *Environment Protection and Biodiversity Conservation Act* (1999).

Foreseeable future under the EPBC Act Environmental Offsets Policy this is either the life of the offset or 20 years, whichever is shorter.

the Guide is the Offsets Assessments Guide that accompanies the EPBC Act Environmental Offsets Policy.

the Offsets Policy is The Environment Protection and Biodiversity Conservation Act (1999) Environmental Offsets Policy (2012).

Prior authorisation under the prior authorisation exemption, assessment and approval under the EPBC Act is not required if:

- before 16 July 2000, the action was authorised by a *specific environmental authorisation* under a law of the Commonwealth, state or a self-governing territory before 16 July 2000; and
- as at 15 July 2000, no further environmental authorisation was necessary to allow the action to be taken lawfully; and
- the specific *environmental authorisation* remains in force at the time the action is taken (in limited circumstances a renewal may satisfy this requirement).

Protected tenure status in this report refers to land either in private or Indigenous tenure that has been both permanently (for at least the same duration as the duration of the impact) and securely (requiring more than one party to alter the agreement) protected for the purposes of conservation either through legal mechanisms (e.g. under control of an Act of Parliament), or via other effective means (including contract, covenant, agreements, or other legal instrument). Protected tenure status can be an effective mechanism by which to reduce Risk of Loss at a proposed offset site, and it is in this context it is applied within this report.

Use rights in this report refers to those activities for which approvals/permits are either not required or have already been obtained. *Potential* use rights in this report refers to those allowable activities which are permitted or controlled by legislation or planning documents, but for which approvals/permits have not yet been obtained. That is, the activity can legally happen (provided the required levels of permission is sought) but this potential is currently not acted upon.

Risk of Loss describes the chance that the habitat on the proposed offset site will be lost completely (i.e. no longer hold any value for the protected or impacted matter) due to anthropogenic drivers. It does not include degradation to the site, or loss due to natural drivers.

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Guidance for deriving 'Risk of Loss' estimates when evaluating biodiversity offset proposals under the EPBC Act

1. Introduction

Estimating the Risk of Loss (ROL) of a proposed offset site is in essence an attempt to predict changes to biodiversity under future unobservable scenarios, and is both a daunting and a difficult task. However, it is an unavoidable one, as all offset approaches that involve protection and maintenance of biodiversity intrinsically require this step (Maron et al. 2015). This process involves comparing a 'with offset' scenario to a 'without offset' (or 'business as usual') scenario (the counterfactual) to estimate the amount of conservation gain an offset would provide. The counterfactual scenario therefore describes the likelihood that the site would be lost completely within the foreseeable future (see Feature Box) should the proposed offset site not be secured, and needs to capture the future trajectory of biodiversity. Counterfactual scenarios are very difficult to estimate, but they are just as important to derive as the 'with offset' scenario when assessing the value of an offset proposal (Maron et al. 2016).

Globally, biodiversity offset policies incorporate assumptions about future trajectories of biodiversity which have a considerable influence on the size of the offset required. These trajectories are typically assumed to be declines, but this is rarely explicitly described within policies (Maron et al. 2013, Maron et al. 2015). This is problematic because these assumptions have a direct influence on the outcome for biodiversity matters of concern.

1.1 Averted loss offsets and the importance of plausible counterfactual scenarios

A combination of averting loss of area (averted loss offsets) and restoration activities can be used to achieve conservation gain via a biodiversity offset (Figure 1). Restoration activities are aimed at creating new or improving existing habitat while averted loss offsets are secured via legal mechanisms that maintain biodiversity value or change the tenure status (e.g. conservation covenants or incorporating new areas into existing reserve networks) in order to protect existing habitat that is otherwise unprotected. In taking this action the potential future loss of unprotected habitat may be averted. The extent to which loss is averted by an offset action at a specific site is determined by describing the risk that the site will be lost in the future and the ability of the offset action to alleviate this risk. Calculating this ROL therefore provides a methodology to help quantify the value of averted loss offsets and the thus the conservation gain.

What does 'lost completely' in the foreseeable future mean?

The ROL score within the Offsets Assessment Guide captures only complete loss (i.e. no longer hold any value for the protected or impacted matter) that is attributable to anthropogenic drivers.

It does **not** include:

- Loss due to natural events (e.g. drought, storm events, wild fire, outbreaks of disease, insect induced dieback).
- Degradation of condition.

Consideration of factors which cause degradation to a site are captured separately under the Quality score within the Offsets Assessment Guide. This includes degradation of a site due to existing land use pressures (e.g. stock grazing, fertilisation, water extraction) that will eventually lead to the functional loss of the site.

The **foreseeable future** under the EPBC Act Environmental Offsets Policy is either the life of the offset or 20 years, whichever is shorter.

This report deals only with estimating the risk of complete loss.

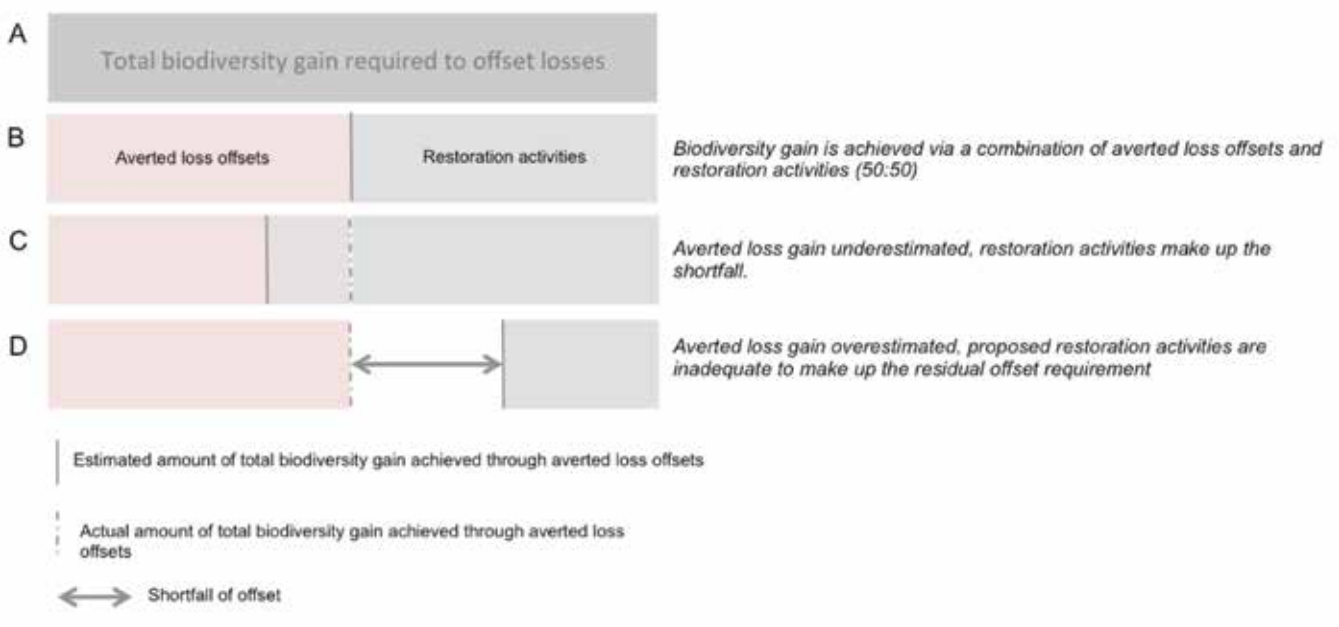

Figure 1: *The influence of Risk of Loss estimates on the total biodiversity gain achieved via an offset. Panel A shows the total biodiversity gain required to adequately offset loss. This gain can be achieved via a combination of averted loss calculated using ROL estimates (red bars) and restoration activities (grey bars), which make up the residual offset requirement (e.g. Panel B). In Panel C the averted loss gain has been estimated (solid line) to be less than what would actually be gained (dashed line). In this situation, the offset is more than adequate as averted loss offsets and restoration activities overlap (red and grey striped area). Underestimation of averted loss gains has implications for the cost incurred by the proponent. In Panel D gains achieved via averted loss offsets have been estimated to be greater than what would actually be gained. As a consequence, the residual component made up of restoration activities is underestimated and the total offset is inadequate to compensate for losses (by the magnitude indicated by the arrow). Overestimation of ROL therefore leads to more biodiversity loss and entrenching trajectories of decline.*

Averted loss offsets are appealing as they reduce the requirement to rely on highly uncertain restoration gains (Maron et al. 2012). Compared to the complexities, uncertainties, expense, and long timeframes associated with restoration efforts, changing tenure status is a relatively straight-forward and inexpensive process. There are however, risks associated with averted loss offsets. Averted loss offsets can only legitimately be claimed where proposed offset sites are genuinely under threat of clearance within the time period that ROL is being evaluated. Where there is no threat of loss, there is no loss to avert (Gordon et al. 2011, Maron et al. 2013), and a genuine conservation gain cannot be delivered. This illustrates the importance of describing counterfactual scenarios as accurately as possible.

A key concern with the use of offsets under the EPBC Act prior to 2012 was a reliance on delivering offsets through the protection of existing, previously unprotected, habitat. The EPBC Act Environmental Offsets Policy (the Offsets Policy) was designed to direct offset proposals that protected habitat away from protecting land that was not under threat of loss (Miller et al. 2015). However, inflated ROL estimates based on unrealistic counterfactual scenarios undermines this intent, by resulting in averted loss claims that are not experienced in reality. Consequently, offset proposals can fall short of adequately compensating for losses resulting from the development impact. As a further consequence, unrealistic counterfactual scenarios not only lead to offsets that under-compensate for losses, they become self-fulfilling by 'locking in loss' (Maron et al. 2015). This is because averted loss offsets are predicated on the assumption of continuing decline (without which there would be no loss to avert), and thus averted loss offsets at best only return biodiversity to the rate of decline prior to the impact (Moilanen & Laitila 2015; Maron et al. 2016). **Overestimating the trajectory of decline will guarantee further biodiversity losses.**

Under the EPBC Act's Offset Policy a biodiversity offset may be required as part of conditions of approval to compensate for residual impacts on Matters of National Environmental Significance (MNES) such as the Endangered Carnaby's Black Cockatoo. Image: Maksym Polyakov

Averted loss gains should in fact be more difficult to achieve under the Offsets Policy than previously considered to be the case, as (i) much development induced clearing of habitat will itself require an offset; and (ii) the actual risk of loss is usually considerably smaller than the values used in practice (Maron et al. 2015). **Greater gains for MNES can more credibly be made via offset actions that improve condition of habitat and ecological communities and abate threats to species persistence.**

1.2 Risk of Loss estimates under the EPBC Act Environmental Offsets Policy

Section 3 of the Offsets Policy includes ten overarching principles that are to be applied in determining the suitability of offset proposals. The first of these principles is to:

> *"deliver an overall conservation outcome that improves or maintains the viability of the aspect of the environment that is protected by national environmental law and affected by the proposed action"*

Offset sites can therefore either be sites that currently contain the target threatened species or ecological communities, sites that, through offset actions (e.g. creation or restoration of habitat, or threat abatement) will contain the target threatened species or ecological communities in the future, or sites that contain other values, protection of which will contribute to improving or maintaining the viability of the target threatened species (e.g. forage habitat or breeding habitat).

