Landscape scale outcomes from market based instruments

Design principles for biodiversity offsets

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Australian Government

Department of Sustainability, Environment, Water, Population and Communities

Supported by the Australian Government's Transition Program for the Marine and Tropical Sciences Research Facility (MTSRF)

Transition Project 38: Landscape scale outcomes from market based instruments

This report should be cited as:
Coggan, A., Whitten, S.M. and Martin, T. (2010) *Landscape scale outcomes from market based instruments. Design principles for biodiversity offsets.* Marine and Tropical Sciences Research Facility (MTSRF) Transition Project Final Report. Published by the Reef and Rainforest Research Centre Limited, Cairns (32pp.).

Published by the Reef and Rainforest Research Centre on behalf of the Australian Government's Transition Program for the Marine and Tropical Sciences Research Facility (MTSRF).

The four-year term of the Australian Government's Marine and Tropical Sciences Research Facility (MTSRF) officially concluded at the end of June 2010. The Commonwealth Environmental Research Facilities (CERF) Transition Program for the MTSRF aimed to deliver new and additional synthesis products based on the contemporary information needs of the primary end users through the synthesis and analysis of pre-existing MTSRF outputs. In addition, the MTSRF Transition Program extended research that is highly relevant to the future CERF key investment areas of the Great Barrier Reef and Torres Strait, northern Australia and terrestrial biodiversity.

This report is available for download from the
Reef and Rainforest Research Centre Limited website:
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Reef & Rainforest
RESEARCH CENTRE

December 2010

Contents

Acronyms Used In This Report

AARES ..... Australian Agricultural and Resource Economics Society
BBOP..... Business and Biodiversity Offset Program
CSIRO..... Commonwealth Scientific and Industrial Research Organisation
DECCW ..... New South Wales Department of Environment, Climate Change and Water (now Office of Environment and Heritage, Department of the Premier and Cabinet)
DEEDI..... Queensland Department of Employment, Economic Development and Innovation
DERM ..... Queensland Department of Environment and Resource Management
DSE..... Victorian Department of Sustainability and Environment
EPBC..... Environment Protection and Biodiversity Conservation (Act) (Commonwealth)
ESA..... United States Endangered Species Act
MTSRF..... Marine and Tropical Sciences Research Facility
NSW..... New South Wales
PRM..... Permittee Responsible Mitigation
PVPs..... Property Vegetation Plans
QGEOP..... Queensland Government Environmental Offset Policy
SEWPaC..... Commonwealth Department of Sustainability, Environment, Water, Population and Communities
USEPA..... United States Environmental Protection Agency

Acknowledgements

This research was conducted with the funding support of the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) through the Marine and Tropical Sciences Research Facility (MTSRF) Transition Program and the CSIRO.

We gratefully acknowledge the attendees at a workshop held in Brisbane on 25 November 2010 for their input into the discussion paper and broader discussion and debate regarding the offset design principles.

Errors and omissions remain the responsibility of the authors.

Introduction

Offsetting damage to environmental assets is becoming accepted practice internationally and within Australia. The increased use of offsets has not coincided with consensus on offset scope or design. Instead, experience across locations including the United States, Latin America, Canada, New Zealand and Australia reveals a suite of different offset design approaches. These offset markets range from formalised and centralised exchanges with established metrics and systems to support anonymous and price based trading, through to offset requirements based on expert opinion with transactions dependent on individual relationships and negotiation. Offset evaluation and commentary to date has tended to focus on whether offsets are able to deliver the desired biophysical effect rather than on design effectiveness.

The purpose of this project was to begin to address the deficiency of design evaluation and to deliver a set of best practice principles for offset design and implementation.

To do this, we:

1. Reviewed the empirical and theoretical literature about offsets and developed a discussion paper with our thinking around three core and a number of supporting principles that inform offset type and design; and
2. Facilitated a workshop of key decision makers and offset policy implementers about the principles. Attendees of this workshop represented local (southeast Queensland councils), regional (far northern Queensland), state (Queensland, New South Wales and Victoria) and federal government levels. Also in attendance were representatives of the private and academic sectors (University of Queensland, Queensland University of Technology and Griffith University). At the workshop we discussed the principles articulated in the discussion paper. Comments on the principles were taken from workshop attendees and other interested parties for two weeks following the workshop.

