*Critical review of assumptions of gains in biodiversity under Victorian
offsetting policy*

A thesis submitted in partial fulfilment of the requirements for the degree of
Master in Urban Planning and Environment

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Candidates' Declaration

I declare that the thesis entitled *Critical review of assumptions of gains in biodiversity under Victorian offsetting policy* and submitted for the degree of Master of Urban Planning and Environment is the result of my own independent research, except where otherwise acknowledged, and that this thesis (or any part thereof) has not been submitted for a degree to this or any other university or institution.

Signed: Anna O'Brien

Date: 30/05/2020

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Abstract

Global biodiversity is declining faster than at any time in human history. This loss is largely attributed to human activities, in particular urban, industrial and agricultural development. Biodiversity offsetting seeks to balance the environmental impacts from development through the generation of measurable gains in biodiversity that compensate for loss. To achieve No Net Loss or a Net Gain in biodiversity, the biodiversity gains from offsetting must be at least equivalent or greater to the biodiversity losses from development. But while losses from development are typically immediate, gains from offsetting are generated over longer timeframes, often after the impact has occurred. Determining equivalence between an impact and an offset thereby requires projecting the gains that will be generated over an offset management period. As biodiversity is in decline, gains may be generated from averting further loss in biodiversity, as well as from improving the biodiversity at an offset site. To determine the gains attributable to an offset, assumptions must be made about changes in biodiversity with and without the offset. These assumptions have serious implications on achieving a No Net Loss outcome from offsetting, however they may not always be drawn from empirical data.

In this thesis, I review the assumptions used to calculate gains from offsets in two loss-gain exchange case studies under Victorian offsetting policy. These gains were used to offset losses in native vegetation from permitted development impacts, and reflect the gains from projected averted loss and improvement in native vegetation over the 10-year offset management periods. The assumptions of gain vary between the case studies according to the native vegetation condition, foregone land use entitlements and proposed management activities, but the assumptions are not entirely explicit nor supported by empirical data. When compared to available data on native vegetation change without an offset, I reveal that the assumptions of gain from averted loss are significantly over-estimated. Over-estimating gains from offsetting is problematic, as it allows a larger development impact for the same offset, resulting in a net loss of native vegetation and exacerbating biodiversity decline. I conclude that a No Net Loss outcome was unlikely to have been achieved in either case study presented in this thesis, and that it is questionable whether No Net Loss is possible under the current policy framework in Victoria. Based on my analysis of the two case studies, I make eight recommendations to improve the plausibility and transparency of the assumptions of gains under Victorian offsetting policy, and to ensure that the policy is more likely to achieve its No Net Loss objective.

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Glossary

Biodiversity	The diversity of life on earth.
Biodiversity Metrics	A numerical framework used to measure biodiversity value, including projected losses and gains in value.
Bioregion	A landscape-scale approach to classifying the environment into biogeographical regions using a range of attributes such as climate, geomorphology, geology, soils and vegetation. There are 28 bioregions identified within Victoria.
Biota	The animal and plant life of a particular region, habitat, or geological period.
Crediting Baseline	Value of biodiversity (as defined by selected metrics) against which a gain in biodiversity is measured.
Credit Owner	The individual(s) or legal entity that owns native vegetation offsets registered on the Victorian Native Vegetation Credit Register (NVCR).
Debiting Baseline	Value of biodiversity (as defined by selected metrics) against which a loss in biodiversity is measured.
Ecological Vegetation Class (EVC)	The standard unit for classifying vegetation types in Victoria.
EVC Benchmark	The average characteristics of mature stands of native vegetation of the same EVC, in the same bioregion, in a 'natural' or 'undisturbed' condition.
First Party Offset	A developer is responsible for the implementation of their own offset either in close connection to the impact site (on-site) or off-site.
Gain	The predicted improvement in value of biodiversity due to active management and protection from loss.
General Habitat Unit	The unit of measure for the loss and gain in overall biodiversity value of native vegetation in Victoria.
Habitat Hectare	A site-based measure of native vegetation quality and quantity.
Habitat Score	The native vegetation quality assessment score (out of 100) as a percentage of the EVC benchmark.
Habitat Zone	A contiguous area of native vegetation that represents that same EVC and vegetation condition (habitat score)
Impact	An action that causes loss in biodiversity.
Large Tree	A native canopy tree with a Diameter at Breast Height (DBH) greater than or equal to the large tree benchmark for the relevant bioregional EVC.
Like-for-like/ in-kind	A type of offset that matches key characteristics of the biota impacted.
Loss	A measured reduction in value of biodiversity from a permitted residual impact.

Multipliers	Factors that account for uncertainty when projecting gains from offsetting.
Native Vegetation	Plants that are indigenous to Victoria, including trees, shrubs, herbs and grasses.
Net Gain	The outcome of a loss-gain exchange that results in additional gain in biodiversity beyond the equivalent loss from the development impact.
No Net Loss	The outcome of a loss-gain exchange that is neutral for biodiversity, whereby the gain in biodiversity is equivalent to the loss from the development impact.
Offset	An action to compensate for an impact to biodiversity.
Patch	An area of vegetation where at least 25% of the total perennial understorey plant cover is native, any area with three or more native canopy trees where the drip line of each tree touches the drip line of at least one other tree, forming a continuous canopy, or any mapped wetland included in the Victorian Current wetlands map (DELWP 2020b).
Scattered Tree	A native canopy tree that does not form part of a patch.
Section 173 Agreement	A permanent, legally-binding agreement, made between a Victorian local Council and a landowner, that places restrictions on how a landowner can use the land under the <i>Planning and Environment Act 1987</i> . Restrictions may include the permanent protection of selected native vegetation. These agreements can be used to secure first party offsets in Victoria.
Section 69 Agreement	A permanent, legally-binding agreement placed on a property's title to ensure selected native vegetation on the property is protected in-perpetuity under <i>Conservation, Forests and Lands Act 1987</i> . These agreements can be used to secure first or third party offsets in Victoria.
Species Habitat Unit	The unit of measure for the loss and gain in biodiversity value of native vegetation for a particular rare or threatened species.
Third Party Offset	A developer (permit holder) purchases offsets from another party, who takes the responsibility for the implementation and success of the offset.
Trust for Nature Deed of Covenant (Offset)	A permanent, legally-binding agreement placed on a property's title to ensure selected native vegetation on the property is protected in-perpetuity under the <i>Victorian Conservation Trust Act 1972</i> . These agreements can be used to secure first or third party offsets in Victoria.
Vegetation Quality Assessment (VQA)	The standardised vegetation assessment methodology used in Victoria to measure native vegetation condition using the habitat hectare assessment method.

1. Introduction

Biodiversity¹ is the diversity of life on earth. It encompasses all living organisms, including plants, animals, fungi and micro-organisms, their species diversity, their genetic diversity, the diversity of ecosystems in which they inhabit, including terrestrial, aquatic and marine, and the ecological complexes that they are a part of (DELWP 2017a; CBD 2019; IPBES 2019a). The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) *Global Assessment Report on Biodiversity and Ecosystem Services* reveals that global biodiversity “is declining faster than at any time in human history” (IPBES 2019b, p. 2), with nearly one million species now facing extinction in the coming decades. This loss is largely attributed to human activities, including vegetation and habitat clearance for development and resource-use (McLellan et al. 2014; IPBES 2019a). The loss of species and their genetic diversity will lead to the loss of essential ecosystem services that they provide to humans populations, including food and energy production, clean drinking water, and pest, disease and climate control. Constanza et al. (2014) estimated that biodiversity contributed more than \$US125 trillion of value to the global economy in 2011 alone.

Biodiversity offsetting is a regulatory instrument that seeks to balance biodiversity loss² from development. It involves the generation of measurable gains³ in biodiversity to compensate for loss (IUCN 2014), where gains may be equal to, or greater than, the loss of biodiversity (Gibbons et al. 2015). While losses from development may be immediate, gains from offsetting are generated over longer timeframes (e.g. over a 10 or 20-year offset management

¹ Refer to Glossary.

² Refer to Glossary.

³ Refer to Glossary.

period), often after the impact⁴ has occurred. As biodiversity is in decline, gains from offsetting may be generated from measures that protect the existing biodiversity from further loss (averted loss gain), as well as restoring or enhancing the existing biodiversity (improvement gain), at an offset site (BBOP 2012; Gardner et al. 2013; Dorrough et al. 2019). To determine the gains from averted loss and improvement in biodiversity, multiple assumptions must be made about the projected decline in biodiversity without the offset⁵ (averted loss) and the improved biodiversity value with the offset (improvement).

Biodiversity offsets were first incorporated into legislation in the 1970s by the United States of America (US) to mitigate development impacts on wetlands (Madsen et al. 2011), and are now being utilised by governments and development agencies in over 80 different countries worldwide, including separate schemes in all Australian states and territories (Maron et al. 2015a & 2018). Offset policy objectives include No Net Loss⁶ or Net Gain⁷ in biodiversity with ongoing development. In theory, development will have, at least, a neutral impact on biodiversity under an effective offsetting scheme (IUCN 2014; Gibbons et al. 2015). The efficacy of these schemes to meet their policy objectives and counterbalance biodiversity loss from development is, however, continually called into question worldwide (Bull et al. 2013; Quétier et al. 2014; OECD 2016). In particular, the predicted gains from offsetting may not be plausible or transparent, and, in some cases, are clearly overestimated (Maron et al. 2015a; Dorrough et al. 2019). If the gains from offsetting are overestimated, the offset will not compensate for the biodiversity loss, and No Net Loss will not be achieved.

⁴ Refer to Glossary.

⁵ Refer to Glossary.

⁶ Refer to Glossary.

⁷ Refer to Glossary.

In this thesis, I will undertake a critical review of the Victorian offsetting policy, and examine two loss-gain exchange case studies permitted under this policy. I will identify the assumptions of gain from these case studies, the plausibility of these assumptions, and whether the policy objective is likely to be achieved.

2. Biodiversity Offsetting Policy Frameworks

Biodiversity offsetting policy frameworks vary between governments and other implementing agencies across the globe. However, there are a number of key features of that are recurrent throughout many policies. These key features are discussed below.

2.1 No Net Loss Objective

A No Net Loss objective for biodiversity forms the basis of many biodiversity offsetting policies worldwide (Madsen et al. 2011; Bull et al. 2016). It aims to ‘neutralise’ biodiversity loss from a development impact by generating an equivalent gain in biodiversity elsewhere, where biodiversity is defined by the metrics used and the scope of the policy, rather than encompassing all impacts to all components of biodiversity (Maron et al. 2018). No Net Loss offsetting schemes do not halt biodiversity decline from other impacts that are beyond the scope of the policy, such as illegal clearance, climate change, pollution or pest plant and animal invasion. And they are not intended to provide additional gains for biodiversity beyond the equivalent loss from the development impact (Maron 2015; Maron et al. 2015b).

A Net Gain objective (also known as “net positive impact”) (e.g. NRE 2002; IFC 2012; TBC & FFI 2012) aims to achieve additional gain in biodiversity beyond the equivalent loss from the development impact. A Net Gain objective acknowledges the need for greater biodiversity conservation globally, however the small scale of these additional gains are not considered adequate to reverse global trends in biodiversity loss (Bull et al. 2016). Additional conservation targets committed by government and non-government agencies beyond offsetting schemes remain vital in order to address the catastrophic biodiversity loss experienced globally (Maron 2015; Maron et al. 2015b; IPBES 2019a).

2.2 Target Biota and Target Impacts

Biodiversity is a complex network of ecosystems, species, micro-organisms, their genetic diversity and their interconnections, the majority of which are effectively unknown to humankind (Ponder and Lunney 1999; CDB 2000 & 2019; Burgin 2011). Devising an effective accounting system to measure an equivalent loss and gain of biodiversity that captures this complexity is problematic (Maron et al. 2016).

Consequently, Biodiversity offsetting policies do not target all components of biodiversity. They target impacts to specific biota⁸ and/or ecosystems from development, further defined by the metrics used. The impacts and biota targeted by offsetting policies often reflect the societal values of the state or agency implementing the policy, as well as the technical data available to measure losses and gains in the target biota (McKenney and Kiesecker 2010, Moreno-Mateos et al. 2015; Bull et al. 2015a; Maron et al. 2016).