The Offsets Assessment Guide (the Guide) has been designed to give effect to the Offsets Policy and to assist in evaluating the appropriateness and adequacy of proposed offsets while ensuring that the proposed offset *"improves or maintains the viability of protected matter as compared to what is likely to have occurred under the status quo, that is if neither the action nor the offset had taken place"*.

The Guide includes a number of calculations across several components to evaluate offset proposals. **One** of these components is the ROL score (Figure 2 overleaf).

In what situations would development not require an offset?

A development proposal would not trigger an offset requirement under the EPBC Act when:

1. *The site where the development is to occur is a:*

- Ecological community (habitat) not listed as a threatened ecological community, and not providing habitat for a threatened species listed in the EPBC Act.
- Threatened ecological community listed as 'Vulnerable' in the EPBC Act.
- Threatened ecological community listed in the EPBC Act as 'Critically Endangered' or 'Endangered' but which does not meet stated Condition Classes or Condition Thresholds.

and/or

2. *Situations where:*

- Continuing use rights exist (s.43B).
- A prior authorisation exemption applies (s43A).
- Impacts of the proposed development are below the threshold for significance (as defined in the significant impact guidelines).

However, an offset requirement under **any** legislation influences the ROL at a proposed offset site, and offset requirements under state/territory legislation or local government legislation also need to be taken into account. See Section 3.1.

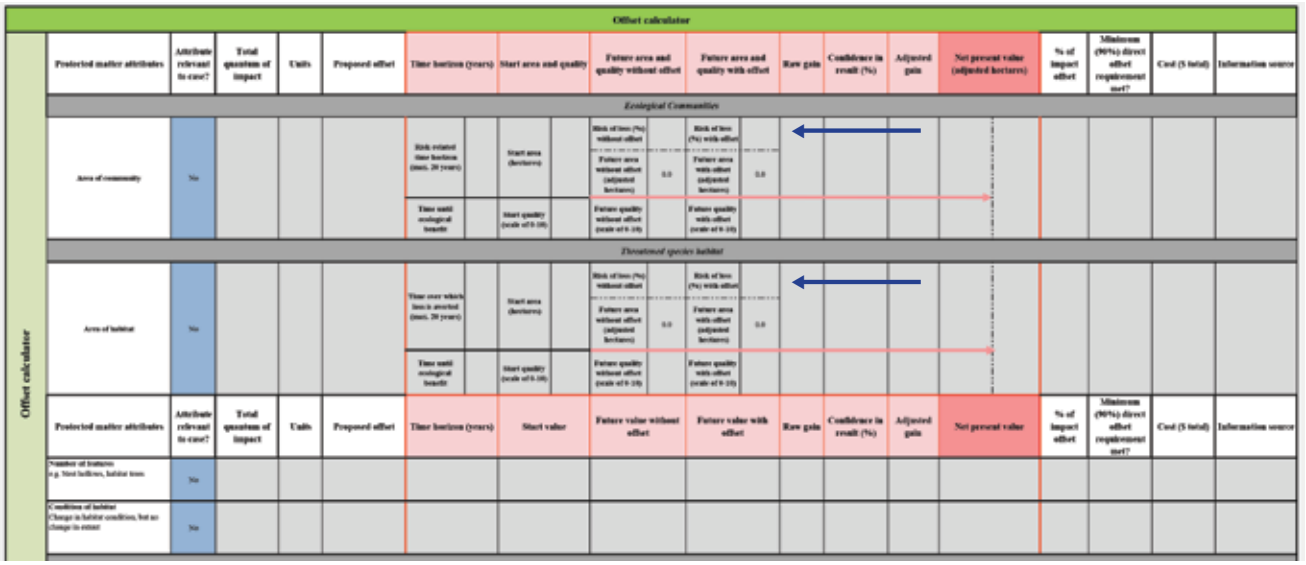

Figure 2: Screen shot of the offset calculator section of the Guide, showing the entry point for ROL estimates (blue arrows) for both with and without offset scenarios. Note that ROL estimates are entered separately to the 'quality' and 'confidence in result' scores.

The *How to Use the Offsets Assessment Guide* defines ROL as:

> *The risk of loss is a percentage figure that describes the chance that the habitat on the proposed offset site will be completely lost (i.e. no longer hold any value for the protected matter) over the foreseeable future (either the life of the offset or 20 years, whichever is shorter).*

A ROL estimate is required for both the with offset and without offset scenarios in order for the Guide to calculate the amount of biodiversity gain via an averted loss that the proposed offset offers.

The Guide accompanying the Offsets Policy is underpinned by scientifically robust method (Gibbons et al. 2015, Miller et. 2015). However, there are difficulties in deriving credible ROL estimates. Inflated ROL estimates undermine the conservation gains delivered by offsets at the site scale, and risk further imperilling species which are already highly threatened. The use of implausibly high ROL values reduces overall offset policy effectiveness, and can entrench biodiversity decline across the landscape at a higher rate than historically observed (Maron et al. 2015). There are also considerable equity implications, as inaccurate ROL estimates can have significant impacts on the share of costs borne by proponents, regulators, and the Australian public for threatened species protection. In the absence of clear guidance, the estimation of ROL can become a largely subjective exercise influenced more by negotiation between parties than defensible evidence. Critically, the risk of perverse outcomes increases with the degree of inaccuracy in the ROL estimate.

Key Points

In reading this report there are several key points to keep in mind:

- This report deals only with the ROL score within the Guide, which is just one component of the Guide. Readers should also be familiar with the broader guidance for using the Guide, especially the existing *How to Use the Offsets Assessment Guide* documentation.
- The ROL score does not include consideration of habitat condition or certainty about the success of the proposed offset — these aspects are dealt with separately within the Guide under the 'quality' and 'confidence in result' scores.
- The ROL score also does not take into account the suitability of the proposed offset site. This report assumes that all considerations related to site suitability have been assessed.
- ROL estimates only account for complete loss (not degradation) due to anthropogenic causes within the foreseeable future and not natural causes of loss (see feature box on page 1).
- The Guide only evaluates suitability of proposed offsets to compensate for impacts on the viability of threatened species or ecological communities (as listed in the EPBC Act) and not other MNES.

1.3 The need for 'best practice' guidelines in deriving Risk of Loss estimates

Some guidance on estimating ROL is available to users of the Offsets Policy and the Guide, but the Department of the Environment and Energy (DotEE) has identified that independent guidance for 'best practice' in deriving ROL would be useful to reduce the risk of negative consequences and improve transparency, consistency, and robustness in ROL estimates. Provision of this advice has subsequently become a component of the approved Phase 1 of the 'Better offsets for threatened species' project (Project 5.1), of the Threatened Species Recovery Hub's research programme, funded by the National Environmental Science Programme (NESP).

This guidance was developed following a workshop with DotEE staff, elicitation of structured feedback on the factors typically incorporated into ROL estimates, and a review of actual ROL estimates from recent approved offset proposals obtained from DotEE.

2. Factors commonly used to estimate Risk of Loss

The current guidance document *How to Use the Offsets Assessment Guide* suggests that:

There are a number of factors that could influence the ROL of a site, including:

- *presence and strength of formal protection mechanisms currently in place on the proposed site (e.g. zoning, restrictive covenants or state vegetation clearing laws);*
- *presence of pending development applications, mining leases or other activities on the proposed offset site that indicate development intent and likelihood; and*
- *average risk of loss for similar sites.*

While this guidance informs which factors may influence ROL, there is currently little indication of in which circumstances (and why) these factors would apply. Documentation provided by the DotEE suggest that the factors used to estimate ROL vary between teams, assessment officers, and projects. It was not uncommon to include factors listed above to estimate ROL, but other factors were also used including:

- documented background rates of loss;
- site specific variables such as proximity to existing settlement, land form, production potential of underlying soils; and
- stochastic events (e.g. drought, storm events, wild fire, outbreaks of disease, insect induced dieback).

The rationale used to derive ROL estimations have been inconsistent across projects and states/territories. The extent of documented or explicitly stated evidence for ROL estimates provided by proponents also varied between projects. Given the lack of guidance, access to information, and time restraints, assessment officers face a difficult task in validating ROL estimates put forth by proponents.

An assessment of the social and technical advantages and disadvantages of incorporating the above factors into ROL estimates, and the theoretical consequences for biodiversity outcomes of doing so is provided in Table 1 overleaf.

Table 1: Social and technical advantages and limitations of common practices used in estimating risk of loss and the theoretical consequences for biodiversity outcomes.

Common practices when estimating risk of loss	Advantages	Limitations	Consequences for biodiversity outcomes
Use of background rates of loss	Based on data; removes subjectivity from estimates; reduces the ability to implausibly inflate averted loss gains. The ability to determine current extent from remote sensing techniques is improving. Data can be regularly updated.	Relies on past clearance rates to estimate future clearance rates. Data availability limited in some places, for some habitat types, or at some resolutions (e.g. grasslands and wetlands).	More realistic estimates of biodiversity gains.
Consideration of protected tenure status	Provides a credible indication of protection that would reduce the risk of clearance in the future.	Small losses or loss of threatened species or ecological communities not protected by legislative offset requirements may still occur where the activities leading to such losses are not prevented by the mechanism of tenure protection.	More realistic estimates of biodiversity gains.
Incorporating use rights (e.g. as evidenced by development approval documents; mining licences etc.) or potential use rights (e.g. as implied by permitted vegetation clearance; zoning for development) into ROL estimates	Attempts to account for site-specific likelihood of loss.	Future development of proposed offset sites containing threatened species or ecological communities are likely to trigger an offset requirement which neutralises the impact of this development, thus there would be no loss to avert. Elevating risk of loss under a without offset scenario based on the possibility that clearance can happen can lead to site-level engineering of ROL estimates that does not reflect the true likelihood of loss as evidenced by rates of loss at the landscape level, and creates incentives to increase the risk to individual sites with a view to increasing biodiversity gains claimed.	For sites containing threatened species or ecological communities whose clearance would trigger an offset requirement, biodiversity gains are claimed where none exist. For sites where ROL is calculated based on potential use rights, biodiversity gains are overstated.
Incorporating site-specific variables into ROL estimates (e.g. production potential of underlying soils; proximity to existing settlement etc.)	Attempts to account for site-specific likelihood of loss.	Where incorporated alongside background rates of loss, can inflate the ROL estimate by double-counting the influence of biophysical and geographical drivers of loss as these factors are implicit in background rate of loss figures. This is because such factors are typically drivers of rates and patterns of clearance (e.g. rates of loss have historically been greater in areas with productive soils than in areas with less productive soils).	Biodiversity gains are overstated.
Incorporating probability of stochastic events into ROL estimates (e.g. drought; storm events; wild fire; outbreaks of disease; insect induced dieback)	Attempts to recognise complexity of drivers of loss at the site-scale	This approach is outside the current guidance on estimating ROL scores in the Guide as only anthropogenic causes of loss, and not stochastic events, are listed as being a relevant factor for calculating ROL estimates. In addition, it is extremely difficult to accurately predict both likelihood and severity of events, thus estimates based on stochastic events are likely to have a high degree of uncertainty.	Stochastic events will be equally likely under both the with offset and without offset scenario. Therefore, the same risk estimate would be applied to both scenarios and there would be no influence on calculated biodiversity gains.