The discussion paper will be developed into a journal manuscript (with a draft paper accepted for presentation at the Australian Agricultural and Resource Economics Society (AARES) conference to be held in Melbourne in February 2011).

A further ‘key aim’ of this project was to expand our understanding of patch for patch (non strategic focussed on impact) offset design best practice principles to those that can apply to a sustainable landscape framework. Future research opportunities with a focus on offsets and landscape outcomes are provided later in this report.

Designing better biodiversity offset schemes: what works where, and why?

Offsets Workshop discussion paper

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One major objective of this project was to consolidate thinking on what makes a good biodiversity offset program, and therefore what needs to be considered in biodiversity offset scheme design and implementation. Key components of this thinking have emerged in previous offset research conducted by members of the research team, including research completed as a part of the Marine and Tropical Sciences Research Facility (MTSRF). This research project provided the opportunity to consolidate this dispersed thinking on design. To ground truth our thinking and to communicate the results of our research we developed a discussion paper and ran a biodiversity offset workshop with key stakeholders and policy decision makers in biodiversity offsets. The draft discussion paper was circulated to participants prior to the workshop and was a large focus of discussion. The workshop was held in Brisbane on 25 November 2010 (agenda and slides from participants are presented later in this report).

Here, we present the revised discussion paper. This version contains revisions based on workshop discussions as well as suggested changes received from participants.

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1. Introduction

Environmental offsets (herein referred to as 'offsets') are increasingly being adopted as a way of reconciling the dual objectives of development and conservation of environmental assets. Offsets are a form of environmental policy which compensate or mitigate the adverse impacts that landuse change or development may have on the environment such that there is an overall 'no net loss' in environmental quality (Race and Fonseca, 1996; ten Kate *et al.* 2004; Norton, 2009; Moilanen *et al.* 2009). Offsets are generally only permitted after actions of impact avoidance and minimisation on-site have been exhausted. They are intended to address residual impacts of development. Offsets are only an option when actions addressing this residual impact are equally effective whether they occur on or off the site of impact (i.e. mitigation is substitutable) (Coggan *et al*. 2010a).

Offset application experience to date applies to a range of environmental outcomes (biodiversity, water quality, carbon, air quality) and also demonstrates the range of implementation models available. These range from formalised and centralised exchanges with established metrics and systems to support anonymous and price based trading, through to offset requirements based on expert opinion with transactions dependent on individual relationships and negotiation. Which offset design is best, and in what

circumstance, is a question that has not been clearly addressed to date.[1] The purpose of this research is to explore this question specifically for biodiversity offsets. We identify the core elements in effective biodiversity offsets design based on theory, literature and biodiversity offset experiences to date.

This discussion paper presents the draft results from our analysis for feedback, discussion and further development and is structured as follows:

- In Section 2 we provide some background on offsets;
- In Section 3 we provide some brief insights into a number of well established Australian and US based offset schemes;
- In Section 4 we consolidate the key lessons and experiences of these offset applications to date; and
- Present a number of core and supporting design principles in Section 5.

2. What are offsets?

Biodiversity offsets are intended to avoid the loss of biodiversity through directly destructive activities such as landuse change and development activities. Offsets are primarily a policy instrument designed to achieve a no net loss, or even a net gain in biodiversity, in the context of development (BBOP, 2009). Decisions as to where offsets are an acceptable option are to a large degree political. While such political decisions are informed by science feasibility, the scope of the offset mandate is largely beyond the intent of this paper. Our emphasis is on informing design and implementation of successful offset schemes within the political mandate.

When offsets are considered to be a politically feasible approach to impact management, offsets are undertaken within a mitigation hierarchy which requires that if the development application is approved, actions are first taken to avoid, minimise and mitigate damage on-site (negotiation of offsets is usually part of the development approval process, see Box 1). Offsets relate to activities that are undertaken away from the development site (off-site) to compensate for significant residual adverse biodiversity impacts arising from project development after appropriate prevention and mitigation measures have been taken (BBOP 2009). While biodiversity offsets can be voluntary (conducted voluntarily by a developer due to a perceived business advantage) or mandatory (required by law), the focus in this paper is on design approaches for mandatory offsets. Offsets may also be provided by the developer on another site (first party offset) or provided by another party (third party offset).