The *US Compensatory Mitigation and Wetland Banking* program was implemented to reverse the trend of wetland loss in the US (NRC 2001). The Australian *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) *Environmental Offsets Policy* targets impacts to ‘protected matters’ listed under the Australian EPBC Act, such as world heritage sites, Ramsar listed wetlands, listed threatened species and ecological communities, the Great Barrier Reef Marine Park and other Commonwealth marine areas (SEWPaC 2012). France’s *Biodiversity impact mitigation and offsetting* and the *New South Wales (NSW) biodiversity offsets scheme* target impacts to threatened flora and fauna species, and ecological communities (Legifrance 2016; OEH 2017a). The Victorian *Guidelines for the removal, destruction or lopping of native*

⁸ Refer to Glossary.

vegetation Victoria targets impacts to all native vegetation, and habitat for rare and threatened flora and fauna species (DELWP 2017a).

Bull et al. (2016) argue that offset schemes with an objective of No Net Loss of biodiversity can be misleading, as in reality they only target impacts to specific biota and ecosystems as surrogates for biodiversity. Impacts to other components of biodiversity from development may be addressed by other regulatory requirements, such as impacts to soil or water catchment health, or not addressed at all, such as impacts to fungi, micro-organisms and genetic diversity (Bull et al. 2014a).

Equally biodiversity offsetting policies do not target all types of impacts from development (Maron et al. 2018). Targeted impacts are the negative outcomes to specific biota that are directly attributable to the development activity, are measurable, are permissible by the overseeing regulatory authority (e.g. a council permit application process), and can be offset in accordance with the relevant offsetting policy. Indirect impacts, such as a reduced viability to adjacent habitat, or cumulative impacts, may not be addressed unless explicitly stated in the policy. The NSW Government *Biodiversity Assessment Methodology* (BAM) lists a number of indirect impacts relevant to the policy (OEH 2017b). The Victorian *Guidelines for the removal, destruction or lopping of native vegetation* requires the assessment of cumulative impacts at a development site up to five years prior (DELWP 2017a).

2.3 Mitigation hierarchy

Mitigation hierarchies guide decisions by regulatory authorities on whether to permit an impact to target biota. Many hierarchies typically follow a three-step approach of: 1. Avoidance, 2. Minimisation, and 3. Offsetting (Gardner et al. 2013; Bull et al. 2016). That is,

proposed impacts to biodiversity from development should first be avoided through changing the project scope, siting or design. Unavoidable impacts should then be minimised during project implementation through project siting, design, timing, construction methods and procedures. And finally, all residual impacts to biodiversity, that are considered ‘unavoidable’ and ‘minimised’, and are permissible by the regulatory authority, must be offset (OECD 2016; DELWP 2017a).

The aim of the mitigation hierarchy is to ensure that any permitted biodiversity loss is restricted to what is absolutely necessary, and appropriately compensated for. However, as policies typically lack clear standards for steps 1 and 2, and there is usually overlap in their definition, these steps are rarely considered in isolation of each other, nor early in the project development phase (IUCN 2014; OECD 2016; Maron et al. 2016). In the absence of clear and enforceable standards, offsetting often becomes the first and only step undertaken in the mitigation hierarchy (Bull et al. 2016).

2.4 Offsetting Mechanisms

Permitted residual impacts must be offset in accordance with the mechanisms available from the relevant offsetting policy framework. These generally include:

1. **Developer-led offset.** Also known as a first party offset⁹, the developer (permit holder) responsible for the permitted impacts to biodiversity may implement their own offset either on-site (in close connection to the impact site) or off-site, and bears the responsibility for the implementation and success of the offset. Without sufficient monitoring and reporting requirements, developer-led offsets have often been highly

⁹ Refer to Glossary.

fragmented, costly and non-compliant (Maron et al. 2012; Bull et al. 2013; OECD 2016).

They are also typically implemented after the impacts to biodiversity have been permitted, which results in the trading of immediate losses with delayed gains, the success of which is uncertain (Bull et al. 2013; Maron et al. 2016; Dorrough et al. 2019).

2. **Offset banking.** Also known as a third party offset¹⁰, offset banking mechanisms allow developers to purchase offsets from an existing bank of offset sites. It takes the responsibility of the implementation and success of the offset away from the developer to a third party offset provider. The gains generated by a third party offset may be sold to one or multiple permit holders to meet their offset requirements from permitted losses elsewhere. Offset banking is the most widely recommended offsetting mechanism, as it provides the potential for gains in biodiversity to be generated in advance of permitted losses to reduce uncertainty. However, given the time required to generate a gain from offsetting (e.g. a 10 or 20-year offset management period), gains may only be partially achieved when sold under an offset banking model (Bekessy et al. 2010; Gibbons et al. 2016; Maron et al. 2016).
3. **Payment in-lieu.** In-lieu fees may be paid into a collective offset fund to aggregate funds and invest into suitable offsets consistent with offset requirements. The fund manager therefore becomes responsible for the implementation and success of these offsets. Under the *NSW Biodiversity Offsets Scheme*, a proponent may choose to pay into the Biodiversity Conservation Fund instead of sourcing the offsets themselves or through a third party (NSW Government 2016). Payment in-lieu mechanisms normally result in

¹⁰ Refer to Glossary.

delayed offsetting, however they could assist in creating larger, more strategic and better managed offsets through the aggregation of resources.

Maron (2015) warn against the misuse of biodiversity offsetting funds into existing protected areas or redirected to meet pre-existing conservation commitments. The Convention on Biological Diversity (CBD) requires that gains in biodiversity from offsetting would not have otherwise been achieved (CBS 2011; Maron 2015). If permitted losses of biodiversity are not offset with gains that are additional to existing conservation commitments and targets, the offsets will not achieve a No Net Loss objective (Maron et al. 2015b).

2.5 Like-for-like offsetting

Also known as ‘in-kind’ offsets, like-for-like¹¹ offsets are required to match the key characteristics of the biota being impacted with that of the offset, such as location, type and condition (Bull et al. 2016). The Australian *EPBC Act Environmental Offset Policy* and *NSW biodiversity offsets scheme* require impacts to threatened species or ecological communities be offset through protecting and/or restoring habitat for the same species or communities, as close to the impact site as possible (SEWPaC 2012; OEH 2017a).

Although biodiversity is never truly identical in different locations, in-kind offsets provide a connection between the impact and the offset (Bull et al. 2016). ‘Out-of-kind’ offsets do not need to match key characteristics of the biota being impacted, which may lead to a disproportionate loss of biota with certain characteristics over others. Under the *NSW biodiversity offsets scheme*, ‘trading up’ with a higher value offset (e.g. a more threatened

¹¹ Refer to Glossary.

community) may be possible if certain like-for-like requirements cannot be met (e.g. same ecological community) (OEH 2017a). Trading up and other strategic offsetting approaches could be more valuable from a conservation perspective, however they remove the connection between the impact and the offset. Bull et al. (2016) argue that any out-of-kind offsets conflict with a No Net Loss objective.

2.6 Biodiversity metrics, measuring loss and gain

To achieve a No Net Loss objective, biodiversity offsetting policies must demonstrate equivalence between the permitted loss from development, and the gain from an offset (Maseyk et al. 2016; Maron et al. 2018). To evaluate equivalence, the same metrics must be used to quantify the losses and gains (Peterson et al. 2018). If the losses and gains are assessed under different metrics and/or set of assumptions, any evaluation of a loss-gain exchange to determine if No Net Loss is achieved will be invalid. Different kinds of biodiversity metrics¹² have been developed by governments and integrated into offsetting policy, all of which face challenges in demonstrating equivalence between losses and gains (Gibbons et al. 2016).

Under the *US Compensatory Mitigation and Wetland Banking* program, metrics are used to establish equivalence between the permitted wetland loss and proposed gain, and achieve an overall No Net Loss of wetland values and functions. However, their application has varied considerably between US states and development projects (OECD 2016). Some have used a simple area measure, while others have used more sophisticated measures to achieve a like-for-like offset, including their ecological characteristics, quality and ecological function.

¹² Refer to Glossary.

However sophisticated, the metrics used at the loss site have rarely paralleled those used at the offset site. This disjunct has made it difficult to demonstrate equivalence between an impact and offset, and therefore whether the policy achieves its goal of no net loss (Simenstad and Thom 1996; Zedler and Callaway 1999; Burgin 2011).

The NSW *Biodiversity Assessment Method* employs a composite measure for vegetation condition (called a *Vegetation Integrity Score*) using vegetation composition, structure and function against a relevant benchmark vegetation community, coupled with landscape context measures and threatened species habitat requirements (OEH 2017b). Permitted losses are calculated using the current *Vegetation Integrity Score* at the impact site and the expected loss of this vegetation. Gains are calculated by comparing the current *Vegetation Integrity Score* at the offset site with the projected *Vegetation Integrity Score*, 20 years into the future, with (improvement) and without (averted loss) the offset (Figure 1). This method applies a consistent metric across the state to measure loss and gain, however the level of uncertainty in predicting a future gain compared to loss is often poorly quantified (Bekessey et al. 2010; Dorrough et al. 2019). Multipliers¹³ are commonly used in offsetting to account for this uncertainty, but they may not be drawn from empirical data and are typically severely under-estimated (Bull et al. 2013 & 2017).

Under the Australian *EPBC Act Environmental Offset Policy*, a number of estimated values are used to account for the uncertainty of future gains, including the risk of loss with and without the offset (e.g. through natural decline and other factors), the likelihood of success of the proposed offset, and the confidence in result (SEWPaC 2012b). The onus however is on the

¹³ Refer to Glossary.

developer to estimate these values and, due to a current lack of empirical data available, may not always be based on scientific evidence (Bull et al. 2013; Maron et al. 2016; Peterson et al. 2018; Dorrough et al. 2019).

As Australia's biodiversity is shown to be in continual decline (Cresswell & Murphy 2017), Australian, NSW and Victorian biodiversity offsetting policies all assume a decline in the target biota without an offset. Gains in biodiversity are therefore generated from averted loss, as well as from improvement in biodiversity over an offset management period. Figure 1b illustrates the total gain available from both improvement and averted loss in biodiversity relevant to its value at the beginning of the offset management period, and to its declining baseline value without the offset. The selection of accurate baseline scenarios against which to evaluate loss and gain (debiting and crediting baselines¹⁴, Figure 1) is integral to achieving a true loss-gain equivalence and No Net Loss outcome for biodiversity (Gordon et al. 2011; Peterson et al. 2018).

Figure 1. Measuring (a) loss in biodiversity from a development impact, and (b) gain in biodiversity from an offset due to averted loss and improvement in biodiversity over an offset management period.

¹⁴ Refer to Glossary.

2.7 Debiting and Crediting Baselines

Also known as “frame of reference”, “reference scenarios”, “baseline scenarios” and “counterfactuals” (Bull et al. 2016; Maron et al. 2016 & 2018), debiting and crediting baselines provide a reference against which a loss at the impact site (debiting) or gain at the offset site (crediting) is measured (Figure 1). Debiting baselines at the impact site are typically fixed (Bull et al. 2016). Loss is the difference between the biodiversity value before the development impact and the value after the development impact (Figure 1a). Crediting baselines at the offset site may be fixed or dynamic, and include assumptions about future biodiversity change with and without the offset (Maron et al. 2018, Figure 1b).

Fixed crediting baselines may be aligned with the biodiversity value at the offset site prior to offset implementation, and provide a ‘snapshot’ of the target biota at a particular point in time (Maron et al. 2018). Gains can only be generated through improving or restoring the target biota (see improvement gain in Figure 1b) (Maron et al. 2012). Fixed baseline scenarios carry less risk, as they do not require assumptions about future change without an offset (Maron et al. 2018). They do require making assumptions about the expected improvement in biota from the proposed offset management activities, but these may be verified at the end of the offset management period.

Fixed crediting baselines that only award gain from improving or restoring biodiversity may not however result in the best offsetting outcomes, as they encourage the selection of offset sites comprising lower biodiversity value, as they have a greater improvement or restoration potential (Dorrough et al. 2019). This could also result in the perverse incentive for the degradation of sites prior to initiating an offset, allowing the offset to deliver larger gains.

Ecological restoration also takes considerable time, and the success rates are well below 100% (Maron et al. 2012; Curran et al. 2014; Gibbons et al. 2015).