3. Recommendations for deriving Risk of Loss estimates

3.1 At what spatial scale is Risk of Loss assessed?

The How to Use the Offsets Assessment Guide clearly defines ROL as the chance that the habitat on the proposed offset **site** will be completely lost. However, how ROL scores are estimated can require consideration of risk both at the site and the landscape scale. This is because the Guide requires ROL to be **estimated** for both the with offset and the without offset scenario — both of which are not yet observed, and one of which will never be observed. Considering landscape scale risk does not change the definition of ROL, but rather provides a means by which to estimate defensible counterfactual scenarios.

Where the scenario cannot be observed (the counterfactual scenario), ROL can be estimated based on typical, recent patterns of loss at the landscape level, at sites similar to the one under consideration. An assumption that the ROL at the site will be similar to that of other similar sites in the landscape is more objective, robust, and consistent than guessing or negotiating a site-specific outcome for an unobservable scenario. For example, ROL estimates for the foreseeable future for a site under a without offset scenario can be derived using background rates of loss of habitat for the area where the site is located.

Landscape scale evaluation is also introduced to ROL estimates when considering whether future clearance of the proposed offset site would trigger an additional offset requirement under either the EPBC Act, state/territory legislation, or local government legislation. This is because while the impacted values (e.g. threatened species or ecological communities) may be lost from the proposed offset site within the foreseeable future, this loss would be neutralised at the landscape scale in cases where this loss would itself trigger an offset requirement. Thus, an averted loss cannot be claimed in these situations as any future loss would be accounted for. Applying this concept is critical to avoiding overestimating averted loss offsets and when evaluating the ability of the proposed offset to meet the 'improve or maintain' principle of the Offset Policy. *Incorporating this concept into ROL estimates is further detailed in Section 3.2.*

When is state/territory or local government legislation relevant to assessing Risk of Loss for a proposed offset site under the EPBC Act?

The Offsets Policy is triggered when a development proposal is likely to significantly impact on a threatened species or ecological community listed in the EPBC Act. State/territory or local government legislation is not relevant at this stage of the assessment and approval process and does not apply to the impact site.

However, state/territory or local government legislation is relevant when estimating ROL at the proposed *offset site*. This is because offset requirements under any legislation contribute to the ability of an offset proposal (as per the EPBC Act's Offset Policy) to meet the 'improve or maintain' principle of the Offset Policy.

NOTE:

The *How to Use the Offsets Assessment Guide* provides a list of suggested factors to incorporate into ROL estimates (see Section 2). These suggestions are not equally applicable to all proposed offset sites. This section clarifies which factors should be incorporated into ROL estimates, when, and why.

REMINDER:

Some development proposals will not require an offset and some proposed offset sites will not trigger an offset requirement. See page 3.

In these situations, **Situation Two** is relevant.

3.2 What factors should be included in Risk of Loss estimates?

When considering the ROL of a proposed offset site, it is important to determine whether future impacts to the proposed site will already be subject to any form of regulatory protection that would likely require an offset. This includes protection under the EPBC Act, state/territory legislation, or protection under local council legislation. This is because the factors to include when estimating ROL are different for sites that trigger such protection than sites that do not; as follows:

*Situation One: Factors to use for estimating Risk of Loss when clearance of a proposed offset site **triggers** an offset requirement*

If the proposed offset site contains a threatened species, ecological community, or other Matter of National Environmental Significance that is protected under either the EPBC Act, state/territory, or local government legislation, the loss of the protected value from the offset site would be subject to a separate assessment and approval process and would likely require an offset. This requirement neutralises the influence of development pressures. In such situations, only two factors are relevant for deriving ROL:

- background rates of loss; and
- protected tenure status.

Situation Two: Factors to use for estimating Risk of Loss when clearance of a proposed offset site ***does not trigger*** *an offset requirement*

When is it appropriate to include site-specific factors that indicate pending development applications or development approvals into ROL estimates?

Evidence of pending development applications can be relevant factors to include in ROL estimates in situations where the offset site is not subject to any form of regulatory protection that would require an offset (as described in Situation Two). Such factors are not relevant in situations where any future loss would trigger an offset requirement under any legislation (Situation One).

Less commonly, a proposed offset site might not contain a threatened species, ecological community, or Matter of National Environmental Significance protected under the EPBC Act, state/territory legislation, or local government legislation. In this situation future loss of the site would not require a separate assessment and approval process, and therefore would not require an offset.

Such a site could still be an appropriate offset for the impacted matter, for example where:

- it is feasible to create new habitat for a threatened species,
- restoration effort will be invested to improve habitat quality to meet the criteria for a particular ecological community in the future, or
- the site contains a value that is not protected under any legislation but which contributes to the viability of the impacted matter (e.g. forage habitat, tree hollows), and the protection of which would represent a biodiversity gain.

In these cases the following factors (which are currently captured in the *How to Use the Offsets Assessment Guide*) are likely to be relevant for making ROL estimates:

- background rates of loss;
- protected tenure status; and
- presence of pending development applications or development approvals.

3.3 Recommendations for Risk of Loss estimates

Guidance on calculating appropriate ROL estimates is provided for both with offset scenarios (Figure 3 & Table 2), and without offset scenarios (Figure 4 & Table 3). Both Figures 3 & 4 include ROL estimates for the range of potential offset sites, including sites not currently comprising a matter protected under the EPBC Act (e.g. degraded sites, or non-listed habitat).

Accounting for uncertainty in Risk of Loss scores

Confidence in ROL score under *without offset* scenarios is not formally captured within the Offsets Assessment Guide. However, if the recommendations within this report are followed, we suggest that there can be greater confidence in ROL scores than if ROL scores are derived outside of these recommendations.

For *with offset* scenarios, uncertainty in ROL scores can be captured within the 'confidence in result' score within the Guide which describes the level of certainty about the success of the proposed offset.

For the area of community and area of habitat attributes entered into the Guide, the confidence in result score relates to:

- **change in habitat quality:** the level of certainty about the successful achievement of the proposed change in quality; and
- **averted loss:** the level of certainty about the strength and effectiveness of the proposed risk-mitigation measures, and the capacity of these measures to mitigate the risk of loss of the site.

It is within the averted loss component of the confidence in result score that uncertainty or concern regarding the ability of protected tenure status to reduce ROL for a proposed offset site can be captured.

Adjusting the confidence in result score is preferable to adjusting the ROL estimates from those recommended in this report.

Further detail on the confidence in result score is provided in the *How to Use the Offsets Assessment Guide*.

Key principles to consider when estimating Risk of Loss

These principles underpin the guidance provided for estimating ROL under with offset scenarios (Figure 3 & Table 2) and under without offset scenarios (Figure 4 & Table 3) and will provide a useful guide when calculating ROL for situations not accounted for in this report.

Principle 1: An offset (triggered by any legislation including the EPBC Act, state/territory legislation, or local government legislation) neutralises a loss, so a threat to a potential offset site that would, if it occurred, itself trigger an offset, should be excluded from consideration of ROL.

Principle 2: When calculating ROL estimates, protected tenure status over a proposed offset site should be considered in the context of its effectiveness at reducing ROL. Effectiveness of the protection mechanism to meet other criteria (e.g. that for 'private protected areas' within the Australian National Reserve System) are not relevant for ROL. However, other considerations of the protection mechanism maybe relevant to include elsewhere in the Guide. For example, where grazing is an allowable activity within a protected area the future condition of the proposed offset site under such a covenant would be captured in the 'quality' score of the Guide.

Principle 3: Taking into account *Principle 2*, it is assumed that securing protected tenure status will reduce ROL at a proposed offset site to below the background rate of loss. This is because the risk of loss within protected areas is likely slower than the risk of loss outside protected areas. In situations where tenure status is not adequate to prevent all development pressures due to certain activities remaining allowable, *Principle 1* and *Principle 4* should be taken into account. If there is remaining uncertainty or concern regarding the ability of protected tenure status to reduce ROL for a proposed offset site, this can be accounted for within the 'confidence in result' score in the Guide. Adjusting the confidence in result score is preferable to adjusting the ROL estimates from those recommended in this report.

Principle 4: Where use rights (see glossary) exist over a proposed offset site (that is, there is no legislative mechanism to prevent development pressures), the likelihood of such pressures actually occurring needs to be considered. Just because development *can* happen does not mean it *will* happen. Claims of intention to develop need to be plausible and supported by credible evidence (see box page 15).

Biodiversity offsets have been used to compensate for residual impacts on the Critically Endangered Swift Parrot. Image: Heather W. FlickrCC

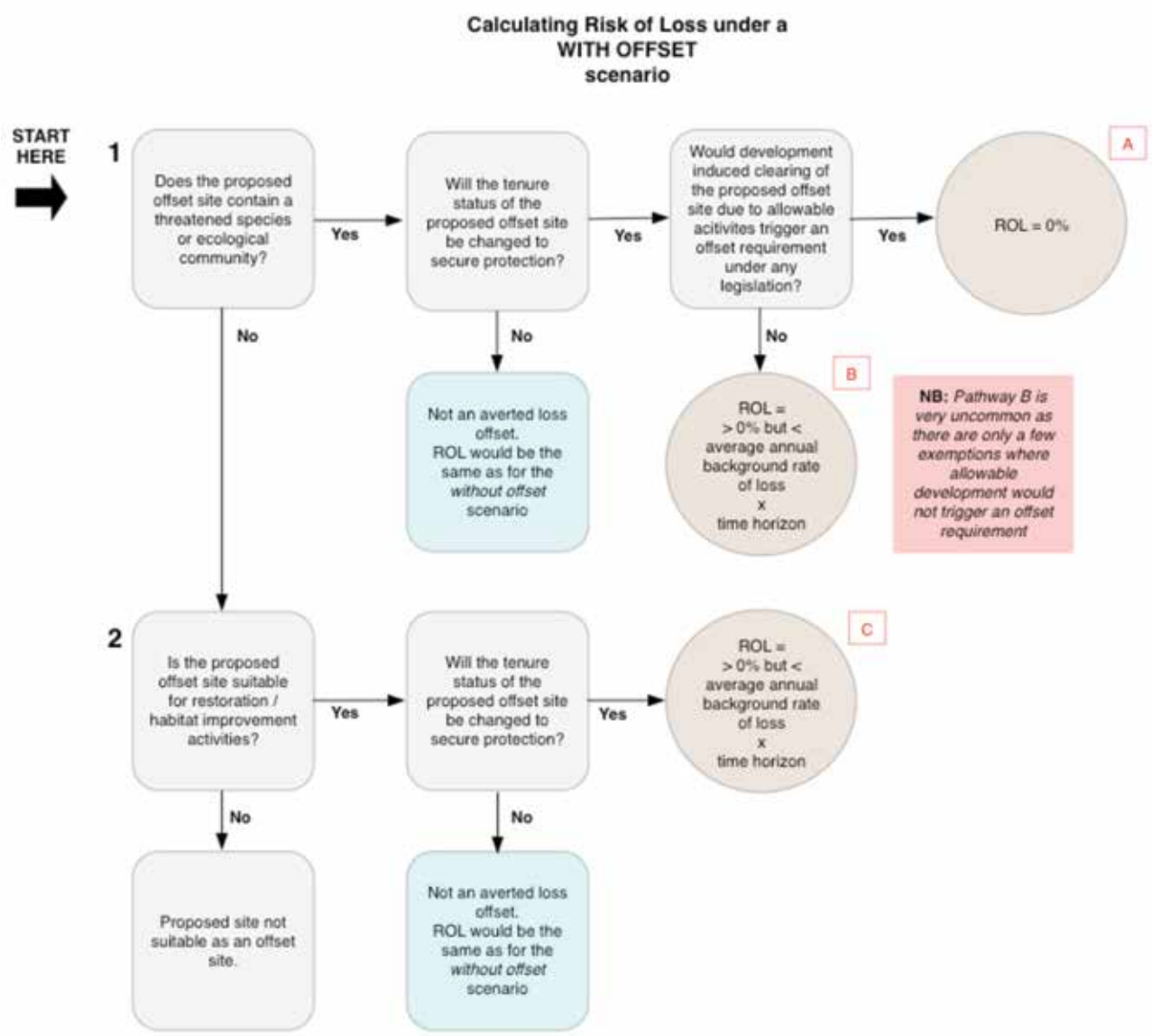

Figure 3: Decision tree for calculating Risk of Loss under a with offset scenario. Each pathway (identified by the red letters) is further explained in Table 2.