The concept of offsets is illustrated in Figure 1. The initial potential predicted impact of development is first reduced via actions to avoid or minimise damage, and is partially mitigated by on-site activities (impact becomes less negative). The residual impact is then offset by a third party with a financial exchange from the developer to the offset provider securing the exchange of obligation to the third party. In this case the offset is sufficient to overcome residual impacts and provide a net gain. Consideration of net gain from offset approaches at the aggregate scale requires the risk associated with the portfolio of offsets to be taken into account.

[1] We note that there has been some research into broad/macro guidance on offsets and principles for their use (for example, the Business and Biodiversity Offset Program (BBOP)), but very little that explores the micro element of alternative parameters of offset design for differing circumstances. We see this discussion paper as building upon the work conducted by the BBOP and the ten macro principles for offset principles presented by this group.

Box 1: When are offsets applicable in the development process?

Development approval processes that encompass the potential for environmental offsets usually comprise three types of response with respect to environmental damage: prohibition, conditional approval and automatic approval. Prohibition is applied where any environmental impact is considered unacceptable, and for biodiversity may apply to high value assets such as rare species, unique landforms or grossly damaging activities. Automatic approval is applied where no significant environmental impacts are anticipated, such as for brown-fields developments or highly degraded sites. Finally, conditional approval requires sufficient environmental protection to be provided to ensure no net environmental impact from development (potentially including offsets). Developments requiring approval may be rejected at a later point in the approval process if appropriate conditions cannot be described for the proposed development.

The most common approach to conditional approval involves a developer approaching the consent authority with their development idea inclusive of initial options for impact avoidance, minimisation and on-site mitigation. At this stage the consent authority will either reject the application outright (if impacts are considered to outweigh the benefit) or provide advice (possibly including negotiation) regarding avoidance, minimisation and on-site mitigation activities, and where relevant, off-site offsets. Following this process, the approver may still have the option to reject the development application because either damage to environmental assets remains unacceptable or offset compensation is inadequate. The developer may also withdraw the development proposal if the cost of the impact mitigation hierarchy and any additional offsets exceeds the benefits from development.