Dynamic crediting baselines require making assumptions about what will happen without an offset (Sonter et al. 2017; Maron et al. 2018). Under dynamic baselines, gains are accumulated against a trajectory of change over a selected offset management period (Figure 1b). As global biodiversity shows continual decline (IPBES 2019a), dynamic crediting baselines generally assume that there will also be a decline in biodiversity over time without an offset (Salzman and Ruhl 2010; Pawliczek and Sullivan 2011; TBC & FFI 2012). Gains in biodiversity are therefore generated from averting loss (Maron et al. 2013). In fact, many offset policies allow the generation of gains from averted loss, through the protection and maintenance of existing biodiversity, without making further improvements (U.S. Fish and Wildlife Service 2003; Wilcove and Lee 2004; Brown et al. 2014). A No Net Loss objective under a dynamic crediting baseline thereby aims to maintain a trajectory of background decline (Maron et al. 2015a & 2018), which can be misleading, particularly if the assumptions of decline are not explicitly stated or supported by empirical data (Gordon et al. 2015; Maron et al. 2016; Maseyk et al. 2020).

Selecting a future trajectory of biodiversity decline is problematic due to the uncertainty in future projections, and entails significant risks for biodiversity offsetting (Gordon et al. 2015; Maron et al. 2015a; Dorrough et al. 2019). The assumed trajectory must be based on plausible and detailed projections of future change (Maron et al. 2018). If they are not plausible, biodiversity offsetting is unlikely to achieve its policy objectives. Bull et al. (2014b) caution that economic and political incentives exist to overestimate biodiversity decline. Crediting baselines that overestimate biodiversity decline without the offset will overestimate the gains

from averted loss attributable to the offset, allowing a larger impact in exchange for the same offset. A No Net Loss objective becomes meaningless if an offset is able to generate an unrealistically large amount of gain, and in reality will result in a net loss of biodiversity and further exacerbate biodiversity decline (Salzman and Ruhl 2010; Gordon et al. 2015; Maron et al. 2015a).

Projections of future change must also consider the threats that drive biodiversity decline and the policies, laws and conservation activities already in place to address these threats (Maron et al. 2013; Maseyk et al. 2020). Gains in biodiversity should be additional to these future intentions to protect biodiversity (Gordon et al. 2015). The *NSW biodiversity offset scheme* requires crediting baselines to account for the minimum legislative requirements for land management under different pieces of state legislation (OEH 2017b). Biodiversity offsets only include conservation actions that go beyond these minimum requirements.

Despite the inherent risks, guidance on the specification of crediting baselines is limited (Bull et al. 2015a; Peterson et al. 2018; Maseyk et al. 2020). Few studies have attempted to quantify ecological outcomes with and without an offset (Bull et al. 2013; Dorrough et al. 2019). Instead, offsetting policies may be guided by expert opinion, however informally and without consideration of variation and uncertainty of opinions. A recent expert elicitation undertaken in NSW found that on average experts predicted averted loss and improvement gains to be only modest with an offset (Dorrough et al. 2019). However, the uncertainty and variation among experts was large, and highlighted the need to improve empirical data with long-term site-based monitoring, and, in the interim, to adopt a precautionary approach when determining crediting baselines and estimating offset gains.

Assumptions built in to crediting baselines under biodiversity offsetting policies are rarely explicit or drawn from empirical data, and in some cases are clearly inaccurate (Bull et al. 2014b & 2015b; Maron et al. 2015a). Maron et al. (2015a) examined the assumptions of gain in biodiversity offsetting policies across all six Australian states and two territories, and found that on average crediting baselines assumed rates of loss five times steeper (0.36%-4.2% per annum) than recent rates of woody native vegetation loss in Australia (0-0.5% per annum). Victorian biodiversity offsetting policies assumed one of the largest declines in biodiversity at 2-4.2% per annum, with 1% of this loss due to loss of extent, more than double the recent observed deforestation rates in Victoria (0.43% per annum), and the remainder (1-3.2% per annum) due to loss of condition. Maron et al. (2015a) revealed that their study was limited by the lack of adequate background information in offsetting policies and data on loss of native vegetation condition and non-woody native vegetation. Gordon et al. (2015) called for greater transparency around the development of crediting baselines in order to adequately demonstrate No Net Loss.

As the Victorian offsetting policy assumes one of the largest declines in biodiversity compared to other national policies, Victorian biodiversity may be under greater risk if this assumed decline is not plausible. In the next section, I will undertake a critical review of Victorian biodiversity offsetting policy and examine the assumptions of gain in two permitted impact and offset case studies. I will examine the transparency and plausibility of these assumptions and whether they meaningfully contribute to a No Net Loss objective.

3. Victorian biodiversity offsetting policy

In Victoria, biodiversity offsets are required to compensate for the permitted removal of native vegetation¹⁵, including habitat for rare or threatened species (DSE 2013; DEPI 2014). Native vegetation is central to biodiversity conservation in Victoria (VEAC 2011) and is considered to be a cost effective and useful surrogate to measure biodiversity (DEWHA 2009). Although native vegetation alone does not capture all biodiversity, it does capture habitat for the large portion of Victorian native flora and fauna, and plays a major ecological role in maintaining critical ecosystem processes and catchment health, including the quality of soil, water and air.

Native vegetation is defined as “plants that are indigenous to Victoria, including trees, shrubs, herbs and grasses” (DELWP 2017a, p. 6). It can be assessed as a patch¹⁶ or scattered tree¹⁷, where a patch of native vegetation is either:

- an area of vegetation where at least 25% of the total perennial understorey plant cover is native; or
- any area with three or more native canopy trees where the drip line of each tree touches the drip line of at least one other tree, forming a continuous canopy; or
- any mapped wetland included in the Current wetlands map (DELWP 2017a & 2020b).

¹⁵ Refer to Glossary.

¹⁶ Refer to Glossary.

¹⁷ Refer to Glossary.

A scattered tree is a native canopy tree that does not form part of a patch. It may be large or small in accordance with the relevant Ecological Vegetation Class¹⁸ (EVC) benchmark¹⁹ size for a large tree²⁰, and applied a circle area with either a 15 metre radius (0.071 hectares) or 10 metre radius (0.031 hectares) respectively. The total extent of native vegetation proposed to be removed includes the extent (in hectares) of any patches of native vegetation and scattered trees (see Box 1 below).

3.1 The 2017 Guidelines

The Victorian *Guidelines for the removal, destruction or lopping of native vegetation* ('2017 Guidelines') (DELWP 2017a) is the current (as at May 2020) overarching policy document that outlines the permitted impact and offset requirements for native vegetation in Victoria. The 2017 Guidelines is an incorporated document in all local government ('Councils') planning schemes in Victoria, is applied through the Victorian Planning Provisions, and legislated under Victoria's *Planning and Environment Act 1987*.

The 2017 Guidelines must be applied when a permit is required under Clauses 52.16 (Native Vegetation Precinct Plan) and 52.17 (Native Vegetation) of the Victorian Planning Provisions (DELWP 2020a), and taken into consideration when preparing planning scheme amendments and making decisions on development plans or other planning decisions in order to meet state objectives for native vegetation protection and management (e.g. Clause 12.01 Biodiversity, under the State Planning Policy Framework). The 2017 Guidelines may also be considered under other approval processes for the removal of native vegetation outside planning

¹⁸ Refer to Glossary.

¹⁹ Refer to Glossary.

²⁰ Refer to Glossary.

schemes, such as approvals under the *Pipeline Act 2005* and *Mineral Resources (Sustainable Development) Act 1990*, or when the removal of native vegetation is exempt from the requirement for a planning permit (DELWP 2017a).

The purpose of Clauses 52.16, 52.17 and 12.01-2S of the Victorian Planning Schemes is to ensure “no net loss in biodiversity as a result of the removal, destruction or lopping of native vegetation” by applying the following three step mitigation hierarchy to all applications to remove native vegetation:

1. Avoid the removal, destruction or lopping of native vegetation;
2. Minimise impacts from the removal, destruction or lopping of native vegetation that cannot be avoided; and,
3. Provide an offset to compensate for the biodiversity impact if a permit is granted to remove, destroy or lop native vegetation (DELWP 2020a).

This hierarchy should ensure that offsets are treated as a last resort, however the 2017 Guidelines only outline non-binding considerations for authorities to assess efforts to avoid and minimise impacts to native vegetation and threatened species habitat (DELWP 2017a). These considerations allow authorities to work through development siting and design options with applicants. They do not allow authorities to refuse development applications based upon proposed impacts to biodiversity alone.

3.2 Assessment Pathway

The assessment pathway determines the impact assessment requirements for an application to remove native vegetation and the decision guidelines for authorities (DELWP 2017a). The three assessment pathways are ‘Basic’, ‘Intermediate’ or ‘Detailed’, and are determined by

the relevant location category and extent of native vegetation to be removed, including removal on the same parcel of land in the same ownership in the previous five year period (Table 1). Three location categories are applied across the whole of Victoria and indicate the potential risk to biodiversity from removing a small amount (<0.5ha) of native vegetation (Figure 2). Location category 2 includes coastal areas and known areas of endangered EVCs and/or sensitive wetlands. Location category 3 includes areas where a small amount of native vegetation removal may have a significant impact on habitat for rare or threatened species.

Table 1. Determining the assessment pathway

Extent of native vegetation	Location category		
	1	2	3
Less than 0.5 hectares, and not including any large trees	Basic	Intermediate	Detailed
Less than 0.5 hectares, and including one or more large trees	Intermediate	Intermediate	Detailed
0.5 hectares or more	Detailed	Detailed	Detailed

Figure 2. Location Map with three different location categories (DELWP 2017a & 2020b).

Under the Detailed assessment pathway, native vegetation condition must be assessed through an on-site vegetation quality (habitat hectare) assessment²¹ conducted by an accredited assessor (e.g. qualified ecologist) (Appendix 1). A habitat hectare²² is a measure of native vegetation quality and quantity, assessed against the relevant EVC benchmark (Parkes et al. 2003; DSE 2004; DELWP 2020c). Benchmarks have been developed for each EVC known to occur in each of the 28 Victorian bioregions²³. Under Basic or Intermediate assessment pathways, the native vegetation condition may be determined either through an on-site assessment or by using modelled native vegetation condition data available on the Victorian Government *Native Vegetation Information Management (NVIM)* system (DELWP 2020b). Scattered trees are assigned a default native vegetation condition score of 0.20 when identified by an accredited assessor, or the modelled condition score when an on-site assessment is not undertaken. All applications must demonstrate the three-step approach of avoid, minimise and offset, and additional decision guidelines are applicable to Intermediate and Detailed assessment pathways (DELWP 2017a).

²¹ Refer to Glossary.

²² Refer to Glossary.

²³ Refer to Glossary.

Box 1. Metrics for Loss and Gain under Victorian Offsetting Policy (DELWP 2017a)						
Native Vegetation Extent	Extent of patches (ha) + extent of scattered trees (ha) + no. of large trees					
Habitat Score	Vegetation Quality Assessment Score (Appendix 1) out of 100					
Habitat Hectares of loss	= Habitat Score/100 x Area (Hectares) to be lost					
Gain Score	Prior Management Gain + Security Gain + Maintenance Gain + Improvement Gain					
Habitat Hectares of Gain	= Gain Score/100 x Area (Hectares) to be protected for offset					
General landscape factor	Strategic biodiversity value score/ 2 + 0.5					
Species landscape factor	Habitat importance score/ 2 + 0.5					
General habitat units of loss	Habitat hectares of loss	x	general landscape factor	x 1.5	+ no. Large Trees	Impact
Species habitat units of loss	Habitat hectares of loss	x	species landscape factor	x 2	+ no. Large Trees	
General habitat units of gain	Habitat Hectares of gain	x	general landscape factor		inc no. Large Trees	Offset
Species habitat units of gain	Habitat Hectares of gain	x	species landscape factor		inc no. Large Trees	

3.3 Measuring Loss

A loss in native vegetation from an impact is measured in General or Species Habitat Units²⁴ (HUs) using the modelled or assessed habitat (condition) score²⁵, the area (ha) proposed for loss, the *general or species landscape factors*, and the relevant multipliers (see Box 1). The *general landscape factor* is the adjusted *Strategic Biodiversity Value* (SBV) score at the impact site (Figure 3). The SBV is a modelled score between 0-1 which varies across Victoria, and reflects a site's ranked contribution to the conservation of Victoria's biodiversity (DELWP 2017b). The SBV data was drawn from the Zonation conservation planning software, which integrates threatened species information into land-use planning (Gordon et al. 2009).

²⁴ Refer to Glossary.

²⁵ Refer to Glossary.