Reference for Table

To calculate the ROL score, the average annual rate at the chosen resolution is multiplied by the time period over which ROL is being estimated. For the examples provided in Table 2 & Table 3, the resolution used to calculate rates of loss = Local Government Area boundaries; and the time period = 20 years (the maximum time defining the 'foreseeable future' under the EPBC Act). Thus, the background rate of loss within the relevant LGA is multiplied by 20 years. *Average annual background rates of loss between 2005–2014 by Local Government Area (LGA) are provided in Appendix 1.*

Table 2: Explanation for the recommended Risk of Loss (ROL) for the with offset scenarios as mapped in Figure 3.

The ROL recommendations for the **with offset scenarios** are predicated on the assumption that the proposed protection mechanism is effective in reducing the ROL from what it would be *without* the protection. If it is considered that the proposed protection mechanism does not meet this assumption, then the ROL score entered into the Guide should be the same as the ROL score entered for the without offset scenario. In these cases there would be no biodiversity gain via averting loss, and other offset actions (e.g. threat abatement or habitat improvement) would need to be relied on to fulfil the offset requirement in full.

Pathway (as mapped in Figure 3)	**Recommended Risk of Loss**	**Explanation**	**Example**
1. Proposed offset site contains an EPBC Act listed threatened species or ecological community			
A. • Proposed offset site contains an EPBC Act listed threatened species or ecological community, AND • tenure status will be changed to secure protection of the proposed offset site, AND • allowable development (not prevented by the protection mechanism) would trigger an offset requirement.	0%	Any allowable development (i.e. that not prevented by the protection mechanism, such as mineral exploration or extraction) would trigger an offset requirement and therefore the risk of any future loss is neutralised.	An area of Central Hunter Valley Eucalypt Forest and Woodland (Critically Endangered) in Cessnock, NSW, protected tenure status will be secured via a BioBanking Agreement under the *Threatened Species Conservation Act 1995* (NSW). ROL with offset = 0% over 20 years.
B. • Proposed offset site contains an EPBC Act listed threatened species or ecological community, AND • tenure status will be changed to secure protection of the proposed offset site, BUT • allowable development (not prevented by the protection mechanism) would not trigger an offset requirement.	> 0% but < average annual background rates X time horizon	**This situation is very uncommon** as there are only a few exemptions where allowable development would not trigger an offset requirement. *For examples of development proposals that would not trigger an offset see the feature box on page 3.* In these occasional cases a reasonable ROL would be > 0% but < the average annual background rate of loss multiplied by 20 (to obtain ROL over 20 years) in recognition that protected tenure status will reduce the ROL, but some residual risk remains which is neither removed via the proposed protection mechanism or neutralised via an offset requirement. In such situations it is plausible for ROL to be high, however the supporting evidence needs to be robust and indisputable. See feature box on page 15.	An area of habitat for Forest Red-tailed Black- Cockatoo (south-eastern) (Endangered) in Denmark, Western Australia, protected tenure status will be secured via the Western Australian Conservation Commission under management of the Western Australian Department of Parks and Wildlife. However, requirements to offset future development that would otherwise be triggered would not be in this example due to continuing use rights in existence at the offset site. ROL with offset = 2% over 20 years (the average annual background rate of loss for Denmark = 0.17. In this example rate of loss was considered to be 0.1 and multiplied by 20 years).
2. Proposed offset site is suitable for restoration / habitat improvement but does not contain an EPBC Act listed threatened species or ecological community			
C. • The proposed offset site is suitable for restoration / habitat improvement offset actions, AND • tenure status will be changed to secure protection of the proposed offset site.	> 0% but < average annual background rates X time horizon	In these cases, a reasonable ROL would be > 0% but < the average annual background rate of loss multiplied by 20 (to obtain ROL over 20 years) in recognition that protected tenure status will reduce the ROL, but some residual risk remains which is neither removed via the proposed protection mechanism or neutralised via an offset requirement.	Less than 1 ha of Lowland Native Grasslands of Tasmania ecological community in Southern Midlands, Tasmania protected with a Conservation Covenant under the *Nature Conservation Act (2002)*. ROL with offset = 2% over 20 years (the average annual background rate of loss for Southern Midlands = 0.28. In this example rate of loss was considered to be 0.1 and multiplied by 20). **NB:** In this example we have used the background rates of loss informed by forest deforestation data (Appendix 1) as a proxy for background rates of loss of Lowland Native Grasslands in the absence of objective, robust, habitat-specific data pertaining to native grasslands. We recommend habitat extent and change over time data be obtained to more accurately inform background rates for non-forest habitats.

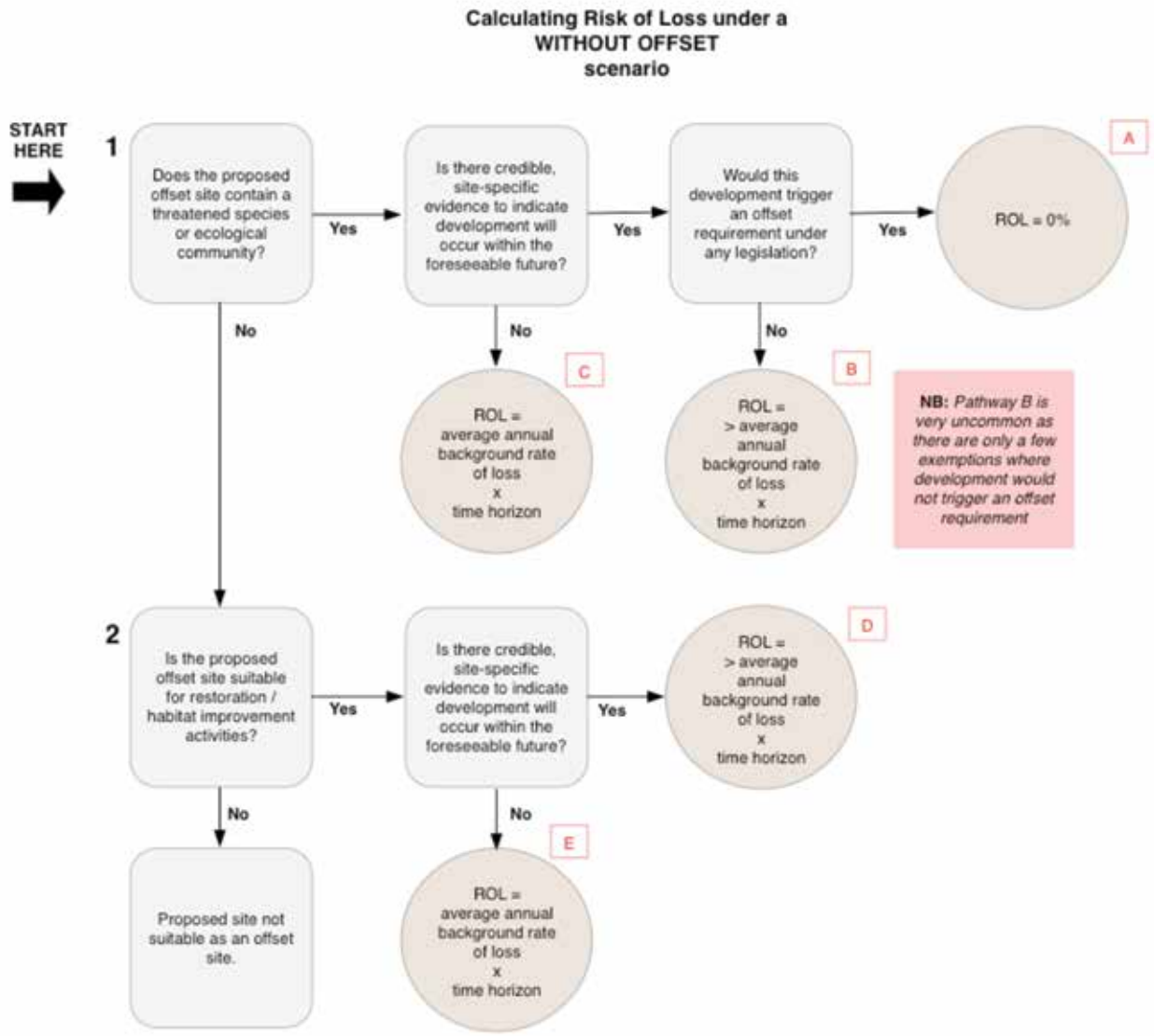

Figure 4: Decision tree for calculating Risk of Loss under a without offset scenario. Each pathway (identified by the red letters) is further explained in Table 3.

In the example provided to illustrate Pathway B in Table 2, securing protected tenure status will be used as the offset action to avert future loss of habitat for the Endangered Forest Red-tailed Black-Cockatoo. Image: Andy. FlickrCC

Table 3: Explanation for the recommended Risk of Loss (ROL) for the without offset scenarios as mapped in Figure 4.