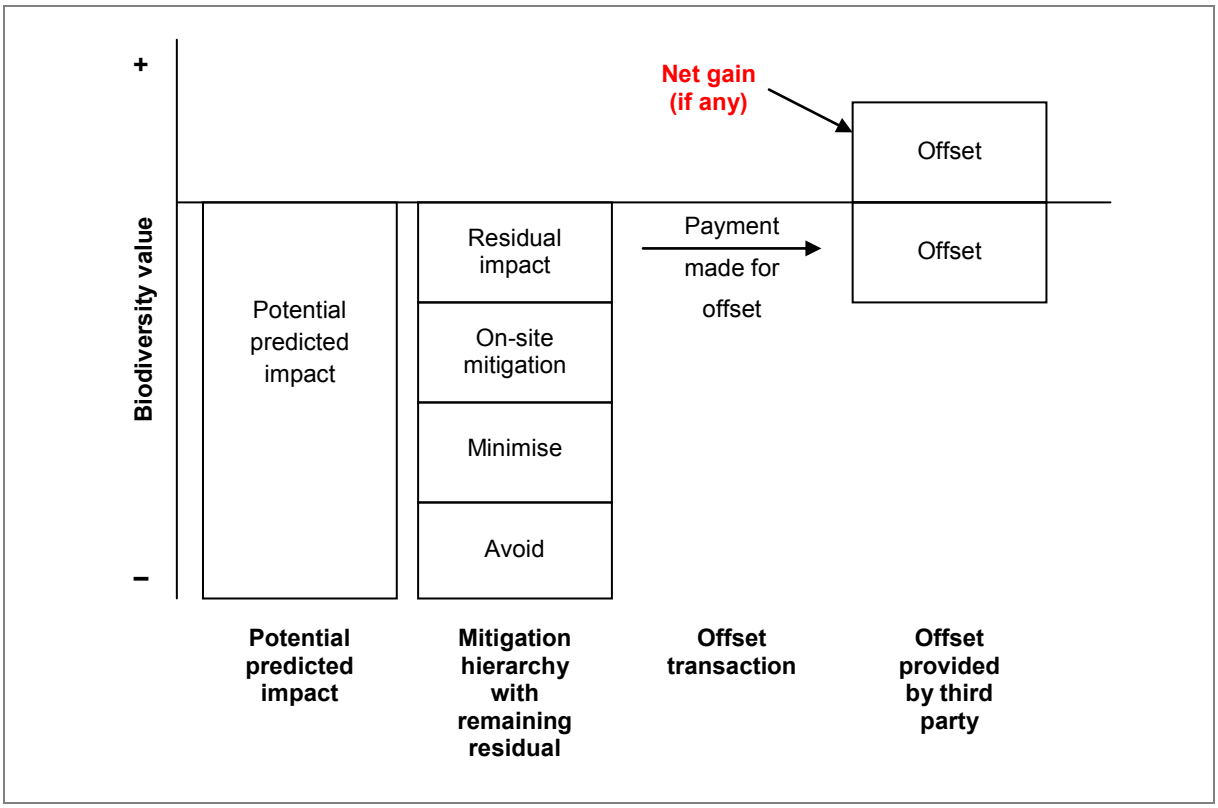

Figure 1: The mitigation hierarchy and the biodiversity offset. Adapted from BBOP (2009).

Offsets have been applied in various settings for some time and a set of basic performance or design objectives has largely been agreed to. For example, the BBOP defines ten principles to describe biodiversity offsets as follows (BBOP, 2009):

1. Designed and implemented to achieve no net loss or a net gain in biodiversity;
2. Will achieve additional conservation outcomes;
3. Adhere to the mitigation hierarchy;
4. Recognise limits to what can be offset;
5. Planned in a landscape context;
6. Involve stakeholders effectively in design and implementation;
7. Designed and implemented in an equitable manner;
8. Planned to secure outcomes that last as long as the project's impact but with a preference for perpetuity;
9. Conducted and communicated transparently; and
10. Applied using sound science and traditional knowledge.

The potential for biodiversity offsets lies in protecting the aggregate biodiversity values enjoyed by society whilst facilitating economically beneficial development. They form part of government's policy toolkit for efficiently achieving biodiversity improvement goals and offer commercial opportunity to third parties to provide and manage biodiversity assets – including business, community, indigenous and other participants. Offsets with clear guidelines and processes can also contribute to improving working relationships between developers and government. There are limits to what can be offset, however. Some habitats may be impossible to replicate and some compensatory measures may never succeed. The values of some habitats and locations may be considered too high to be offset.

3. A sample of offset applications

There are numerous applications of offsets internationally, however most of the activity in offset design and implementation stems from North America and Australia. In North America offsets have been adopted to manage the impact of development on wetlands and the habitat of endangered species (Fox and Nino-Murcia, 2005) through a mix of national and state policies (including devolved responsibilities). In Australia, offsets are primarily applied at a state level to manage impacts of development on native vegetation and biodiversity, and at a national level to manage the impacts of development on matters of national environmental significance (Australian Government, 2007a, 2007b). A brief description of these major offset schemes in North America and Australia is provided in this section. There are many other instances of biodiversity offsets internationally, but few of which are designed offset programs of the type described below.

3.1 Wetland offsetting and mitigation banking (United States)

Arguably the most well known environmental offset program is wetland offsets introduced in the United States (US) under the *Clean Water Act* (1972). The potential for wetland offsets was introduced as a means to arresting the decline in wetland areas attributable to land use change; such as for property development. The offset requirement allows a developer to substantially alter a wetland only if they ensure the protection, restoration or enhancement of another wetland. Initially, offsets required 'site-specific' offset resulting in bilateral trades where buyers and sellers are contractually linked. The performance of these site-specific

offsets however was poor due to evidence that the functional benefits of the replacement wetlands were lower than the converted wetlands (Salzman and Ruhl, 2000).