Figure 3. Victorian Strategic Biodiversity Value Scores (DELWP 2020d)

The *species landscape factor* is the adjusted *Habitat Importance Score* (HIS) for a rare or threatened flora and fauna species listed under Victoria’s Advisory Lists of rare or threatened plants and animals (DSE 2013; DEPI 2014). HIS data is drawn from habitat distribution models (HDMs) that have been developed for all rare or threatened Victorian species (DELWP 2017b). The *species landscape factor* is applied when native vegetation loss will have a significant impact on habitat for a rare or threatened species (DELWP 2017a). Figure 4 shows an example of the HIS data for the rare Veined Spear-grass *Austrostipa rudis* subsp. *australis* in East Gippsland (DELWP 2020d). Impacts to native vegetation in these areas may require a species offset (measured in Species HUs) for Veined Spear-grass, and offsets in these areas are likely to generate species offsets for Veined Spear-grass. Site assessment data may replace the modelled habitat data for a species at either the impact or offset site.

Figure 4. Habitat Importance Score for Veined Spear-grass in the East Gippsland Shire Council (DELWP 2020d)

The 2017 Guidelines state that the use of multipliers “applies the precautionary principle to ensure no net loss to biodiversity is achieved as a result of native vegetation removal” (DELWP 2017a, p. 16). They are intended to account for the potential timelag between a permitted loss and an offset, and balance the risk of a predicted gain from an offset not being achieved. A multiplier of 1.5 is applied to all general offsets and a multiplier of 2 is applied to all species offsets. The higher species offset multiplier is intended to account for the greater loss in biodiversity value when rare or threatened species are impacted and the increased risk if offsets are not successful. Bull et al. (2017) found that multipliers should in theory be in the tens and hundreds to account for ecological uncertainties. The 2017 Guidelines or other related policy documents do not provide any justification for the specified multiplier values, and how they will compensate for offset timelags and the risk of gains not being achieved. Therefore it is not clear how the use of these multipliers will “ensure no net loss to biodiversity”. More explicit information about the selection of multiplier values in Victorian policy is required to better support its No Net Loss objective.

3.4 Like for like requirements

Under a general offset (measured in General HUs), the offset site does not need to comprise the same vegetation or habitat type as the impact site, however it must have a SBV score of at least 80% of the native vegetation to be lost and be located within the same Catchment

Management Authority (CMA) or Local Government Area (LGA) as the impact site (DELWP 2017a). Without maintaining a connection between the native vegetation community or habitat type (e.g. the same EVC) impacted, there is potential for the disproportionate loss of vegetation communities and habitat types at greater risk (e.g. native vegetation close to existing urban areas). Under a species offset, the offset site may be located anywhere in Victoria, however it must comprise mapped or assessed habitat for the same threatened species as the species offset requirement.

General or species offsets must also provide at least the same number of large trees proposed to be impacted, including large trees in patches or as scattered trees (Box 1). This one-for-one large tree requirement does not provide an immediate additionality from an offset. It does however allow for the recruitment of native canopy trees through the protection of an existing large tree, with the potential to develop into large trees in the future, although well beyond a 10-year offset management period.

3.5 Measuring Gain

A gain in native vegetation from an offset is also measured in General or Species HUs, using the *gain score*, the area proposed for offset, and the *general or species landscape factors* (Box 1). The gain score is made up of gain points that are awarded under the four types of gain: prior management gain, security gain, maintenance gain and improvement gain. Table 2 outlines each type of gain as described in Victoria's *Native vegetation gain scoring manual – Version 2* ('gain scoring manual') (DELWP 2017c), and shows the range of gain points that may be awarded under each type according to the offset land tenure, in-perpetuity protection, offset type, vegetation habitat (condition) score at the beginning of the 10-year offset management period, and proposed management activities to be implemented.

Table 2. Types of Gain Available on Freehold and Crown Land (DELWP 2017c)

Type of Gain	Description	Potential Gain Accrued			Range of Gain points available per ha (0-1)
Prior Management Gain	This gain acknowledges management undertaken by landowners on a freehold site since State-wide planning permit controls for native vegetation removal were introduced in 1989.	Freehold	10% of current habitat score		0.02-0.08
		Crown land	NA		0.00
Security Gain	This gain results from increasing the administrative protection of native vegetation on a specific site through a suitable on-title security agreement, transferring freehold land to a secure Crown land reserve managed for conservation purposes, or reclassifying existing Crown land to a Crown land reserve managed for conservation purposes.	Freehold	Enter into on-title agreement (e.g. s173 or s69 agreements or conservation covenant)	10% of current habitat score	0.02-0.08
			Transfer freehold land to the Crown	20% of current habitat score	0.04-0.16
		Crown land	Reclassify <i>Crown land</i> – <i>multiple/other purpose to Crown Land</i> – Conservation as primary purpose	10% of current habitat score	0.02-0.08
			<i>Crown land</i> – <i>conservation as primary purpose, no change</i>	NA	0.00
Maintenance Gain	This is gain from commitments that contribute to the maintenance of the current vegetation quality over time (i.e. avoiding any decline).	Freehold	Proportionate points of gain for each relevant habitat attribute and foregoing land use entitlements (eg. livestock grazing, firewood collection)	Patch Woody Vegetation	0.0005-0.13
				Patch Non- Woody Vegetation	0- 0.2
				Revegetation	0-0.05
				Scattered Tree	0.056-0.136
		Crown land		Patch/ Scattered Tree	0.02
				Revegetation	0-0.05
Improvement Gain	This is gain resulting from management commitments beyond existing obligations under legislation to improve the current vegetation quality	Freehold	Proportionate points of gain for each relevant habitat attribute and proposed actions to improve quality over 10-year management period (eg. weed control)	Patch Woody Vegetation	0.02-0.176
				Patch Non- Woody Vegetation	0.01-0.075
				Revegetation	0.1-0.15
				Scattered Tree	NA
		Crown land		Patch	0.15-0.33
				Scattered Tree	NA
				Revegetation	0-0.05

According to the Victorian gain scoring manual, the maintenance and improvement gains provide gain for averted loss and improvement in native vegetation respectively (Table 2).

The crediting baseline under Victorian offsetting policy, against which a gain at an offset site is measured, is therefore dynamic and assumes a decline in native vegetation without an offset (Figure 1b). The maintenance gain is generated from averted loss in native vegetation over a 10-year management period as a result of foregoing the existing entitled land uses that may degrade or clear native vegetation, such as agriculture and firewood collection, and controlling threats, such as weed and pest invasions.

Improvement gain is generated from undertaking management actions to improve native vegetation condition over the 10-year management period. These management actions must

be above and beyond the existing land management obligations, such as native vegetation protection requirements under existing overlays or controlling declared noxious weeds under the *Catchment and Land Protection Act 1994* (CaLP Act). Management actions that generate improvement gains include controlling other weeds, pest animals and significant threats to the offset, such as livestock grazing or spray drift from adjacent land, revegetation or supplementary planting, the introduction of logs, and biomass control in grassland ecosystems (DELWP 2017c). The gain points awarded for maintenance (averted loss) and improvement gains are proportionate to the habitat (condition) score at the beginning of the offset management period, and therefore represent the assumed loss and gain in native vegetation condition with and without the offset.

The role of prior management and security gains is less clear (Table 2). Prior management gain rewards landowners on freehold land for maintaining native vegetation at an offset site prior to the offset occurring. The incentive behind this gain may be to discourage landowners from intentionally degrading or clearing native vegetation prior to an offset in order to inflate the potential improvement gains. In my opinion, this is a perverse incentive given it rewards landowners for not degrading or clearing native vegetation, which may include legal (i.e. entitled uses) or illegal land use activities. Activities undertaken prior to an offset to avert the loss of native vegetation are also not providing any additionality that is attributable to the offset itself, and therefore should not contribute to gains from the offset.

Minimum native vegetation condition and habitat requirements for offsets are a more appropriate mechanism to discourage landowners from undertaking activities that may degrade vegetation and habitat prior to an offset. Victoria's gain scoring manual already outlines minimum vegetation condition requirements for offsets. These include:

1. Any patch of native vegetation must have a minimum 'site condition score'²⁶ of 30 out of 75; and,
2. Any treeless EVCs, such as grassland and wetland EVCs, must have a minimum 'lack of weeds score'²⁷ of 7 out of 15 (DELWP 2017c).

These minimum vegetation condition requirements discourage activities that would potentially degrade native vegetation and risk its qualification for an offset. I argue that the prior management gain is therefore a double up of existing mechanisms, and, as it does not relate to additionality from an offset, would artificially inflate the gains in native vegetation from an offset.

The security gain is awarded for increasing the administrative protection on the land title in perpetuity through an on-title security agreement (on freehold) that provides permanent protection status under legislation, such as a Section 69 (*Conservation, Forests and Lands Act 1987*) Agreement²⁸, Conservation Covenant²⁹ (*Victorian Conservation Trust Act 1972*) or a Section 173 (*Planning and Environment Act 1987*) Agreement³⁰, transferring freehold to the Crown or reclassifying Crown land to *Crown land – Conservation as primary purpose*. This involves the preparation of agreements, offset management plans and other associated paperwork, which permanently restricts allowable land uses at an offset site to conservation activities in perpetuity. Represented as a percentage of the habitat (condition) score, the

²⁶ The site condition score is determine in accordance with the Victorian Government's *Vegetation Quality Assessment Manual – Guidelines for applying the habitat hectares scoring method Version 1.3* (DSE 2004)

²⁷ The lack of weeds score is determine in accordance with the Victorian Government's *Vegetation Quality Assessment Manual – Guidelines for applying the habitat hectares scoring method Version 1.3* (DSE 2004)

²⁸ Refer to Glossary.

²⁹ Refer to Glossary.

³⁰ Refer to Glossary.

security gain also accounts for averted loss in native vegetation condition from foregoing existing land use entitlements.

Maron et al. (2015a) interpreted the security gain under the Victorian gain scoring manual as averted loss of native vegetation extent. This is a reasonable interpretation, as applying a suitable administrative protection to an offset site will permanently prevent any permitted removal of native vegetation. However, this is not explicitly stated in the policy, and the security gain is not proportionate to the total native vegetation extent or habitat hectares but rather its habitat (condition) score alone. In my opinion, the security gain is a double up of the maintenance gain, and could be addressed through minimum offset site security requirements rather than awarding further gain for averted loss. In addition to prior management gain, security gain has the potential to artificially inflate the gains in native vegetation from an offset.

The maintenance, prior management and security gains are all awarded for averted loss of native vegetation with an offset, either as a percentage of the total habitat score or an aggregate of points relevant to each habitat attribute value that make up the total habitat score (Appendix 1; Table 2; DELWP 2017c). The gain points generated under these gains therefore reflect the assumed decline in native vegetation that is projected to occur without an offset. The projections are however not referenced by any published research or supported by other policy. Maron et al. (2015a) found that Victorian offsetting policy assumed one of the largest declines in biodiversity compared to other national policies, at 20-42% loss over a 10-year offset management period, or 2-4.2 % per annum. The study noted that this assumed decline was significantly higher than recent rates of woody native vegetation extent loss (0.43% per annum).

The improvement gain is awarded for improvements to native vegetation from an offset, as an aggregate of points relevant to each habitat attribute value (Appendix 1; Table 2; DELWP 2017c). The projected increase in native vegetation condition from offsetting is also not referenced by any published research or supported by other policy. Although not explicitly stated, the Victorian Government may have drawn on expert advice to determine the assumptions of decline in native vegetation without an offset and of improvement in native vegetation with an offset. However, as Dorrough et al. (2019) found, the uncertainty and variation among experts can be large, and should not replace the use of empirical data.

If the assumptions of gain from offsetting are not accurate, equivalence between an impact and an offset, and the achievement of a No Net Loss policy objective, cannot be validated. In the next section, I will review two loss-gain exchange case studies that were permitted under Victorian offsetting policy. I will outline the assumptions of gain awarded for each offset for averted loss and improvement in native vegetation, and investigate whether these assumptions are plausible, or whether they are likely to be overestimated in line with the findings of Maron et al. (2015a).

4. Loss-Gain Exchange Case Studies under Victorian Offsetting Policy

Two loss-gain case studies that were permitted under Victorian offsetting policy are presented below. Both case studies relate to the loss and gain of General HUs comprising woody native vegetation types at the impact and offset sites. These case studies do not reflect all the possible loss-gain scenarios under Victorian policy. They are two examples of a loss-gain exchange that were available for this study, and provide an opportunity to investigate the plausibility of the assumptions of gain under Victorian offsetting policy. To protect confidentiality, all references specific to the development projects, purchasers and credit owners in each case study have been removed.