Pathway (as mapped in Figure 3)	**Recommended Risk of Loss**	**Explanation**	**Example**
1. Proposed offset site contains an EPBC Act listed threatened species or ecological community			
A. • Proposed offset site contains an EPBC Act listed threatened species or ecological community, AND • credible evidence exists to indicate development will occur at this particular site within the foreseeable future in the absence of the offset action, BUT • this development would trigger an offset requirement	0%	Any future development at the proposed offset site would trigger an offset requirement and therefore the risk of any future loss is neutralised.	Habitat for Carnaby's Black Cockatoo (Endangered) in Coorow, Western Australia, site subject to residential development proposal. ROL without offset = 0% over 20 years.
B. • Proposed offset site contains an EPBC Act listed threatened species or ecological community, AND • credible evidence exists to indicate development will occur at this particular site within the foreseeable future in the absence of the offset action, BUT • this development would not trigger an offset requirement	> average annual background rates of loss X time horizon	**This situation is very uncommon** as there are only a few exemptions where development would not trigger an offset requirement. *For examples of development proposals that would not trigger an offset see the feature box on page 3.* In this situation, ROL is elevated above the average annual background rate of loss as credible evidence is available proving that the site will be lost within the foreseeable future as there are no mechanisms in place to either reduce (e.g. legal protection) or neutralise (offset requirement) this risk. In such situations it is plausible for ROL to be high, however the supporting evidence needs to be robust and indisputable. See feature box on page 15.	Natural Temperate Grassland of the Victorian Volcanic Plain Ecological Community (Critically Endangered) in Moyne, Victoria, property has prior authorisation to crop (exempting the site from EPBC Act requirements). ROL without offset = >2.45% over 20 years, but in proportion to the likelihood that cropping will occur. **NB:** In this example we have used the background rates of loss informed by forest deforestation data (Appendix 1) as a proxy for background rates of loss of Lowland Native Grasslands in the absence of objective, robust, habitat-specific data pertaining to native grasslands. We recommend habitat extent and change over time data be obtained to more accurately inform background rates for non-forest habitats.
C. • Proposed offset site contains an EPBC Act listed threatened species or ecological community, AND • there is no credible evidence to indicate development will occur at this particular site within the foreseeable future.	average annual background rates of loss X time horizon	As there is no evidence to suggest that the ROL to the site will be any greater than other sites in the landscape, the background rates of loss for the relevant LGA can be used to calculate ROL.	Habitat for Swift Parrot (Critically Endangered) in Wagga Wagga, New South Wales, no evidence exists to indicate development will occur at this particular site within the next 20 years. ROL without offset = 1.9% over 20 years.

Table 3: Explanation for the recommended Risk of Loss (ROL) for the without offset scenarios as mapped in Figure 4. (continued)

Pathway (as mapped in Figure 3)	Recommended Risk of Loss	Explanation	Example
2. Proposed offset site is suitable for restoration / habitat improvement but does not contain an EPBC Act listed threatened species or ecological community			
D. • The proposed offset site is suitable for restoration / habitat improvement offset actions, AND • credible evidence exists to indicate development will occur at this particular site within the foreseeable future in the absence of the offset action.	> average annual background rates of loss X time horizon	In this situation, ROL is elevated above the average annual background rate of loss as credible evidence is available proving that the particular site will be lost within the foreseeable future (in the absence of the offset action), and as clearance of the site would not trigger an offset requirement. In such situations it is plausible for ROL to be high, however the supporting evidence needs to be robust and indisputable See feature box on page 15.	Young Brigalow regrowth in Banana, Central Queensland subject to regular, permitted, clearance for agricultural activity. ROL estimates will be subject to frequency of clearance. For example, where all regrowth is less than 20 years old, a ROL between 90 and 100% is plausible. Older regrowth present in the landscape would indicate that clearance within 20 years is less certain and a lower ROL is more credible. Age frequency of regrowth habitat in the landscape can be used to inform ROL estimates in such cases.
E. • The proposed offset site is suitable for restoration / habitat improvement offset actions, AND • there is no credible evidence to indicate development will occur at this particular site within the foreseeable future.	average annual background rates of loss X time horizon	As there is no evidence to suggest that the ROL to the site will be any greater than other sites in the landscape, the background rates of loss for the relevant LGA can be used to calculate ROL.	Degraded area of habitat formerly part of the White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grasslands ecological community in Wellington, Victoria. ROL without offset = 6.85% over 20 years.

Supporting Risk of Loss estimates with specific, credible, and robust evidence

This report provides recommended ROL estimates for various situations under both *with* and *without offset* scenarios. Increasing ROL above background rates of loss is recommended in only a few situations, e.g. pathway B under a *with offset* scenario, and pathways B & D under a *without offset* scenario, although both 'B' pathways will be very uncommon (Figures 3 & 4 and Tables 2 & 3). In these cases, and in any situation where a proposed ROL deviates from ROL estimates recommended here, evidence is required to provide the justification for not following the recommendations. Evidence needs to be **credible, robust**, and **site-specific** and adequate to clearly describe the likelihood of development occurring at a **particular offset site**.

Credible, robust, and site-specific evidence reduces the uncertainty associated with the predicted likelihood under *without offset* scenarios that the stated development will occur within the time horizon. When reliable evidence is not available, the ROL score for the proposed offset site **should not** exceed the background rate of loss for the relevant LGA.

For *with offset* scenarios, documentation needs to be sufficient to ensure confidence that the proposed protection mechanism will be secured at the proposed offset site. When reliable evidence to this effect is not available, the ROL score for the proposed offset site should be the same as the ROL estimate for that particular site under a *without offset* scenario.

When evaluating evidence to support ROL estimates, four key points should be considered:

1. *The evidence needs to illustrate not just that the action **can** occur, but describe the **likelihood** that it will occur **at the particular site** within the time horizon. For example, illustrating that a given development activity is allowed within planning legislation is not adequate to describe the likelihood that the activity will happen at the proposed offset site.*
2. *Evidence needs to be **specific to the proposed offset site**. For example, illustrating that mining activities are common in the surrounding landscape is not adequate evidence to describe the likelihood that mining will occur at the proposed offset site.*
3. *The requirement for site-specific evidence at a particular offset site should not be interpreted as an incentive to generate threats in order to claim a greater amount of averted loss. This would create perverse outcomes (over inflating ROL) and set precedents for unrealistic ROL estimates. Evidential documents should be reflective of a genuine likelihood of development at the particular offset site, and not merely obtained to inflate risk.*
4. *Evidence should be documented and publically available, wherever possible.*

Under the EPBC Act's Offset Policy an offset may be required as part of conditions of approval to compensate for residual impacts on Matters of National Environmental Significance (MNES) such as Central Hunter Valley Eucalypt Forest and Woodland ecological community. Image: Tony Rodd. FlickrCC

4. Determining background rate of loss

For any habitat or vegetation cover, the background rate of loss is calculated by assessing the average annual rate of loss between two points in time at a specified resolution of detection. This average rate of loss provides a useful, if imperfect, prediction of likely future rates of loss that can be used to estimate ROL. It is also important that the habitat / vegetation cover captured by the assessment is also clearly described to provide clarity on what the background rate of loss applies to. Below we discuss the temporal horizon and resolution recommended to assess ROL within the Guide.

Section 4.3 describes the methodology used to calculate rates of loss of forest habitats between 2005 and 2014 as used in this report to estimate background rates of loss (Appendix 1).

4.1. Temporal horizon

The ROL assessment is an attempt to estimate a plausible prediction of the rate of biodiversity loss for the foreseeable future. Therefore, background rates of loss need to be assessed over a historical period of time where land use patterns and drivers of loss can reasonably be assumed to mirror the likely scenario for the 'foreseeable future' (20 years under the EPBC Act Environmental Offsets Policy). Where distinct changes in drivers of loss can be identified, this would mark a sensible point in the past from which to evaluate rates of loss. Otherwise, a temporal horizon of 10 years prior to the present is recommended to be long enough to establish a reliable trend in the data while excluding more historic patterns of loss that are less likely to reflect future patterns of loss (Maron et al. 2015).

4.2. Resolution

The resolution at which background rates of loss are derived is important. Too broad a resolution is less likely to provide a realistic estimate for a site. Too fine a resolution can also introduce inaccuracies, and occurs at a scale that invites negotiating a rate of loss at a site that deviates from the background rate of loss. This would reintroduce subjectivity and bias into the process of estimating ROL. It also risks introducing incentives to manipulate rates of loss — a perverse outcome that is much less likely when information from the broader landscape, not just a single property, is considered. Therefore, choosing the resolution at which to calculate background rates of loss requires a balance between retaining accuracy whilst maintaining objectivity. It is recommended that Local Government Area (LGA) boundaries provide a suitable level of resolution.

4.3. Methodologies used to calculate background rates of deforestation of forest habitats between 2005 and 2014

Change in forest extent was measured for the most recent ten-year period available—between 2005 and 2014—using forest extent and change imagery derived from Landsat MSS, TM & ETM+ satellite imagery (Australian Department of the Environment, 2015), as described in Evans (2016) and Maron et al. (2015).

'Forest' is defined as:

> *woody vegetation with at least 20% canopy cover, reaching, or with the potential to reach, at least 2 m high, covering an area of at least 0.2 ha*

Forest change events were attributed to human intervention, meaning that 'natural' forest change due to factors such as fire (and associated recovery), dieback, salinisation, drought and seasonal flushing were removed (Furby, 2002).

We first re-classified the forest change imagery to separate where clearing had occurred for the first time (primary deforestation), and where regrowth vegetation was cleared. It was assumed that forest extent in 1972 (the earliest year in the data set) was all primary vegetation. We then deducted the amount of primary deforestation from the forest extent layers in each year, resulting in an estimate of primary forest remaining in each Local Government Area (LGA) from 1972–2014. Using a national land use dataset (ABARES 2010), we excluded protected areas, private forestry and water bodies from the analysis, and so considered forest change only where the land use was for residential and urban development, agriculture, grazing and mining. We then calculated the annual rate of primary deforestation in each LGA between 2005 and 2014, which is expressed as a proportion of the remaining primary forest extent. The average annual rates of loss (primary deforestation) between 2005 and 2014 for each LGA were then calculated.

We then identified outlier LGAs — the LGAs where the average annual background rates of loss fall outside the expected range of values for rates of loss within all LGAs across Australia. These outlier LGAs were identified by calculating the interquartile range (IQR) of the average annual rate of loss data, and then identifying any LGA where the average annual rate of loss was 1.5 IQRs above the third quartile of the data. The outlier LGAs were typically those that were either:

1. *Small LGAs, or LGAs with little woody vegetation remaining*, where there was limited forest extent and change imagery data which reduced the accuracy of background rates of loss, resulting in greater than expected (outlier) estimates, or
2. *Urban or peri-urban LGAs*, which have experienced greater development pressures than other LGAs due to urbanisation which has also resulted in greater than expected (outlier) estimates.

To address outlier values, we have taken the average of the background rate of loss for the remaining (non-outlier) LGAs within the appropriate state/territory and used this average value as a proxy measure of background rates of loss for each outlier LGA.

It is appropriate to adjust high values experienced in urban or peri-urban in this way because the change of forest extent between 2005 and 2014 is dominated by loss due to development activities that would have triggered offset requirements which would have neutralised these impacts (see section 4.4), but does not account for this neutralisation. This limitation in our methodology applies to all LGAs, but is particularly problematic within urban and peri-urban environments which have experienced greater development pressures than other LGAs due to urbanisation (and hence have background rates of loss greater than would otherwise be expected). As we can confidently attribute the majority of the observed deforestation within urban and peri-urban LGAs to development that would have triggered offsets, we can be confident that a ROL derived from these outlier values would misrepresent the real ROL within these urban and peri-urban LGAs. We acknowledge that this approach to compensate for this issue is imperfect and applies a broad-brush solution to a localised matter. However, using a state/territory average for outlier urban and peri-urban LGAs is a useful stopgap method to improve the robustness of ROL estimates until such time as appropriate analysis of loss within urban and peri-urban LGAs is conducted. This analysis would need to take into account offset gains triggered by the development activities that induce the recorded losses. Undertaking this analysis would further improve the robustness and accuracy for ROL estimates for these LGAs.