In 1995, Mitigation Banking Guidelines were introduced. This amendment allowed the trading of credits through intermediaries known as a wetland bank – a wetland, stream or other aquatic resource area that has been restored, established, enhanced, or in certain circumstances preserved for the purpose of providing compensation for unavoidable impacts to aquatic resources elsewhere as permitted under Section 404 or a similar state or local wetland regulation (US EPA, undated). Developers also had the option of mitigating wetland impacts through in lieu fees – cash payment to a public agency or non-profit organisation to satisfy their compensation requirement (BenDor, 2009). Attention to loss of wetland function has also meant greater debate about the functional equivalence of offset wetlands (see, for example, Salzman and Ruhl, 2000).

3.2 Endangered species habitat banking (United States)

A conservation bank is a parcel of land that is conserved and managed in perpetuity under a conservation easement for the benefit of rare species. The party that holds the easement is granted credits by a federal or state agency with the credits intended to be directly related to the species impact of the bank. The bank owner may use or sell these credits within a pre-designated service area to fulfil mitigation requirements established by state or federal law (Fox and Nino-Murcia, 2005). Conservation banking is the process of setting up species credits through a banking agreement and the trading (using or selling) of those credits (Bauer *et al.* 2004; Fox and Nino-Murcia, 2005). Species credit trading began in California in 1995. A federal process for species banking began in 2003, facilitated through the US Endangered Species Act (ESA) (Fox and Nino- Murcia, 2005). Once a species is listed under the ESA as endangered or under threat there may be opportunity for a conservation bank to provide offsets in instances where development or other land use such as forestry impacts the species.

Species banking is argued to be ecological beneficial as it often occurs prior to an impact taking place and it facilitates the conservation of large and connected tracts of land (Wheeler and Strock, 1995; Bauer *et al.* 2004). Species banking does however continue to be criticised on the basis that while some areas are protected others continue to be lost and so the total population of many species continues to fall. This argument is weaker where there is clear evidence of additional populations of the target species. The major economic benefit from banking is the conversion of a legal liability (existence of the species on a property) into financial asset (a credit).

3.3 Offsetting impacts to matters of national environmental significance (Australia)

The *Environment Protection and Biodiversity Conservation Act* (1999) (Australian Government, 1999) (hereafter referred to as the EBPC Act) requires development which may impact a matter of national significance to be approved by the Federal Minister for the environment. Revisions to the EPBC Act in 2007 allow for offset provisions to be a condition of approval. Offsets under the EPBC Act can be direct or indirect, on-site or more commonly off-site, and may be undertaken by the first or a third party (Australian Government, 2007a).

Direct offsets include covenants on private land that secure the long-term protection of existing habitat, the restoration of degraded habitat, or re-establishing habitat. Indirect offsets can include financial contributions to a fund that delivers offsets; or a research on ways to further mitigate the impact. Whether offsets are required and whether they should be direct or indirect in any particular circumstance is not prescribed in the EPBC Act or subsequent offset guidelines from federal government; this is assessed on a case-by-case basis (see Coggan *et al.* 2010a). As such there is no standard metric to guide offset trades and most

offset exchanges are conducted following a process of negotiation with buyers and sellers finding each other guided more through relationship than price.

3.4 Vegetation offsetting (Australia)

The most common form of offsetting directed towards biodiversity protection in Australia is to manage the impacts of development (housing, infrastructure and agricultural) on native vegetation. Vegetation offsets are driven at the state level via native vegetation legislation. Local government is also active in this space via direct responsibilities from state legislation and via their own environmental amenity and urban vegetation protection measures. In some states vegetation offsetting has been designed to facilitate anonymous trading between buyers and sellers. That is, there is a metric to assist developers to understand what their offset obligations are likely to be and to indicate the value of vegetation conservation to potential offset suppliers. Like most offset schemes, all of the vegetation schemes suffer from less than optimal engagement from those who can supply offset works (lack of liquidity on the supply side). Supply constraints seem to be due to a lack of knowledge about the opportunity to supply offsets or high entry costs and long lag times before benefits are realised.[2] To overcome this, traders in Queensland, New South Wales (NSW) and Victorian vegetation offset schemes have the option to use a broker, which has been built into the offset process to assist in finding sellers and thereby facilitating their offset trade. There are also numerous private brokers operating in these offset markets to assist in the finalisation of offsets for development approval (see Coggan *et al.* 2010b).