Case Study 1: North Central Catchment Management Authority

In 2018, a permitted impact to native vegetation in the North Central Catchment Management Authority (CMA) was compensated through purchasing offsets from a third party offset, also in the North Central CMA, that met the equivalence requirements under Victoria's 2017 Guidelines (Box 2). The impact covered a long (11.4 kilometres), narrow (20 metres wide), lineal area that traversed three different Local Government Areas (LGAs), and involved the removal of native vegetation representing six different EVCs of three Victorian bioregions (Table B2.1, Box 2).

The offset was purchased from a credit owner³¹ (also the landowner in this instance), who owns the property in the North Central CMA with the registered offset. The property is located in the Northern Grampians Shire, is zoned Farming Zone and did not contain any overlays that restrict land uses at the time of the offset registration (DELWP 2020a). The offset

³¹ Refer to Glossary.

was registered on the land title under a Section 69 (*Conservation, Forests and Lands Act 1987*) Agreement in July 2009, which permanently restricts land use to conservation purposes in accordance with the agreement and 10-year offset management plan.

The entire offset comprises 34.12 hectares of native vegetation that represents multiple EVCs of the Goldfields bioregion, including Heathy Dry Forest (EVC 20), Low Rises Grassy Woodland (EVC 175_61), Creekline Grassy Woodland (EVC 68) and Alluvial Terraces Herb-rich Woodland (EVC 67). However, this loss-gain exchange corresponded to only a small portion (1.283 hectares) of the habitat zone³² known as 1J, which comprises a total of 5.7 hectares of Heathy Dry Forest vegetation (Tables B2.1 and B2.2, Box 2). This EVC was not representative of the native vegetation impacted in this loss-gain exchange.

Table B2.1 (Box 2) demonstrates how equivalence between the General HUs of loss from the permitted impact and General HUs of gain from the offset was determined under the 2017 Guidelines (Box 1; DELWP 2017a). The loss-gain exchange involved the purchase of 0.309 General HUs from habitat zone 1J for a total cost of \$24,720.00 (exc GST), or \$80,000.00 (exc GST) per General HU (Tables B2.1 and B2.2, Box 2). The loss-gain exchange occurred in March 2019, less than four months prior to the completion of the 10-year offset management plan. Therefore, in theory, the majority of the gain for this loss-gain exchange would have been generated in advance of the impact occurring.

Prior to the offset registration, the site was grazed by sheep, and had a significant rabbit population with multiple warrens (*pers comm* with Landowner, 9 September 2019). Management activities undertaken over the 10-year management period involved the

³² Refer to Glossary.

installation and repair of boundary fencing, livestock exclusion, rabbit and fox control, weed control, site monitoring and annual reporting to the Victorian Government (*Agreement made under Section 69 of the Conservation Forests & Lands Act 1987, 9 July 2009*).

The foregone land use entitlements, on-title security agreement, vegetation condition (habitat score) and proposed management activities determined the gains that would be generated from this offset over the 10-year management period in accordance with the former 2006 Victorian gain scoring manual (DSE 2006). Table B2.2 (Box 2) outlines the prior management, security, maintenance and improvements gains that were awarded to habitat zone 1J under the 2006 gain scoring manual. Small adjustments were made to the calculation of the maintenance and improvement gains when the Victorian gain scoring manual was updated in 2017 (DELWP 2017c). Under the 2017 gain scoring manual, the same offset would have generated a slightly higher maintenance gain and smaller improvement gain (Table B2.2, Box 2).

The gain score is the aggregate of the four types of gain awarded to the offset (Table 2). Both the prior management and security gains (7.5 each) are 10% of the offset habitat score of 75 out of 100, and the maintenance and improvement gains are the aggregate of points awarded relevant to each habitat attribute, the offset security arrangement and agreed management activities over the 10-year offset management period (Table 2; Table B2.2, Box 2).

Awarding gain points against each habitat attribute score for maintenance and improvement gains implies that these habitat attribute scores have been projected to either decline without the offset (for maintenance gain) or increase with the offset (for improvement gain) according to the number of gain points awarded. For example, the assessed habitat attribute score for

Tree Canopy Cover is 2. The gain points of 0.1 awarded for the maintenance of Tree Canopy Cover implies that, without the offset, the habitat attribute score for Tree Canopy Cover would decline from 2 to 1.9 over the same 10-year period. The gain points of 0.4 awarded for improvement of Tree Canopy Cover implies that, with the offset, the habitat attribute score for Tree Canopy Cover would increase from 2 to 2.4 over the 10-year offset management period.

Unfortunately, these assumed points of decline without the offset, and assumed points of increase with the offset, are not consistent with habitat hectare methodology used to assess the native vegetation prior to the offset implementation, as 1.9 and 2.4 are not available scores for Tree Canopy Cover in this methodology (Appendix 1). This discrepancy is apparent for maintenance and improvement gain points awarded against multiple habitat attributes, and makes the projected habitat (condition) score impossible to validate at the end of the offset management period using the same habitat hectare assessment methodology. I will discuss this issue in more detail in Section 4.2.2.

The total maintenance gain added to 6.3 gain points (Table B2.2, Box 2), or 8.4% of the offset habitat score (75). The prior management and security gain are also awarded for averted loss from the offset (see Section 3.4). The combined assumption of the prior management, security and maintenance gains is that without the offset, the native vegetation would have declined by 28.4% in 10 years (2.84% per annum, assuming a linear change). At 10.4 gain points, the improvement gain assumes that the native vegetation will improve by 13.87% in 10 years (1.39% per annum, assuming a linear change) with the offset.

As discussed earlier (Section 3.4), the prior management and security gains do not relate to an additionality in native vegetation from the offset, however they accounted for over 47% of the total gain (or \$11,697.16) in this transaction. This proportion would have been even larger under the updated 2017 gain scoring manual (Table B2.2, Box 2; DELWP 2017c). If the prior management and security gains were removed, and only the maintenance gain generated gains for averted loss at 0.84% per annum, the same habitat zone would have generated almost half the total gain (approximately 53%) (Table B2.2, Box 2). If the credit owner priced their offsets under the same per General HU rate (\$80,000/GHU), the General HUs from habitat zone 1J would also be worth close to half the amount. However, if they sought to earn the same total price for their offsets from habitat zone 1J, the per General HU price would increase to approximately \$152,132.96/GHU. This would have increased the price of the case study 1 loss-gain exchange from \$24,720.00 (exc GST) to \$47,009.09 (exc GST).

Box 2. Loss-Gain Exchange Case Study 1 – North Central CMA

Table B2.1. The Loss-Gain Exchange

Attribute	Impact (Loss)	Offset (Gain)
Catchment Management Authority	North Central	North Central
Local Government Area	Central Goldfields, Pyrenees, Hepburn	Northern Grampians
Native Vegetation Type	Patch	Patch
Area (hectares)	0.633	1.283
Bioregion(s)	Victorian Volcanic Plain, Central Victorian Uplands, Goldfields	Goldfields
Ecological Vegetation Classes	Plains Grassy Woodland, Hills Herb-rich Woodland, Creekline Grassy Woodland, Grassy Woodland (Granitic), Box Ironbark Forest, Alluvial Terraces Herb-rich Woodland	Heathy Dry Forest
Habitat Score (Condition)	11-61/100 (0.11-0.61/ha)	75/100 (0.75/ha)
Gain Score		31.7 (0.317/ha)
Habitat Hectares	(of Loss) 0.252	(of Gain) 0.41
Strategic Biodiversity Value (SBV) Score	0.500-0.760 (minimum SBV = 0.515)	0.517
General Habitat Units (GHUs)	(of Loss) 0.309	(of Gain) 0.309
Price per GHU (exc GST)		\$80,000.00
Total Offset Price (exc GST)		\$24,720.00

Table B2.2. Offset Gain Calculator

Attribute			DSE 2006 Gain			DELWP 2017 Gain		
Habitat Zone			1J			1J		
Bioregion EVC name			Goldfields			Goldfields		
			Heathy Dry Forest			Heathy Dry Forest		
		Max	Current condition	Maintenance gain	Improvement gain	Current condition	Maintenance gain	Improvement gain
Scores	Large Trees	10	2			2	0.5	
	Tree Canopy Cover	5	2	0.1	0.4	2	0.1	0.4
	Understorey	25	25	2.5	0	25	2.5	0
	Lack of Weeds	15	15		4	15		4
	Recruitment	10	10	1	4	10	1	0
	Organic Litter	5	3	0.3	2	3	0.3	2
	Logs	5	2	2.4	0	2	2.4	0
	Site Condition	75	59			59		
	Landscape Context	25	16			16		
	Habitat Score	100	75			75		
Subtotal of gains				6.3	10.4		6.8	6.4
Prior Mgt Gain			7.5			7.5		
Security Gain			7.5			7.5		
Total Gain			31.7			28.2		
Size of habitat zone (Ha)			5.7			5.7		
TOTAL GAIN (HHa)			1.81			1.6074		
Strategic Biodiversity Value Score			0.517			0.517		
General Landscape Factor			0.7585			0.7585		
TOTAL GAIN (GHUs)			1.373			1.219		
Price per GHU (exc GST)			\$80,000.00			\$90,106.65		
Total Habitat Zone GHU Price (exc GST)			\$109,840.00			\$109,840.00		
Removing Prior Management + Security Gains (DSE 2006)								

Case Study 2: Port Phillip and Westernport Catchment Management Authority

In 2018, a permitted impact to native vegetation in the Port Phillip and Westernport CMA was compensated through purchasing offsets from a third party offset, also in the Port Phillip and Westernport CMA, that met the equivalence requirements under Victoria's 2017 Guidelines (Box 3). The permitted impact included the removal of three large scattered trees in an urbanised area of the Greater Dandenong City Council and the Gippsland Plain bioregion (Table B3.1, Box 3).

The offset was purchased from a credit owner (also the landowner), who owns a property in the Port Phillip and Westernport CMA with the registered offset. The property is located in the City of Melton, is zoned Rural Conservation Zone (RCZ), and contains an Environmental Significance Overlay (ESO) and a Bushfire Management Overlay (BMO). Intensive farming practices are not allowed in an RCZ, and other practices, such as livestock grazing, require a permit (DELWP 2020a). An ESO restricts land uses to protect significant environmental values, in this instance, a remnant forest. The BMO required that the offset could not be located within 150 metres of an existing or future dwelling (DELWP 2018; 2020a). The offset was registered on the land title under a Section 69 (*Conservation, Forests and Lands Act 1987*) Agreement and implemented from June 2018.

The entire offset comprises 10.71 hectares of native vegetation that represents Box Ironbark Forest (EVC 61) of the Central Victorian Uplands bioregion. However this loss-gain exchange corresponded to only a small portion (0.145 hectares) of the habitat zone known as 1A, which comprises a total of 6.275 hectares of Box Ironbark Forest (Tables B3.1 and B3.2, Box 3). This EVC was not representative of the native vegetation permitted for impact in this loss-gain

exchange. The offset also did not comprise any large scattered trees (as were impacted), only large trees in a patch of native vegetation.

Table B3.1 (Box 3) demonstrates how equivalence between the General HUs of loss from the permitted impact and the General HUs of gain from the offset were determined under the 2017 Guidelines (Box 1; DELWP 2017a). The loss-gain exchange involved the purchase of 0.030 General HUs with 3 Large Trees from habitat zone 1A for a total cost of \$19,090.91 (exc GST), or \$181,818.18 (exc GST) per General HU and \$4,545.45 (exc GST) per large tree (Tables B3.1 and B3.2, Box 3). The loss-gain exchange occurred in January 2019, only 6 months into the 10-year offset management plan. Therefore, in theory, the majority of the gain for this loss-gain exchange would have been generated over 9.5 years after the impact occurred.

Prior to the offset registration, the site was not used for agriculture or any other commercial purposes. It was however being accessed by unauthorized vehicles, including motorbikes, and pedestrians from neighbouring properties for recreation and firewood collection (*pers comm* with Landowner, 10 April 2018). Locking access gates, erecting signs and communicating with neighbours regarding the conservation of the offset site and prohibited activities was an important management activity to deliver this offset (*Agreement made under Section 69 of the Conservation Forests & Lands Act 1987, 20 June 2018*). Other management activities being implemented over the 10-year offset management period include fencing maintenance, rabbit and fox control, weed control, site monitoring and annual reporting to the Victorian Government.