Fourteen of the 564 LGAs across Australia were not covered by primary forest in 1972, and therefore the average annual rate of loss estimates could not be calculated for these LGAs. This included two LGAs in Queensland, four in South Australia, three in Northern Territory, and five in Western Australian (see Appendix 2). For these LGAs we recommend a ROL score of 0% as a precautionary measure until reliable data to describe background rates of vegetation communities within these LGAs becomes available.

The average annual background rates of loss for each LGA are provided in Appendix 1. The corresponding ROL estimates are also provided in Appendix 1, based on a 'foreseeable future' time horizon of 20 years. Maps of Australia indicating the range of average annual background rates of loss between 2005 and 2014 and ROL within Local Government Areas boundaries are provided in Appendix 2.

REMINDER:

A ROL score based on considerations outside of the recommendations provided in this report should be supported by specific, credible, and robust evidence (see feature box, page 15).

4.4. Limitations to using background rates of loss to calculate Risk of Loss estimates

The background rate of loss estimates provided in Appendix 1 incorporate clearance of habitat that occurred over the period 2005–2014 that would have triggered offset requirements, and for which the loss will be balanced with offset gains at some point in the future. Therefore, the background rates of loss provided here are likely overestimated as they have not been adjusted to account for any future offset gains, and effectively double-count ROL by accounting for loss in background rates and again when estimating ROL at individual sites. Consequently, the actual background rates of loss would be less than reported in Appendix 1. This is a limitation of our approach that we cannot avoid, although we have accounted for it within outlier LGAs (see section 4.3) where we can confidently attribute loss to development that would have triggered offset requirements. However, this limitation remains for LGAs where background rates of loss fall within expected values. Despite this limitation, quantified background rates of loss are the most robust and readily available data at this point in time.

Currently, sufficiently robust and accessible data is only available for changes in extent of forested habitats over time. However, it is a reasonable assumption that non-forested habitat would be lost at the same (or similar rate) as the drivers of loss (e.g. socio-economic factors driving patterns of development) will be operating similarly within the same landscape. Therefore, in absence of better, more habitat-specific data, the background rates of loss provided here (Appendix 1) are more plausible than subjective estimations. However, it is recommended that where possible, efforts are made to obtain habitat / ecological community specific data.

It is recommended that a similar process to that outlined above is followed for future updates of deforestation rates or assessments of background rates of loss for other (e.g. non-wooded) habitats or ecological communities.

Biodiversity offsets have been used to compensate for residual impacts on the Endangered Carnaby's Black Cockatoo. Image: Maksym Polyakov

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Appendix One

Average annual background rates of loss between 2005 and 2014 and Risk of Loss over a 20 year time period for each Local Government Area

Note 1: Data includes only forested habitat, where 'forest' is defined as *woody vegetation with at least 20% canopy cover, reaching, or with the potential to reach, at least 2 m high, covering an area of at least 0.2 ha.*

Note 2: To calculate Risk of Loss over a different time period, multiply the average annual background rate of loss by the chosen time horizon.

Note 3: The Guide has a built-in formula to multiply the value entered into the ROL score column of the Guide by 20. Therefore the average annual background rates of loss (column 2 in this table) should be entered into the Guide to provide a ROL score over a 20 year period.

* LGAs where average annual background rates of loss estimates were identified as outliers. For these LGAs, the average of the background rate of loss for the remaining LGAs within the appropriate state/territory has been used as a proxy measure of background rate of loss.

^ LGAs where background rates of loss were not calculated as there was no primary forest cover within these LGAs in 1972. For these LGAs, a ROL of 0% is recommended.

Enter these values into the Guide

Local Government Area	Average annual background rate of loss 2005–2014 (%)	Risk of Loss over twenty years (%)
AUSTRALIAN CAPITAL TERRITORY		
Unincorporated	0.03	0.56
NEW SOUTH WALES		
Albury	0.06	1.23
Armidale Dumaresq	0.10	1.99
Ashfield	0.00	0.00
Auburn	0.00	0.00
Ballina	0.07	1.33
Balranald	0.03	0.60
Bankstown	0.00	0.00
Bathurst Regional	0.14	2.85
Bega Valley	0.27	5.47
Bellingen	0.12	2.39
Berrigan	0.01	0.25
Blacktown	0.07	1.36
Bland	0.04	0.77
Blayney	0.21	4.18
Blue Mountains	0.02	0.32
Bogan	0.33	6.67
Bombala	0.27	5.33
Boorowa	0.07	1.46
Botany Bay	0.00	0.00
Bourke	0.56	11.28
Brewarrina	0.16	3.25
Broken Hill	0.00	0.00

Local Government Area	Average annual background rate of loss 2005–2014 (%)	Risk of Loss over twenty years (%)
Burwood	0.00	0.00
Byron	0.05	1.06
Cabonne	0.05	0.97
Camden	0.00	0.05
Campbelltown	0.05	0.92
Canada Bay	0.00	0.00
Canterbury	0.00	0.00
Carrathool	0.12	2.38
Central Darling	0.01	0.15
Cessnock	0.27	5.43
Clarence Valley	0.06	1.24
Cobar	0.20	3.98
Coffs Harbour	0.34	6.73
Conargo	0.03	0.59
Coolamon	0.19	3.81
Cooma-Monaro	0.06	1.17
Coonamble	0.38	7.56
Cootamundra	0.52	10.41
Corowa Shire	0.31	6.14
Cowra	0.05	0.92
Deniliquin	0.01	0.28
Dubbo	0.15	2.94
Dungog	0.06	1.14
Eurobodalla	0.22	4.50
Fairfield	0.00	0.00
Forbes	0.01	0.14
Gilgandra	0.34	6.73
Glen Innes Severn	0.20	3.96
Gloucester	0.07	1.36
Gosford	0.09	1.79
Goulburn Mulwaree	0.18	3.67
Great Lakes	0.15	3.07
Greater Hume Shire	0.24	4.81
Greater Taree	0.18	3.51
Griffith	0.00	0.05
Gundagai	0.15	3.04
Gunnedah	0.12	2.46
Guyra	0.14	2.74
Gwydir	0.06	1.21
Harden	0.05	0.95
Hawkesbury	0.04	0.73
Hay	0.05	1.08
Holroyd	0.00	0.00
Hornsby	0.02	0.39
Hunters Hill	0.00	0.00
Hurstville	0.00	0.00
Inverell	0.10	1.98
Jerilderie	0.01	0.10
Junee	0.53	10.59
Kempsey	0.21	4.26

Local Government Area	Average annual background rate of loss 2005–2014 (%)	Risk of Loss over twenty years (%)
Kiama	0.07	1.40
Kogarah	0.00	0.00
Ku-ring-gai	0.00	0.00
Kyogle	0.04	0.78
Lachlan	0.19	3.86
Lake Macquarie	0.25	5.05
Lane Cove	0.00	0.00
Leeton	0.03	0.63
Leichhardt	0.00	0.00
Lismore	0.02	0.47
Lithgow	0.19	3.75
Liverpool	0.01	0.18
Liverpool Plains	0.07	1.46
Lockhart	0.47	9.32
Maitland	0.22	4.41
Manly	0.00	0.00
Marrickville	0.00	0.00
Mid-Western Regional	0.13	2.63
Moree Plains	0.09	1.79
Mosman	0.00	0.00
Murray	0.01	0.13
Murrumbidgee	0.01	0.11
Muswellbrook	0.06	1.14
Nambucca	0.27	5.33
Narrabri	0.17	3.49
Narrandera	0.68	13.62
Narromine	0.19	3.82
Newcastle	0.59	11.77
North Sydney	0.00	0.00
Oberon	0.29	5.82
Orange	0.04	0.71
Palerang	0.21	4.13
Parkes	0.15	3.05
Parramatta	0.00	0.00
Penrith	0.09	1.76
Pittwater	0.00	0.00
Port Macquarie-Hastings	0.27	5.39
Port Stephens	0.20	3.96
Queanbeyan	0.00	0.00
Randwick	0.00	0.00
Richmond Valley	0.13	2.63
Rockdale	0.00	0.00
Ryde	0.00	0.00
Shellharbour	0.09	1.90
Shoalhaven	0.22	4.45
Singleton	0.03	0.67
Snowy River	0.10	1.94
Strathfield	0.00	0.00
Sutherland Shire	0.00	0.08
Sydney	0.00	0.00

Local Government Area	Average annual background rate of loss 2005–2014 (%)	Risk of Loss over twenty years (%)
Tamworth Regional	0.06	1.18
Temora	0.05	1.03
Tenterfield	0.08	1.54
The Hills Shire	0.04	0.84
Tumbarumba	0.45	8.97
Tumut Shire	0.18	3.53
Tweed	0.04	0.77
Unincorporated NSW	0.00	0.00
Upper Hunter Shire	0.09	1.83
Upper Lachlan Shire	0.14	2.82
Uralla	0.03	0.52
Urana	0.24	4.84
Wagga Wagga	0.10	1.90
Wakool	0.02	0.34
Walcha	0.52	10.31
Walgett	0.59	11.76
Warren	0.29	5.87
Warringah	0.02	0.44
Warrumbungle Shire	0.08	1.66
Waverley	0.00	0.00
Weddin	0.01	0.11
Wellington	0.17	3.32
Wentworth	0.04	0.89
Willoughby	0.00	0.00
Wingecarribee	0.27	5.35
Wollondilly	0.09	1.80
Wollongong	0.05	0.95
Woollahra	0.00	0.00
Wyong	0.12	2.44
Yass Valley	0.10	1.97
Young	0.10	2.02
NORTHERN TERRITORY		
Alice Springs^	n/a	0
Barkly	0	0
Belyuen	0	0
Central Desert^	n/a	0
Coomalie	0.36	7.17
Darwin	0.01	0.14
East Arnhem	0.01	0.11
Katherine	0	0
Litchfield	0.10	2.00
MacDonnell^	n/a	0
Palmerston	0	0
Roper Gulf	0.00003	0.00
Tiwi Islands	0	0
Unincorporated NT	0.04	0.72
Victoria-Daly	0.00002	0.00
Wagait	0	0
West Arnhem	0.002	0.04