Despite the apparent similarity in design across NSW, Victoria and Queensland there is substantial difference in the actual scheme designs. Vegetation offsetting in NSW is split into two schemes. Agricultural land use conversion may proceed with on-site offsets (there is the potential for off-site offsets here but these have proven difficult to enact) managed through property vegetation plans (PVPs), a voluntary but legally binding agreement under the *Native Vegetation Act* (2003) between the landholder and the local catchment management authority. Large scale and urban developments must manage impacts on species and ecosystems either through the standard development permitting processes or through the BioBanking offset scheme (entry into BioBanking is voluntary). BioBanking offsetting is more complex compared with the PVP offset process (more sophisticated trading rules and processes). This is because BioBanking has been designed to facilitate a large number of anonymous offset trades with buyers and sellers coordinated through price. Offset sites receive at least some payment in perpetuity.

Victoria has a similar vegetation offsetting scheme built around the Victorian Native Vegetation Management Framework. In Victoria, however, vegetation offsets are mandatory and linked directly to clearing decisions and offsets only related to vegetation (however, with some consideration of importance of vegetation for species habitat) and are determined through a codified metric (based on the Habitat Hectares approach; Parkes *et al.* 2003). There are a number of supporting measures in place to assist in procuring offsets where they are required, including brokerage (BushBroker), matching and procurement auction services. Offset sites receive payment for ten years.

3.4.1 Queensland offset approaches

The Queensland Government has been employing a number of 'specific use' offset programs for the management of development impact on koala habitat (offsets for net benefit to koalas and koala habitat, 2006), fisheries (mitigation and compensation for works or activities

[2] Unlike other markets, liquidity on the demand side is not necessarily a plus since it represents damage that needs to be abated. That is, we don't want to go for a highly liquid market without considering the implications for biodiversity.

causing marine fish habitat loss, 2002) and vegetation (policy for vegetation management offsets, September 2007) with the intention of developing a biodiversity offset policy and combining all of these into the Queensland Government Environmental Offset Policy (QGEOP) (Queensland Government, 2008). The koala offset policy specifies that five koala habitat trees must be planted for any one koala habitat tree destroyed in the process of development. This planting may occur on the development site or another site within the same local government area. The koala habitat offset must be protected into perpetuity through a covenant or conservation agreement. The offset can also be achieved through a financial contribution equivalent to $920 per tree lost (Queensland Government, 2010). Koala offset transactions (as payments for offsets or financial contributions) are one-off. Under the fisheries policy, mitigation is considered to be any on-site activities while offsets are compensatory activities that occur off-site. Consideration for mitigation is given following an avoidance and minimisation hierarchy with appropriate measures considered individually for each proposal (Dixon and Baumer, 2002). Compensation is allowed when avoidance and minimisation actions have been exhausted. Compensation may include financial contribution for research into fisheries related activities.

In Queensland, regional vegetation management codes and 'material change of use' or 'reconfiguring a lot' policies under the *Vegetation Management Act* (1999) set out performance requirements that development applications for clearing native vegetation must meet. The Queensland vegetation offset policy refers to an offset as a solution, proposed by a developer, to meet specific performance requirements that require a development to maintain the current extent of a particular regional ecosystem (Queensland Government, 2009). Offsets can only be proposed if the applicant has demonstrated avoidance and mitigation activities prior to proposing the offset. Vegetation offsets cannot be a financial contribution, can be an activity that satisfies criteria for more than one level of government and may be supplied by either the first or a third party. Vegetation put forward as the offset must be additional in that it is either not currently mapped as remnant vegetation (therefore protected) or not currently protected through any other means. At present, offsets are assessed on a case by case basis with a metric most heavily based on location (less offset requirements for offset activities close to the point of impact). A more advanced metric, developed with reference to the Victorian and NSW models is currently being developed. Offset payments to third parties tend to be once-off (although a lot of offset transactions that involve third party offsets occur through brokers and some of these require payment into a trust fund with annual payments to the offset supplier). The Queensland Government recently established EcoFund to assist developers to source and finalise third party offset transactions.

4. Developing principles to guide offset scheme type and application

4.1 Where to start

The objective of this paper is to set out a concise set of principles that support the design and implementation of effective and efficient offset markets. The objective is for offset markets that achieve the best environmental outcomes at least cost to all market participants – thus protecting both environmental assets and allowing economic development.