The foregone land use entitlements, on-title security agreement, vegetation condition (habitat score) and proposed management activities determined the gains that would be

generated from this offset in accordance with the 2017 Victorian gain scoring manual (Table 2; DELWP 2017c). Due to the presence of an ESO over the offset site, the offset was not able to generate maintenance gains under Large Trees, Canopy Cover, Organic Litter and Logs (Table B3.2, Box 3).

Table B3.2 (Box 3) outlines the gains assumed to be generated over the 10-year offset management period relevant to the habitat attribute scores, the site security and agreed management activities. The prior management and security gains (7.8) are 10% of the habitat score of 78 out of 100, and the maintenance gain (3) is 3.9% of the habitat score. The combined assumption of the prior management, security and maintenance gains is that without the offset, the native vegetation will decline by 23.9% in 10 years (2.39% per annum, assuming a linear change). The improvement gain (9) assumes that the native vegetation will improve by 11.5% in 10 years (1.15% per annum, assuming a linear change) with the offset.

Over 56% of the total gain (or \$3,083.00 in this transaction) was for the prior management and security gains, which do not relate to additionality in native vegetation from the offset. If the prior management and security gains were removed, and only the maintenance gain generated gains for averted loss at 0.39% per annum, the same habitat zone would have generated less than half of the total gain (approximately 44%) (Table B3.2, Box 3). If the credit owner priced their offsets under the same per General HU rate (\$181,818.18/GHU), then the General HUs from habitat zone 1A would also be worth less than half the amount. However, if they sought to earn the same total price for their offsets from habitat zone 1A, the per General HU price would increase to approximately \$418,267.18/GHU. As the large tree cost added \$13,636.36 to this offset transaction, this would have increased the price of the case study 2 loss-gain exchange from \$19,090.91 (exc GST) to \$26,184.37 (exc GST).

Box 3. Loss-Gain Exchange Case Study 2 – Port Phillip and Westernport CMA

Table B3.1. The Loss-Gain Exchange

Attribute	Impact (Loss)	Offset (Gain)
Catchment Management Authority	Port Phillip and Westernport	Port Phillip and Westernport
Local Government Area	Greater Dandenong	Melton
Native Vegetation Type	Scattered Trees (3 Large)	Patch
Area (hectares)	0.157	0.145
Large Tree Species	River Red-gum	Red Box, Grey Box, Bundy
Bioregion(s)	Gippsland Plain	Central Victorian Uplands
Ecological Vegetation Classes	EVC 48 Heathy Woodland	EVC 61 Box Ironbark Forest
Habitat Score (Condition)	20/100 (default) (0.2/ha)	78/100 (0.78/ha)
Gain Score		27.6 (0.276/ha)
Habitat Hectares	(of Loss) 0.031	(of Gain) 0.04
Strategic Biodiversity Value (SBV) Score	0.260 (minimum SBV = 0.208)	0.698
General Habitat Units (GHUs)	(of Loss) 0.030	(of Gain) 0.030
Number of Large Trees	3	3
Price per GHU (exc GST)		\$181,818.18
Price per LT (exc GST)		\$4,545.45
Total Offset Price (exc GST)		\$19,090.91

Table B3.2. Offset Gain Calculator

Attribute		DELWP 2017 Gain			
Habitat Zone		1A			
Bioregion		Central Victorian Uplands			
EVC name		Box Ironbark Forest			
		Max	Current condition	Maintenance gain	Improvement gain
Scores	Large Trees	10	2		
	Tree Canopy Cover	5	4		0
	Understorey	25	20	2	5
	Lack of Weeds	15	13		4
	Recruitment	10	10	1	0
	Organic Litter	5	5		0
	Logs	5	4		0
	Site Condition	75	58		
	Landscape Context	25	20		
	Habitat Score	100	78		
Subtotal of gains			3	9	Removing Prior Management + Security Gains (DELWP 2017)
Prior Management Gain			7.8		-
Security Gain			7.8		-
Total Gain			27.60		12
Size of habitat zone (Ha)			6.275		6.275
TOTAL GAIN (HHa)			1.7319		0.753
Strategic Biodiversity Value Score			0.698		0.698
General Landscape Factor			0.849		0.849
TOTAL GAIN (GHUs)			1.470		0.639
Price per GHU (exc GST)			\$181,818.18		\$418,267.18
Total Habitat Zone GHU Price (exc GST)			\$267,272.73		\$267,272.73
Large Tree (LT) No.			8		8
Price per LT (exc GST)			\$4,545.45		\$4,545.45
Total Habitat Zone LT Price (exc GST)			\$36,363.64		\$36,363.64
Total Habitat Zone Price (exc GST)			\$303,636.37		\$303,636.37

4.1 Case Study Summary

Both case studies reviewed here provided equivalence between the impact and the offset as measured in General HUs, and met the like-for-like requirements in accordance with Victorian offsetting policy. These like-for-like requirements were:

1. The offset was located in the same Catchment Management Authority;
2. The Strategic Biodiversity Value (SBV) score of the offset was at least 80% of the SBV of the impact; and,
3. The offset comprised the same number of large trees as the impact site (if any).

In both case studies, the EVCs impacted were not represented in the offset. In case study 2, the type of native vegetation (scattered trees) impacted was also not represented in the offset. As there is no requirement under Victorian offsetting policy to compensate for impacts to native vegetation with offsets in the same bioregion, comprising the same EVCs, and, in the case of scattered trees, the same native vegetation type, there is potential for a disproportionate loss of native vegetation and/or habitat types at greater risk.

Records of native vegetation loss using satellite imagery show a disproportionate loss in extent of particular native vegetation communities in Victoria. The 2018 *State of the Environment Report* reported a total loss of 567,913 hectares of landscapes supporting native vegetation³³ between 1990 and 2015, primarily from urban development, timber production and agriculture (CES 2018). The largest losses were of native grasslands and herblands (462,899 hectares, approximately 20% loss), native scattered trees (149,063 hectares,

³³ Identified as *Mangrove, Native Grass Herb, Native Scattered Trees, Native Trees, Native Shrub, Natural Low Cover, Wetland Intermittent* and *Wetland Seasonal* (CES 2018, Table B.14, p. 65).

approximately 27% loss), native shrubs (48,642 hectares, approximately 29% loss) and intermittent and seasonal wetlands (80,809 hectares, approximately 17% loss). The 2013 *State of the Environment* report also reported larger losses in native grasslands, grassy woodlands and box ironbark forests (CES 2013), and the *Native Vegetation Net Gain Accounting - First Approximation Report* estimated a larger loss of grassy native vegetation extent (3,200 hectares per year) than woody native vegetation extent (1,200 hectares per year), primarily due to the conversion of grassy native vegetation to more intensive agriculture (DSE 2008).

Case studies 1 and 2 both involved impacts to native vegetation communities that already experience a higher rate of loss, including grassy woodland, box ironbark forest and scattered trees. These impacts were not offset with gains in the same vegetation communities or types, and therefore have the potential to cause a disproportionate loss of EVC 55 Plains Grassy Woodland, EVC 61 Box Ironbark Forest and scattered trees in Victoria.

Table 3 below provides a summary of the gains awarded to the offsets in case studies 1 and 2. The gains awarded for averted loss assume that, without each offset, the native vegetation would have declined in condition by 1.86-2.13 habitat points (2.39-2.84%) per annum when amalgamating the prior management, security and maintenance gains, or by 0.3-0.63 habitat points (0.39-0.84%) per annum under the maintenance gain alone (Table 3). While this assumed loss is represented as a loss of condition, measured by the habitat score, it is not explicit in the Victorian gain scoring manual whether part or all of this assumed loss is due to a risk of loss of extent, as well as condition, without the offset.

Table 3. Summary of gains awarded to case study offsets.

Case Study Offset	Habitat Score (HS)	Averted Loss Gains								Improvement Gain	
		Prior Management		Security		Maintenance		Combined Total			
		Pts	Pts / yr	Pts	Pts / yr	Pts	Pts / yr	Pts	Pts / yr	Pts	Pts / yr
1	75	7.5	0.75	7.5	0.75	6.3	0.63	21.3	2.13	10.4	1.04
2	78	7.8	0.78	7.8	0.78	3	0.3	18.6	1.86	9	0.9

These rates of assumed decline are consistent with Maron et al. (2015a), who estimated gains from averted loss at 2-4.2% per annum under Victorian offsetting policy. However, Maron et al. (2015a) only evaluated the plausibility of these rates of decline against available data on rates of woody native vegetation extent loss in Victoria. As the averted loss gains (prior management, security and maintenance gains) are proportionate to the habitat (condition) score they may reflect the assumed decline in native vegetation condition without the offset rather than extent, or a combination of both. The Victorian gain scoring manual is not explicit about whether gains from averted loss reflect a loss in native vegetation condition and/or extent. Accordingly, I provide an evaluation below of the gains from averted loss in case studies 1 and 2 against the available data on both the rates of native vegetation condition loss and rates of woody native vegetation extent loss on private land in Victoria.

The improvement gains awarded to the offsets from case studies 1 and 2 assume that the native vegetation will improve in condition by 0.9-1.04 habitat points (1.15-1.39%) per annum with the offsets (Table 3). To evaluate the plausibility of the improvement gains awarded in case studies 1 and 2, they should be compared with available monitoring data on changes to native vegetation with an offset. The availability of this data is however limited, and I am unable to evaluate the improvement gains awarded in case studies 1 and 2 in this thesis. I discuss the current limitations of evaluating the plausibility of improvement gains under Victorian offsetting policy further below (Section 4.2.2).

4.2 Plausibility of Gains in Case Studies 1 and 2

4.2.1 Plausibility of averted loss gains

Using satellite imagery and land use data, the Victorian Government has estimated annual rates of change in native vegetation on public and private land across Victoria during two time periods, 1994-2004 and 2008-2014 (Table 4) (DSE 2008; CES 2018). Estimates from both periods determined that the remaining native vegetation on private land is either declining or at risk of declining. However they both acknowledge that these estimates carry highly variable and poorly quantified levels of uncertainty, with greater certainty available in the estimates of change in woody native vegetation extent, and less certainty in the estimates of change in non-woody native vegetation extent and native vegetation condition, which included broad assumptions on land use and management.

Table 4. Estimated Annual Rate of Change in Native Vegetation, 1994-2004 and 2008-2014 (DSE 2008; CES 2018)

	Public Land		Private Land		Public and Private Land	
	1994-2004	2008-2014	1994-2004	2008-2014	1994-2004	2008-2014
Gains Sub-total	+ 8,760 HHa/yr	+ 10,500 HHa/yr	+ 4,560 HHa/yr	+ 3,100 HHa/yr	+13,320 HHa/yr	+13,600 HHa/yr
Losses Sub-total	- 2,860 HHa/yr	- 8,400 HHa/yr	- 14,550 HHa/yr	- 13,400 HHa/yr	-17,410 HHa/yr	-21,800 HHa/yr
Net Outcome	+ 5,900 HHa/yr*	+ 2,100 HHa/yr*	- 9,990 HHa/yr*	- 10,300 HHa/yr*	-4,090 HHa/yr*	-8,200 HHa/yr*

HHa/yr = Habitat Hectare per year

* due to significant uncertainties associated with the underlying assumptions, particularly about the amount of vegetation in each of the categories, these figures may be under- or over-estimates, possibly up to 20%

The net loss of native vegetation on public and private land across Victoria for the period 2008-2014 (8,200 HHa/yr) was more than double the net loss estimated for the period 1994-2004 (4,090 HHa/yr) (DSE 2008; CES 2018). This increase was reportedly due to additional losses estimated for public land for the period 2008-2014, which included impacts from controlled management regimes (e.g. recent planned burns) (DELWP 2015).

Losses on private land were more consistent between the two time periods, and were overwhelmingly due to native vegetation condition loss from existing entitled land uses, unmanaged threats beyond legislative obligations (e.g. environmental weeds), removal of native vegetation that is exempt from requiring a permit (e.g. fences and fire protection), and grassy native vegetation extent loss from its conversion to more intensive agriculture (e.g. improved pastures for domestic grazing or cropland) (DSE 2008; DELWP 2015; CES 2018). Losses of native vegetation that were authorised under a formal regulatory and/or planning process and subject to offsetting requirements were considered to result in a neutral outcome for native vegetation under these estimates, as were natural and semi-natural fluctuations (e.g. wildfire and recovery, timber harvesting and regeneration on public land).