Local Government Area	Average annual background rate of loss 2005–2014 (%)	Risk of Loss over twenty years (%)
QUEENSLAND		
Aurukun	0.002	0.05
Balonne	0.12	2.37
Banana	0.08	1.55
Barcaldine	0.42	8.41
Barcoo	0	0
Blackall Tambo	0.00008	0.00
Boulia^	n/a	0
Brisbane	0.17	3.31
Bulloo	0.001	0.01
Bundaberg	0.41	8.14
Burdekin	0.01	0.28
Burke	0.0003	0.01
Cairns	0.02	0.33
Carpentaria	0.003	0.06
Cassowary Coast	0.10	2.02
Central Highlands	0.09	1.81
Charters Towers	0.04	0.86
Cherbourg	0.01	0.10
Cloncurry	0.001	0.02
Cook	0.02	0.45
Croydon	0.004	0.08
Diamantina^	n/a	0
Doomadgee	0	0
Etheridge	0.01	0.22
Flinders	0.07	1.42
Fraser Coast	0.47	9.44
Gladstone	0.34	6.76
Gold Coast	0.29	5.77
Goondiwindi	0.35	7.02
Gympie	0.15	2.91
Hinchinbrook	0.23	4.62
Hope Vale	0.01	0.29
Ipswich	0.47	9.34
Isaac	0.42	8.42
Kowanyama	0	0
Lockhart River	0	0
Lockyer Valley	0.08	1.50
Logan	0.33	6.68
Longreach	0.14	2.72
Mackay	0.60	12.09
Mapoon	0	0
Maranoa	0	0
McKinlay	0	0
Moreton Bay	0.15	2.97
Mornington	0.004	0.08
Mount Isa	0.01	0.23
Murweh	0	0
Napranum	0.01	0.30

Local Government Area	Average annual background rate of loss 2005–2014 (%)	Risk of Loss over twenty years (%)
North Burnett	0.20	4.01
Northern Peninsula Area	0.03	0.53
Palm Island	0	0
Paroo	0.08	1.51
Pormpuraaw	0	0
Quilpie	0	0
Redland	0.14	2.80
Richmond	0.01	0.15
Rockhampton	0.69	13.79
Scenic Rim	0.07	1.47
Somerset	0.15	3.03
South Burnett	0.32	6.36
Southern Downs	0.11	2.28
Sunshine Coast	0.11	2.22
Tablelands	0.02	0.44
Toowoomba	0.22	4.31
Torres	0	0
Torres Strait Island	0	0
Townsville	0.05	1.10
Weipa*	0.12	2.33
Western Downs	0.24	4.81
Whitsunday	0.14	2.77
Winton	0	0
Woorabinda	0.05	1.07
Wujal Wujal	0	0
Yarrabah	0	0
SOUTH AUSTRALIA		
Adelaide Hills	0.09	1.79
Adelaide*	0.14	2.84
Alexandrina	0.06	1.20
Anangu Pitjantjatjara^	n/a	0
Barossa	0.57	11.31
Barunga West	0.22	4.42
Berri and Barmera	0.03	0.66
Burnside	0.01	0.18
Campbelltown	0	0
Ceduna	0.67	13.32
Charles Sturt	0.07	1.40
Clare and Gilbert Valleys	0.03	0.52
Cleve	0.11	2.27
Coober Pedy^	n/a	0
Copper Coast	0.42	8.41
Elliston	0.03	0.54
Flinders Ranges	0.00011	0.00
Franklin Harbour	0.07	1.39
Gawler	0.22	4.33
Goyder	0.03	0.52
Grant	0.03	0.65
Holdfast Bay	0.04	0.79

Local Government Area	Average annual background rate of loss 2005–2014 (%)	Risk of Loss over twenty years (%)
Kangaroo Island	0.19	3.73
Karoonda East Murray	0.54	10.81
Kimba	0.31	6.21
Kingston	0.16	3.16
Light	0.19	3.83
Lower Eyre Peninsula	0.27	5.47
Loxton Waikerie	0.67	13.47
Mallala	0.06	1.30
Maralinga Tjarutja^	n/a	0
Marion	0.13	2.60
Mid Murray	0.15	3.09
Mitcham	0.0007	0.01
Mount Barker	0.23	4.54
Mount Gambier	0.09	1.84
Mount Remarkable	0.03	0.51
Murray Bridge	0.11	2.21
Naracoorte and Lucindale	0.01	0.28
Northern Areas	0.06	1.13
Norwood Payneham St Peters	0.10	2.00
Onkaparinga	0.13	2.61
Orroroo/Carrieton	0.02	0.42
Peterborough	0.0010	0.02
Playford	0.14	2.84
Port Adelaide Enfield	0.13	2.54
Port Augusta	0	0
Port Lincoln*	0.14	2.84
Port Pirie City and Dists	0.03	0.57
Prospect	0	0
Renmark Paringa	0.03	0.67
Robe	0.01	0.20
Roxby Downs^	n/a	0
Salisbury	0.09	1.80
Southern Mallee	0.69	13.77
Streaky Bay	0.05	0.92
Tatiara	0.38	7.65
Tea Tree Gully	0.02	0.36
The Coorong	0.32	6.44
Tumby Bay	0.10	1.91
Unincorporated SA	0.02	0.33
Unley	0	0
Victor Harbor	0.02	0.37
Wakefield	0.38	7.62
Walkerville	0	0
Wattle Range	0.06	1.11
West Torrens	0.19	3.75
Whyalla	0.0005	0.01
Wudinna	0.18	3.54
Yankalilla	0.03	0.57
Yorke Peninsula	0.23	4.68

Local Government Area	Average annual background rate of loss 2005–2014 (%)	Risk of Loss over twenty years (%)
TASMANIA		
Break O'Day	0.39	7.73
Brighton	0.42	8.39
Burnie	0.03	0.68
Central Coast	0.04	0.82
Central Highlands	0.06	1.29
Circular Head	0.10	2.05
Clarence	0.09	1.87
Derwent Valley	0.001	0.01
Devonport	0.04	0.86
Dorset	0.31	6.23
Flinders	0.49	9.90
George Town	0.11	2.20
Glamorgan/Spring Bay	0.23	4.51
Glenorchy	0.004	0.09
Hobart	0	0
Huon Valley	0.04	0.77
Kentish	0.23	4.56
King Island	0.60	11.93
Kingborough	0.10	2.06
Latrobe	0.20	4.07
Launceston	0.37	7.41
Meander Valley	0.05	1.10
Northern Midlands	0.19	3.72
Sorell	0.40	7.92
Southern Midlands	0.28	5.57
Tasman	0.35	6.93
Waratah/Wynyard	0.03	0.69
West Coast	0.04	0.71
West Tamar	0.06	1.30
VICTORIA		
Alpine	0.21	4.23
Ararat	0.29	5.82
Ballarat	0.37	7.35
Banyule	0	0
Bass Coast	0.40	8.01
Baw Baw	0.34	6.85
Bayside	0	0
Benalla*	0.19	3.71
Boroondara	0	0
Brimbank	0.06	1.26
Buloke	0.19	3.84
Campaspe	0.001	0.03
Cardinia	0.30	6.01
Casey	0.21	4.27
Central Goldfields	0.13	2.55
Colac-Otway	0.22	4.39
Corangamite	0.18	3.61
Darebin	0	0
East Gippsland*	0.19	3.71

Local Government Area	Average annual background rate of loss 2005–2014 (%)	Risk of Loss over twenty years (%)
Frankston	0.10	2.03
Gannawarra	0.11	2.21
Glen Eira	0	0
Glenelg	0.08	1.57
Golden Plains	0.34	6.76
Greater Bendigo	0.17	3.42
Greater Dandenong	0.01	0.18
Greater Geelong	0.41	8.14
Greater Shepparton	0.02	0.35
Hepburn	0.06	1.23
Hindmarsh	0.29	5.87
Hobsons Bay	0.03	0.59
Horsham	0.22	4.42
Hume	0.23	4.68
Indigo	0.19	3.86
Kingston	0	0
Knox	0	0
Latrobe	0.68	13.50
Loddon	0.06	1.25
Macedon Ranges	0.36	7.17
Manningham	0.04	0.87
Mansfield	0.70	14.05
Maribyrnong	0	0
Maroondah	0.01	0.24
Melbourne	0	0
Melton	0.21	4.18
Mildura	0.53	10.69
Mitchell	0.40	7.91
Moira	0.01	0.26
Monash	0	0
Moonee Valley	0	0
Moorabool	0.16	3.29
Moreland	0	0
Mornington Peninsula	0.04	0.88
Mount Alexander	0.09	1.82
Moyne	0.12	2.45
Murrindindi	0.60	12.01
Nillumbik	0.48	9.60
Northern Grampians	0.13	2.51
Port Phillip	0	0
Pyrenees	0.20	4.07
Queenscliffe	0.33	6.64
South Gippsland	0.33	6.62
Southern Grampians	0.08	1.52
Stonnington	0	0
Strathbogie	0.21	4.18
Surf Coast	0.23	4.51
Swan Hill	0.18	3.63
Towong	0.28	5.64
Unincorporated Vic	0.23	4.66

Local Government Area	Average annual background rate of loss 2005–2014 (%)	Risk of Loss over twenty years (%)
Wangaratta	0.57	11.40
Warrnambool	0.07	1.39
Wellington	0.34	6.85
West Wimmera	0.13	2.69
Whitehorse	0	0
Whittlesea*	0.19	3.71
Wodonga	0.22	4.48
Wyndham	0.14	2.81
Yarra	0	0
Yarra Ranges	0.31	6.27
Yarriambiack	0.41	8.24
WESTERN AUSTRALIA		
Albany	0.37	7.43
Armadale	0.16	3.21
Ashburton^	n/a	0
Augusta-Margaret River	0.37	7.47
Bassendean	0	0
Bayswater	0	0
Belmont	0.30	6.00
Beverley*	0.24	4.74
Boddington	0.62	12.36
Boyup Brook	0.42	8.49
Bridgetown-Greenbushes	0.38	7.62
Brookton	0.45	9.01
Broome	0	0
Broomehill-Tambellup	0.65	13.09
Bruce Rock	0.22	4.34
Bunbury	0.57	11.35
Busselton*	0.24	4.74
Cambridge	0.002	0.03
Canning	0.06	1.25
Capel*	0.24	4.74
Carnamah	0.46	9.15
Carnarvon	0	0
Chapman Valley	0.09	1.72
Chittering	0.62	12.30
Claremont	0	0
Cockburn	0.35	7.07
Collie	0.26	5.21
Coolgardie	0.02	0.47
Coorow	0.37	7.33
Corrigin	0.43	8.58
Cottesloe	0	0
Cranbrook	0.67	13.33
Cuballing	0.60	12.02
Cue	0	0
Cunderdin*	0.24	4.74
Dalwallinu	0.31	6.15
Dandaragan	0.37	7.41
Dardanup	0.50	9.95