As discussed previously, the overarching decision about whether offsets are appropriate and their application scope is generally a policy decision. While science and practice may inform this *policy domain*, it is beyond the scope of this paper. Our focus is on how to design an offset scheme in practice once the policy limits have been set.

Offsets are generally employed within a development approval process. Accepted practice requires that a hierarchy of avoid, minimise, and mitigate (on-site) has been exhausted (no

simple task in itself). The residual environmental damage is then regarded as the minimum offset to avoid loss of environmental amenity. What constitutes an offset is not always clear and may include closely targeted like-for-like or better approaches across a range of attributes, or at the opposite extreme, a wide range of benefits that are considered equivalent or appropriate compensation for damage (such as research intended to reduce threats to assets or abatement of other unrelated sources of damage). In all cases the first requirement for an effective offset scheme requires a methodology to measure what is to be offset (and the improvement or gain presented by a potential offset). We term this the *measurement domain*.

While some offsets are voluntary, most offsets are a non voluntary regulatory requirement. Hence the second requirement for an effective offset scheme is a legal framework to generate the obligation to protect or maintain the environmental asset. This obligation must be transferable to third parties (within the acceptable space) to facilitate offsets off-site by third parties. Transfer of legal responsibility lies in the *institutional domain*. Offset schemes are essentially constructed systems, the potential for transfer and how these transfers take place sets up a range of opportunities for society to benefit from offset trade but also exposes society to additional risks from environmental loss where the measurement or institutional domain are inadequately described or policed. Designing markets and supporting measures to facilitate exchange and manage the risks of that exchange form the *organisational domain*. These three domains may be interrelated in the sense that the best approach in one domain may have implications for the others and *vice-versa* (Figure 2).

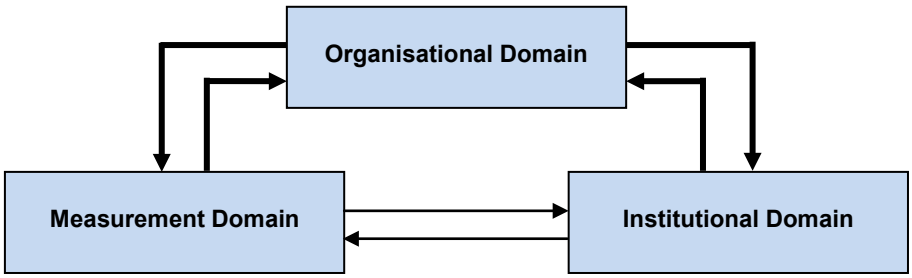

Figure 2: The interrelations between the measurement, institutional and organisational domains. The organisational domain strongly influences the measurement and institutional domain. The measurement and institutional domain have slightly less influence on each other.

We summarise these three critical market components as follows:

1. **The measurement domain:** There must be a clear process for measuring the residual impact (the loss) from development that is to be offset. Similarly, there must be a clear process for measuring the biodiversity gain provided by a potential offset. These gains and losses must be commensurate, potentially across time, space and other biodiversity attributes for society to avoid losing biodiversity.
2. **The institutional domain:** The obligation represented by the offset needs to be valuable, transferable and enforceable. An underpinning requirement is a legal process for describing the obligations and an institutional mechanism which would allow transfer of these obligations to a third party. Since the obligations represent a biodiversity loss and gain they may in fact differ so the transfer process requires ***translation*** of obligations (based on the measurement domain) across parties.
3. **The organisational domain:** There are a range of organisational challenges in facilitating an offset market and managing the risks that offsets entail. Facilitating offsets, including creating measures and institutions, is costly but understanding the scale, scope and

participants in offset schemes can help reduce overall costs. Designing cost effective market and risk processes is an important element of an effective program.

The measurement, institutional and organisational domain are the focus of the remainder of the discussion in this section. It is from these three core concepts that we develop the offset design principles.

4.1.1 Designing offset approaches

There are a range of options available to policy makers in developing and implementing offset regimes[3]. Our focus in this paper is specifically on the design of integrated, mandatory and legislatively supported offset approaches. In this model, government would usually play an active role in market design in each of the domains described previously. The three domains are likely to be interrelated in the sense that the best approach in one domain may have implications for the others and *vice-versa* (Figure 2).