Annual rates of change in native vegetation were estimated in habitat hectares (HHa) of loss or gain, which requires estimates of change in both native vegetation extent and condition (see Box 1) during the two time periods. The 1994-2004 estimated loss on private land (14,550 HHa/yr) applied to 2,598,000 hectares (DSE 2008). There was a loss of extent of 4000 hectares (1,580 HHa/yr) of this area. This leaves 2,594,000 hectares (12,970 HHa/yr) which would have experienced an average loss of 0.5 habitat points in condition per annum to result in a loss of 12,970 HHa/yr. Box 4 below outlines the habitat hectare formula used to reach this per annum condition loss.

The 2008-2014 estimated loss on private land did not provide sufficient detail regarding the loss of native vegetation that was due to the loss of extent compared with the loss of condition, nor the total area of native vegetation on private land that the loss applies to (CES 2018). To be able to undertake this evaluation, I have made two additional assumptions about the 2008-2014 data. The first assumption is that all the annual loss on private land in

2008-2014 (13,440 HHa / yr) related to a loss of condition. However, as a portion of this loss was likely to have been for the loss of native vegetation extent (as was the case in 1994-2004), the true annual loss of native vegetation due to condition loss only is expected to be somewhat less. This assumption is likely to over-estimate native vegetation condition loss during the 2008-2014 period. The second assumption is that the native vegetation loss due to condition loss applied to the same extent of native vegetation on private land (2,594,000 hectares) as the 1994-2004 estimate. However, as native vegetation on private land is declining (DSE 2008; CES 2013 & 2018), the extent of native vegetation remaining on private land during the 2008-2014 period compared to the 1994-2004 period is expected to be less. The second assumption is therefore likely to under-estimate the native vegetation condition loss, as a smaller area would require a higher habitat (condition) score to equal the same habitat hectares.

Box 4. Formulas to Determine Per Annum Native Vegetation Condition Loss				
Habitat Hectares	=	Habitat Score/100	x	Area (Hectares)
1994-2004 (DSE 2008)				
12,970 HHa/yr	=	0.5/100	x	2,594,000 ha
2008-2014 (CES 2018)				
13,440 HHa/yr	=	0.52/100	x	2,594,000 ha

Under these assumptions, the estimated annual loss in condition for the 2008-2014 period is 0.52 habitat points per annum (see Box 4 for formula). While the 2008-2014 estimated annual native vegetation condition loss is not conclusive, it is similar to the 1994-2004 estimated annual condition loss of 0.5 habitat points and therefore appears plausible. The requirement for these additional assumptions highlights the current information gaps in the available data

on native vegetation change in Victoria, which would limit an accurate determination of gains from averted loss.

Figure 5 compares the assumed per annum loss in native vegetation condition (habitat points) without the offsets from case studies 1 and 2, with the estimated per annum loss in native vegetation condition from 1994-2004 and 2008-2014 (Box 4; DSE 2008; CES 2018). It illustrates that the assumed gains from averted loss under the maintenance, security and prior management gains are 3.6-4.3 times higher than the estimated loss in native vegetation condition on private land from the Victorian Government data (DSE 2008; CES 2018). While there are significant uncertainties associated with the Victorian Government's estimates, and additional assumptions were required to be made on the applicable area of the 2008-2014 estimate, the discrepancy between the estimated condition loss on private land and the assumed averted loss in case studies 1 and 2 shows that the assumptions of gain from averted loss with an offset are likely to be significantly over-estimated. The assumed gains from averted loss under the maintenance gain alone are however more consistent with the estimated native vegetation condition loss, with the maintenance gain for case studies 1 being approximately 21-26% higher than this estimate, and the maintenance gain for case study 2 being approximately 40-42% under this estimate.

Figure 5 Average annual gain points awarded for averted loss for Case Study 1 and 2 offsets, compared to estimated annual native vegetation condition loss on private land in Victoria.

While the prior management, security and maintenance gains are calculated according the habitat (condition) score, it is not explicitly stated in the Victorian gain scoring manual as to whether these gains for averted loss are a reflection of the projected decline in native vegetation condition or extent, or a combination of both. Under the habitat hectare formula (Box 4), a percentage loss in the habitat score would result in the same decline in habitat hectares as the equivalent percentage loss of native vegetation extent. Consequently, an assumed loss in native vegetation extent without an offset could be represented as an equivalent gain in the habitat (condition) score from averting this loss. Given this ambiguity, an evaluation of gains from averted loss in case studies 1 and 2 must also consider the rates of native vegetation extent loss on private land in Victoria.

The Victorian Government estimated native vegetation extent loss in hectares across Victoria using satellite imagery (DSE 2008; CES 2018). Figure 6 illustrates the percentage loss of woody native vegetation extent on public and private land during two recent 10-year periods, 1995-2005 and 2005-2015 (CES 2018), compared with the gains awarded for averted loss in case studies 1 and 2, which all comprise woody native vegetation. The assumed averted loss under the prior management, security and maintenance gains is represented as a percentage loss of the habitat score (Figure 6). DSE (2008) also estimated woody native vegetation extent loss in 1994-2004, however it was reported that all this loss was on private land, not public. CES (2018) did not differentiate between woody native vegetation extent loss on public versus private land. Even if all the loss of woody native vegetation during the 1995-2005 and 2005-2015 periods is assumed to have occurred on private land, the averted loss gains (prior management, security and maintenance gains) in case studies 1 and 2 remain 34-218 times higher than any of the recorded losses in woody native vegetation extent across Victoria.

Under the maintenance gain alone, the assumed gains from averted loss are still at least 5-65 higher than the observed woody native vegetation extent loss.

While the Victorian gain scoring manual is not explicit about whether gains from averted loss reflect a loss in native vegetation condition and/or extent, figures 5 and 6 reveal that the projected gains from averted loss in case studies 1 and 2 are likely to be significantly over-estimated when compared to Victorian Government data on either native vegetation condition or extent loss since 1994. Over-estimating gains from averted loss will permit a larger impact in exchange for the same offset. This will result in a net loss of native vegetation in Victoria and further exacerbate biodiversity decline (Salzman and Ruhl 2010; Gordon et al. 2015; Maron et al. 2015a).

Figure 6 Gains from averted loss in Case Study 1 and 2 offsets over 10 years, as a percentage loss of the habitat score, compared to woody native vegetation extent loss on public and private land in Victoria over three 10-year periods.

4.2.2 Plausibility of improvement gain

Site-based monitoring data on improvements in native vegetation from offsetting should be easily collated from existing offset sites throughout Victoria. At 30 June 2019, there were 335 offsets sites registered with the Victorian Native Vegetation Credit Register (NVCR), covering 15,336 hectares of land, with new sites being added each year (DELWP 2020f). These offsets are secured on-title via either a Section 69 Agreement, Trust for Nature Covenant or Section 173 Agreement. While monitoring of offset sites under a Section 173 Agreements varies between Councils, the Victorian Department of Environment, Land, Water and Planning (DELWP) and Trust for Nature (TfN) undertake monitoring for Section 69 Agreements and Covenants every two to four years during the offset management period (*pers comm.* Angela Robb, DELWP and Megan Ivy-Law, TfN, 21 October 2019). The aim of this monitoring is to ensure that the offset is being implemented in accordance with the agreed offset management plan, and that the landowner is compliant with their on-title security agreement. They do not however monitor for improvements in native vegetation condition over the management period. It is assumed that if the offset is implemented in accordance with the security agreement, the predicted gains will also be achieved.

The lack of monitoring for improvement in native vegetation at existing offset sites is a significant opportunity loss to evaluate whether the predicted gains in native vegetation from offsetting are being achieved. The issue that DELWP and TfN are faced with is that the current Victorian gain scoring methodology is not consistent with the habitat hectare methodology that assesses native vegetation condition. The gain points awarded for improvement gain against each habitat attribute score imply that the habitat attributes will improve by the same number of points, which provides a projected habitat (condition) score with the offset.

However, the projected habitat scores may not be possible under the habitat hectare methodology (Table 5; Appendix 1).

Table 5 below compares the projected habitat scores from the offsets in case studies 1 and 2 with the available scores for each habitat attribute under the habitat hectare methodology (Appendix 1). The projected habitat scores in red do not correlate to the available scores, making the habitat hectare methodology unsuitable to confirm whether the projected improvement in native vegetation condition from these offsets will be achieved. This inconsistency between the methodologies prevents DELWP or TfN from accurately determining whether an offset has achieved its projected gains at the end of the offset management period, and therefore whether any loss-gain exchanges have genuinely achieved a No Net Loss outcome.

Table 5. Summary of improvements gains awarded to case study offsets compared to habitat hectare scores.

Habitat Attribute		Case Study 1			Case Study 2			Available Habitat Scores (whole numbers only, no decimals) (see Appendix 1)
		Assessed Habitat Score	Improvement Gain	Projected Habitat Score	Assessed Habitat Score	Improvement Gain	Projected Habitat Score	
Scores	Large Trees	2		2	2		2	0-10
	Tree Canopy Cover	2	0.4	2.4	4	0	4	0-5
	Understorey	25	0	25	20	5	25	0, 5, 10, 15, 20, 25
	Lack of Weeds	15	4	19	13	4	17	0, 2, 4, 6, 7, 9, 11, 13, 15
	Recruitment	10	4	14	10	0	10	0, 1, 3, 5, 6, 10
	Organic Litter	3	2	5	5	0	5	0, 2, 3, 4, 5
	Logs	2	0	2	4	0	4	0, 2, 3, 4, 5
	Site Condition	59	-	59	58	-	58	0-75
	Landscape Context	16	-	16	20	-	20	1-25
	Habitat Score/100	75	10.4	85.4	78	9	87	1-100

5. Discussion

Biodiversity offsetting seeks to balance losses in biodiversity from development with the equivalent gains in biodiversity from an offset. Gains from offsetting may be generated from averting loss, as well as improving biodiversity, at an offset site. If these gains are over-estimated, any permitted loss-gain exchange will only exacerbate biodiversity decline.

In this thesis, I have reviewed two loss-gain exchange case studies that were permitted under Victorian offsetting policy. This policy seeks to achieve “no net loss in biodiversity as a result of the removal, destruction or lopping of native vegetation” (DELWP 2020a). The results from the analyses of these case studies however show that No Net Loss in native vegetation was unlikely to have been achieved under each loss-gain exchange presented here, as the assumptions of gain from averted loss are implausible compared to available native vegetation data, the source of these assumptions is not transparent, and the like-for-like offset requirements are limited. Given that the assumptions of gain under Victoria’s gain scoring manual (see Table 2; DELWP 2017c) are applied consistently to all loss-gain exchanges, it is my view that No Net Loss of biodiversity is not likely to be achievable under the current Victorian policy framework. I discuss specific aspects of this issue below, and make a series of recommendations to help improve biodiversity offsetting outcomes in Victoria.

5.1 The assumptions of gain are implausible

Figures 5 and 6 show that gains from averted loss in case studies 1 and 2 are significantly over-estimated when compared to Victorian Government data on both native vegetation condition and extent loss on private land. Exaggerating the gains generated from offsetting undermines a No Net Loss policy objective by permitting a larger impact to native vegetation for the same offset.

The security and prior management gains predominantly contribute to the over-estimation of gains in both case studies (Figures 5 and 6). As discussed earlier (section 3.3), these gains are a double up of existing offsetting mechanisms, including the maintenance gain (for averted loss), and the minimum requirements for offset site security and native vegetation quality. The removal of the security and prior management gains from the Victorian gain scoring methodology is an immediate policy amendment that would significantly reduce the overestimation of gains from offsetting. Tables B2.2 and B3.2 (Boxes 2 and 3) show that if the offsets in case studies 1 and 2 were not awarded security and prior management gains, the same permitted impacts would require roughly twice the General HUs that were purchased to achieve the same equivalence, which could also potentially double the cost for the developer. While this may be politically unfavourable, it demonstrates that native vegetation offsets, and Victoria's biodiversity, are significantly under-valued under the current policy framework.

Recommendation 1: Remove the security and prior management gains from the Victorian gain scoring methodology, leaving maintenance (averted loss) and improvement gains only.

Figures 5 and 6 also show that while the maintenance gain alone is somewhat consistent with the available data on native vegetation condition loss in Victoria, it is still a significant over-estimation of averted loss from offsetting when compared to the available data on native vegetation extent loss (DSE 2008; CES 2018). Given the lack of clarity in Victorian offsetting policy regarding the underlying assumptions for averted loss (i.e. reflective of native vegetation condition versus extent loss), and the limitations of the available data on native vegetation loss in Victoria, the alignment of the maintenance gain with this data is currently

problematic. Providing more detail in the policy and the collation of more targeted native vegetation data is a better first step to provide greater accuracy to the assumptions of gain from averted loss.