Local Government Area	Average annual background rate of loss 2005–2014 (%)	Risk of Loss over twenty years (%)
Denmark	0.17	3.33
Derby-West Kimberley	0.001	0.03
Donnybrook-Balingup	0.27	5.48
Dowerin*	0.24	4.74
Dumbleyung	0.48	9.58
Dundas	0.001	0.02
East Fremantle	0	0
East Pilbara	0	0
Esperance	0.15	3.07
Exmouth^	n/a	0
Fremantle	0	0
Geraldton-Greenough	0.07	1.47
Gingin	0.41	8.17
Gnowangerup	0.38	7.59
Goomalling*	0.24	4.74
Gosnells	0.15	3.07
Halls Creek	0	0
Harvey	0.51	10.22
Irwin	0.11	2.15
Jerramungup	0.34	6.82
Joondalup	0.03	0.61
Kalamunda	0.08	1.55
Kalgoorlie/Boulder	0.02	0.43
Katanning	0.64	12.81
Kellerberrin	0.23	4.50
Kent	0.52	10.41
Kojonup	0.54	10.83
Kondinin	0.18	3.54
Koorda	0.70	13.98
Kulin	0.56	11.15
Kwinana	0.47	9.42
Lake Grace	0.35	7.09
Laverton	0.03	0.60
Leonora	0.005	0.09
Mandurah	0.41	8.14
Manjimup	0.51	10.28
Meekatharra	0.0001	0.00
Melville	0.09	1.83
Menzies	0.004	0.07
Merredin	0.07	1.40
Mingenew	0.01	0.15
Moora*	0.24	4.74
Morawa	0.12	2.48
Mosman Park	0	0
Mount Magnet	0	0
Mount Marshall	0.11	2.15
Mukinbudin	0.15	2.99
Mullewa	0.09	1.83
Mundaring	0.08	1.65
Murchison	0.0001	0.00

Local Government Area	Average annual background rate of loss 2005–2014 (%)	Risk of Loss over twenty years (%)
Murray*	0.24	4.74
Nannup	0.45	9.07
Narembeen	0.09	1.75
Narrogin	0.63	12.68
Narrogin*	0.24	4.74
Nedlands	0	0
Ngaanyatjarraku^	n/a	0
Northam	0.70	13.95
Northampton	0.05	0.93
Nungarin	0.08	1.53
Peppermint Grove	0	0
Perenjori	0.10	1.97
Perth	0	0
Pingelly	0.60	11.93
Plantagenet	0.43	8.51
Port Hedland^	n/a	0
Quairading	0.47	9.47
Ravensthorpe	0.38	7.58
Rockingham	0.27	5.46
Roebourne^	n/a	0
Sandstone	0.000009	0.00
Serpentine-Jarrahdale	0.22	4.31
Shark Bay	0	0
South Perth	0.02	0.42
Stirling	0	0
Subiaco	0	0
Swan	0.19	3.77
Tammin*	0.24	4.74
Three Springs	0.17	3.49
Toodyay	0.55	11.07
Trayning	0.70	13.94
Upper Gascoyne	0	0
Victoria Park	0.18	3.56
Victoria Plains	0.45	9.02
Vincent	0	0
Wagin*	0.24	4.74
Wandering	0.62	12.35
Wanneroo	0.53	10.66
Waroona*	0.24	4.74
West Arthur	0.46	9.26
Westonia	0.12	2.30
Wickepin*	0.24	4.74
Williams	0.58	11.55
Wiluna	0	0
Wongan-Ballidu*	0.24	4.74
Woodanilling*	0.24	4.74
Wyalkatchem*	0.24	4.74
Wyndham-East Kimberley	0	0
Yalgoo	0.003	0.07
Yilgarn	0.03	0.59
York*	0.24	4.74

Appendix Two

Maps of Australia indicating range of average annual loss between 2005 and 2014 and recommended risk of loss within Local Government Area boundaries

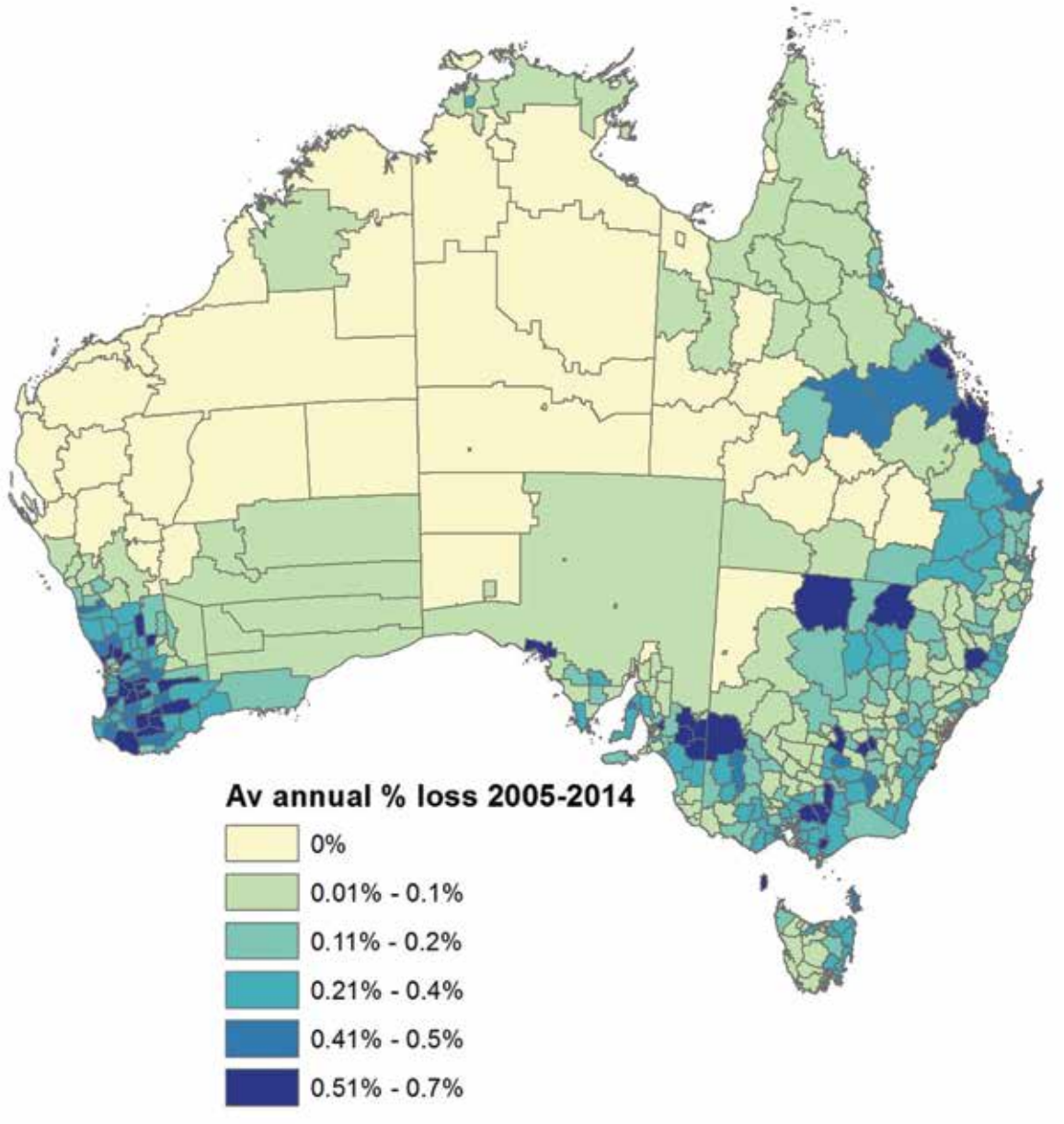

Figure A2.1: Range of average annual rate of loss between 2005 and 2014 shown for each Local Government Area across Australia. Ranges of average annual rates of loss are shown by colour as indicated in the legend.

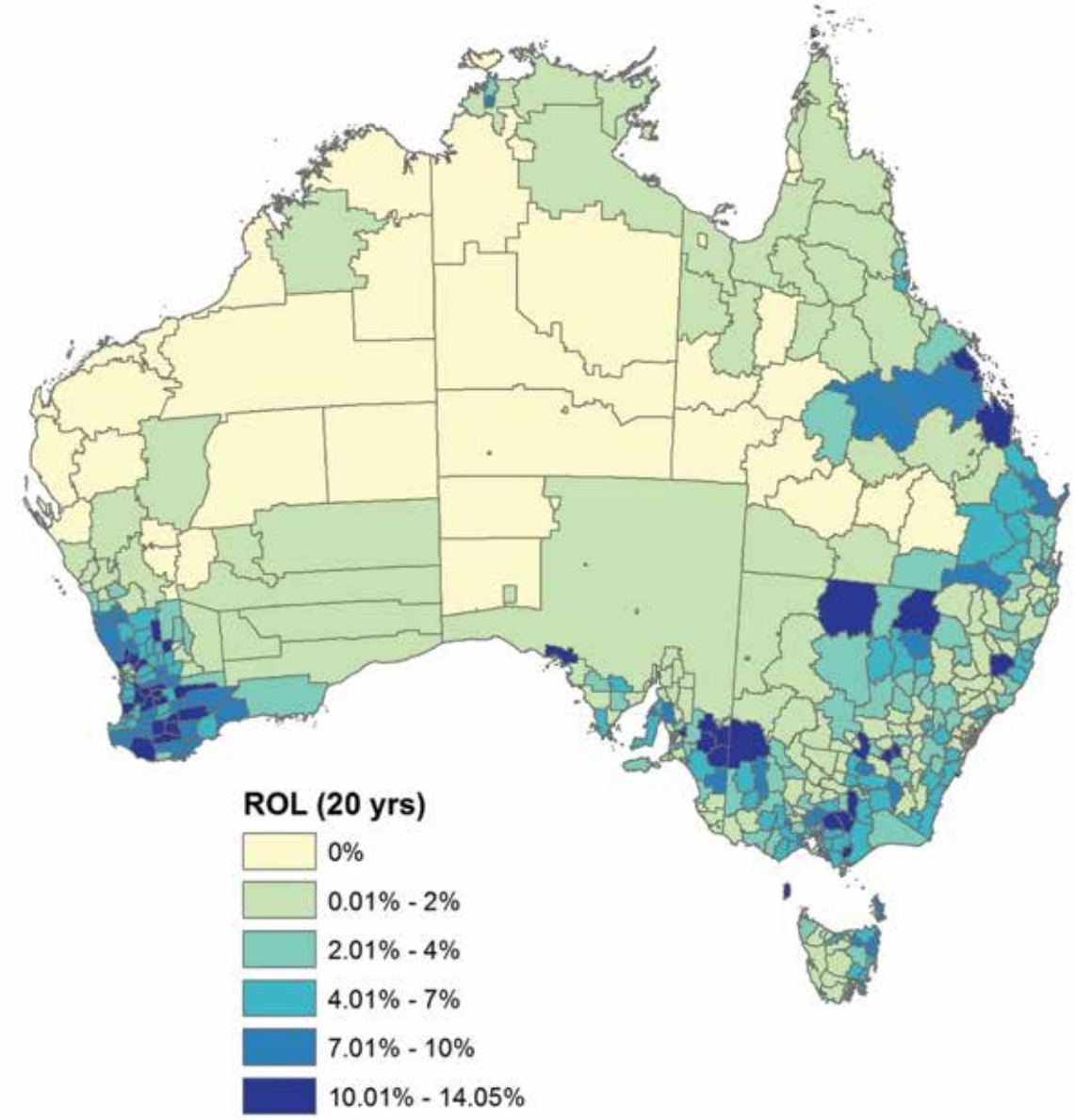

Figure A2.2: Range of recommended Risk of Loss (ROL) over 20 years shown for each Local Government Area across Australia, based on average annual rates of loss. Ranges of recommended ROL are shown by colour as indicated in the legend.

Further information:
http://www.nespthreatenedspecies.edu.au/

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Australian Government

Threatened Species Recovery Hub

National Environmental Science Programme