Recommendation 2: Update the Victorian gain scoring manual to clarify whether gains from averted loss (currently prior management, security and maintenance gains) reflect the projected loss of condition and/or extent in native vegetation.

Recommendation 3: Collate data on native vegetation change in Victoria that is targeted to support the determination of gains from averted loss in the Victorian gain scoring methodology.

In the absence of reliable data on improved native vegetation condition from offsetting in Victoria, it is not currently possible to evaluate the plausibility of the improvement gains awarded to the case study offsets. Aligning the gain scoring methodology with habitat hectares methodology should be an immediate priority and would allow a meaningful evaluation of gains from offsetting. In the interim, expert elicitation could assist to fill the current gaps in reliable site-based offset monitoring data, and a more precautionary approach in awarding gains should be considered to avoid over-estimating gains and misrepresenting a No Net Loss outcome.

Recommendation 4: Align the Victorian gain scoring methodology with habitat hectare methodology to ensure projected improvement in native vegetation from offsetting can be evaluated at the end of the offset management period.

Recommendation 5: Until reliable site-base monitoring data on offsetting outcomes is available, use an expert elicitation and take a precautionary approach to awarding gains from offsetting in the short-term.

5.2 The source of the assumptions of gain is not transparent

The assumptions of gain awarded for averted loss and improvement in native vegetation under Victorian offsetting policy are not referenced by any published research or supported by other policy. The assumptions may have been drawn from expert advice, however this is not explicitly stated in the policy. The lack of transparency in how the assumptions of gain were devised makes their evaluation more difficult. It is not clear what data or information (if any) was used to support these assumptions, nor whether the assumptions were based on other types of data that have not been reviewed in this thesis. Transparency around the assumptions of gain is essential to demonstrate No Net Loss from a loss-gain exchange. It also allows for continual review, evaluation and improvement of policy outcomes.

Recommendation 6: Ensure the assumptions underpinning how gains are awarded to offsets, and the sources of information used to support these assumptions, are transparent in Victorian offsetting policy.

5.3 The like-for-like offset requirements are limited

The native vegetation impacted in case studies 1 and 2 were not offset with the native vegetation of the same EVC, or, in case study 2, the same bioregion and vegetation type. Some of the native vegetation impacted already experiences a higher rate of loss in Victoria (e.g. EVC 55 grassy woodland, EVC 61 box ironbark forest and scattered trees). Permitted loss of native vegetation that is not offset with the same native vegetation community can lead to

the degradation or permanent loss of the unique values that this vegetation provides, particularly for native vegetation at greater risk of loss. Any disproportionate loss of native vegetation communities permitted under Victorian offsetting policy would also conflict with its policy objective of “no net loss in biodiversity as a result of the removal, destruction or lopping of native vegetation” (DELWP 2020a). The Victorian NVCR administers and maintains a record of all loss-gain transactions between permit holders and third party offset providers. A review of the EVCs, vegetation types and bioregions relevant to loss-gain transactions is warranted to determine if the current offsetting policy is resulting in a disproportionate loss of native vegetation communities, and what the long term impacts are of this loss on biodiversity in Victoria.

Recommendation 7: Use the NVCR to investigate whether a disproportionate loss of EVCs, vegetation types and bioregions is occurring from permitted impacts under Victorian offsetting policy, and whether this disproportionate loss contributes further to biodiversity decline in Victoria.

As the risk of loss is disproportionate amongst different native vegetation communities and habitat types, the averted loss from offsetting is also disproportionate amongst native vegetation that is being secured in perpetuity. There is therefore a case to be made for greater losses and gains to be generated from native vegetation at greater risk of loss. The Strategic Biodiversity Value (SBV) Score and the Habitat Importance Score (HIS) incorporate many factors, including land use, vegetation and habitat types, connectivity and threatened species, and may already incorporate higher values for vegetation at greater risk, however further investigation is required.

Recommendation 8: Investigate whether the SBV and HIS address the disproportionate loss of EVCs and bioregions occurring in Victoria. If not, consider options to account for this disproportionate loss in the determination of losses and gains (e.g. stricter like-for-like requirements for losses of native vegetation at greater risk, or awarding larger gains from averted loss for offsets comprising native vegetation at greater risk).

The implementation of these recommendations requires a strong commitment to evidence-based policy, as well as a shared goal for biodiversity protection. Integrating scientific evidence into policy-making has been shown to lead to more effective policies, cost-savings and greater accountability from governments (Ruggerai et al. 2019). In reality, however, policy-making is influenced by politics, current affairs and vested interest groups, which involves constant tradeoffs between competing interests. Researchers have an important advocacy role to ensure that our decision-makers remain accountable to good scientific evidence, and that all sides of politics and voters understand the value of biodiversity protection to humanity.

6. Conclusion

As our global biodiversity continues to decline, biodiversity offsetting policies claim to provide a No Net Loss outcome, or better, for biodiversity impacted by development, through delivering measurable gains to compensate for losses. However, studies have questioned the plausibility of gains from offsetting for averted loss and improvements to biodiversity. If the gains from offsetting are not plausible, a No Net Loss outcome is unlikely.

In Victoria, offsets are required to compensate for permitted impacts to native vegetation and habitat for rare and threatened species. In this thesis, I have reviewed the four types of gain (prior management, security, maintenance and improvement) awarded to offsets in two loss-gain exchange case studies permitted under Victorian offsetting policy. These gains were all generated from protecting and managing remnant woody native vegetation on private land. Based on available data and the analysis undertaken, the gains awarded for averted loss (prior management, security and maintenance gains) to native vegetation are not plausible and are likely to be significantly over-estimated compared to estimated and observed losses of native vegetation condition and extent in Victoria. Over-estimating gains from offsetting permits a larger impact for the same offset, resulting in a net loss of native vegetation in Victoria, and further exacerbating biodiversity decline. It was not possible to evaluate the plausibility of improvement gains awarded to the offsets in case studies 1 and 2, due to the absence of suitable offset monitoring methodology and available data.

I have made eight recommendations to improve the plausibility and transparency of the assumptions of gain under the Victorian offsetting policy, and improve the likelihood of the policy achieving its No Net Loss objective. These include immediate updates to the Victorian gain scoring methodology, and undertaking further investigations and site-based monitoring

to support continual policy improvements. Some of these recommended changes would result in larger offsets being required to compensate for the same impacts, and have the potential to increase the cost of offsetting. While these changes may be politically unfavourable, they show that impacts to native vegetation in Victoria are currently undervalued.

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Appendix 1. Vegetation Quality Field Assessment Sheet

Vegetation Quality Field Assessment Sheet

Version 1.3 - October 2004

Department of
Sustainability and
Environment

Site Name/No.

Location

Date

Assessor(s)

Map Name/No.

AMG / MGA

Tenure

EVC

Bioregion

'Site Condition Score'

Large Trees

Score

Category & Description	% Canopy Health*		
	> 70%	30-70%	< 30%
None present	0	0	0
> 0 to 20% of the benchmark number of large trees/ha	3	2	1
> 20% to 40% of the benchmark number of large trees/ha	4	3	2
> 40% to 70% of the benchmark number of large trees/ha	6	5	4
> 70% to 100% of the benchmark number of large trees/ha	8	7	6
≥ the benchmark number of large trees/ha	10	9	8

Large trees are defined by diameter at breast height (dbh)
- see EVC benchmark.

* Estimate proportion of an expected healthy canopy cover that is present
(i.e. not missing due to tree death or decline, or mistletoe infestation).

Understorey Life forms

LF Code from EVC benchmark	# spp observed / Benchmark spp.	% cover observed / Benchmark % cover	Present (✓)	Modified (✓)
	/	/		
	/	/		
	/	/		
	/	/		
	/	/		
	/	/		
	/	/		
	/	/		
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	/	/		
	/	/		

Tree Canopy Cover

Score

Category & Description	% Canopy Health *		
	> 70%	30-70%	< 30%
< 10% of benchmark cover	0	0	0
< 50% or > 150% of benchmark cover	3	2	1
≥ 50% or ≤ 150% of benchmark cover	5	4	3

Tree canopy is defined as those canopy tree species reaching ≥ 80% of mature height - see EVC benchmark description.

* Estimate proportion of an expected healthy canopy cover that is present
(i.e. not missing due to tree death or decline, or mistletoe infestation).

Lack of Weeds

Score

Category & Description	'high threat' weeds*		
	None	≤ 50%	> 50%
> 50% cover of weeds	4	2	0
25 - 50% cover of weeds	7	6	4
5 - 25% cover of weeds	11	9	7
< 5% cover of weeds**	15	13	11

* proportion of weed cover due to 'high threat' weeds - see EVC benchmark for guide.

'High threat' weed species are defined as those introduced species (including non-indigenous 'natives') with the ability to out-compete and substantially reduce one or more indigenous life forms in the longer term assuming on-going current site characteristics and disturbance regime.

The EVC benchmark lists typical weed species for the EVC in the bioregion and provides an estimate of their 'invasiveness' and 'impact'. In general, those weed species considered to have a 'high impact' are considered *high threat* regardless of their invasiveness.

** if total weed cover is negligible (<1%) and high threat weed species are present then score '13'.

For life forms with benchmark cover of < 10%, considered 'present' if

- any specimens are observed.

For life forms with benchmark cover of ≥ 10%, considered 'present' if

- the life form occupies at least 10% of benchmark cover.

For life forms with benchmark cover of <10%, then considered substantially 'modified' if the life form has either:

- < 50% of the benchmark species diversity; or
- no reproductively-mature specimens are observed.

For life forms with benchmark cover of ≥ 10%, then considered substantially 'modified' if the life form has either:

- < 50% of benchmark cover; or
- < 50% of benchmark species diversity; or
- ≥ 50% of benchmark cover due largely to immature canopy specimens but the cover of reproductively-mature specimens is < 10% of the benchmark cover.

Understorey

Score

Category & Description	
All strata and Life forms effectively absent	0
Up to 50% of life forms present	5
≥ 50% to 90% of Life forms present	10
• of those present, ≥ 50% substantially modified	15
• of those present, < 50% substantially modified	15
≥ 90% of Life forms present	15
• of those present, ≥ 50% substantially modified	20
• of those present, < 50% substantially modified	25
• of those present, none substantially modified	25

Version 1.3 - October 2004

Recruitment	Score
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	10
11	11
12	12
13	13
14	14
15	15
16	16
17	17
18	18
19	19
20	20
21	21
22	22
23	23
24	24
25	25
26	26
27	27
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80	80
81	81
82	82
83	83
84	84
85	85
86	86
87	87
88	88
89	89
90	90
91	91
92	92
93	93
94	94
95	95
96	96
97	97
98	98
99	99
100	100

* high diversity defined as $\geq 50\%$ of benchmark woody species diversity.

Score

Category & Description	Dominated by native organic litter	Dominated by non-native organic litter
< 10% of benchmark cover	0	0
< 50% or > 150% of benchmark cover	3	2
≥ 50% or ≤ 150% of benchmark cover	5	4

[illegible]

Score

Category & Description	Large logs present*	Large logs absent [#]
< 10% of benchmark length	0	0
< 50% of benchmark length	3	2
≥ 50% of benchmark length	5	4

absent if large log length is < 25% of EVC benchmark log length.

'Landscape Context Score'

Score

Category & Description	
< 2 ha	1
Between 2 and 5 ha	2
Between 5 and 10 ha	4
Between 10 and 20 ha	6
≥ 20 ha, but 'significantly disturbed'*	8
≥ 20 ha, but not 'significantly disturbed'*	10

* 'significantly disturbed' defined as per RFA 'Old Growth' analyses eg. roading, coupes, grazing etc. – effectively most patches within fragmented landscapes.

Score

Distance	Core Area not significantly disturbed*	Core Area significantly disturbed*
> 5 km	0	0
1 to 5 km	2	1
< 1 km	4	3
contiguous	5	4

* defined as per RFA 'Old Growth' analyses.

Score

Radius from site	% Native vegetation *	Weighting	
100 m		0.03	
1 km		0.04	
5 km		0.03	
subtract 2 if the neighbourhood is 'significantly disturbed'			
Add Values and 'round-off'			

Multiply % native vegetation x Weighting for each radius from the zone (eg. 40% x 0.03 = 1.2); then add values to obtain final Neighbourhood Value.

Final Habitat Score

[illegible]