The overriding cross-domain influence is the scale and scope of offsets envisaged; that is the nature of the offset market place. Keep in mind that offsetting will only benefit the community when the benefits from allowing offsets (economic development) outweigh the costs of offsets plus the transaction costs to government and others of designing, implementing and administering the offset instrument (assuming that there is no net loss in biodiversity). The shape of any emergent offset market will of course be partly determined by the scope of the coverage of the offset approach (a point returned to below). Scope is derived from the overarching policy domain which should set out what is the objective of the offset scheme and then what is acceptable to be offset (under the mitigation hierarchy of avoid, minimise, on-site mitigation and only then offset). Biophysical offset scope frames the sources of the potential economic benefits from offsets which is the driver of demand for offsets and determines the overall quantity of offsets required, the number of purchasers, and the heterogeneity of offsets required[4]. The opportunity for offset supply will result from the basic biophysical parameters of the offsetting landscape (topography, existing biodiversity, etc.), which in part determines the response to demand heterogeneity, and total offset demand.

An overarching knowledge need before proceeding is an evaluation of offset demand and supply in terms of the number of participants and the biophysical potential for offsets. The rationale being that while any offset approach must address the three domains identified above, the total and distribution of transaction costs between government and the private sector may differ significantly under different policy approaches. In the discussion below, in which we focus on the measurement, institutional and organisational domains in turn, we will return to the issue of market participation repeatedly because of its importance in considering offset design.

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[3] See BBOP Biodiversity Offset Design Handbook (2009) for a discussion of other offset type approaches such as voluntary approaches and in lieu fees, and a general discussion of the roles of government in offset schemes (http://bbop.forest-trends.org/guidelines/oih.pdf).

4 Of course there may also be other players in offset markets such as conservation organisations and speculators; however the primary driver will be proscribed demand to avoid biodiversity loss as a result of economic development.

4.2 Ensuring value equivalence between impact and offset (measurement domain)

The objectives of offset schemes to date have tended to vary. For example, some offset schemes have been designed to offset the impact of development as close to like-for-like as possible (there is even variance within the definition of like-for-like, for example an objective of maintaining a viable population of an endangered species is a different like-for-like objective to an offset scheme which may be targeting habitat of that endangered species). Other offsets are used to achieve broader environmental objectives which may not necessarily be directly linked to the development impact but tend to be focussed on compensating a 'bad' via a 'good' somewhere else in the landscape (such as expansion of the conservation reserve network). The degree to which like-for-like is defined and followed will affect what is measured and how these measures take place.

The empirical and conceptual literature provides extensive discussion on measures of service equivalence (how development impacts on values, what values are provided by an offset), what is critical and desirable when it comes to measures, and the tradeoffs associated with different levels of measures. Critical components to consider when measuring and maintaining values in offsets are the incorporation of offset quality, deciding what is eligible as an offset, trading up, spatial complementarity, time frames when offsets are provided and the management of risk. The remainder of this section presents these critical components to measuring service equivalence.

4.2.1 Measure for quality not just quantity

Probably the most basic and frequently used measure of impact and offset is quantity (area) impacted or provided as an offset. While quantity provides some representation of impact and offset, it does not adequately represent the values that make up the quality of the site that has been impacted upon or which is provided by alternative offset supply activities. For example, area of native vegetation does not reflect the quality of the biological diversity and therefore the resilience, nor does area reflect the soil, recharge or water quality benefits of an action (Salzman and Ruhl, 2000).

There has been extensive analysis on the effects of measures or metrics that do not adequately address the quality attributes of the good being traded – primarily relating to wetland mitigation banking in the US. For example, between 1991 and 1996 the Chesapeake Bay foundation found that despite claims by the Maryland Department of the Environment that the state had gained 122 acres of wetland through mitigation trading, there had been a net loss of wetland function and therefore quality of 51 acres (Salzman and Ruhl, 2000, p. 662). Hallwood (2007) demonstrates that there is a high rate of wetland mitigation failure in terms of function in the US. For example, in 1990, 1,262 permits issued by the Florida Department of Environmental Regulation were monitored for mitigation success to find that only one in four projects were ecologically successful in the sense that they would generate serviceable wetlands of the quality that had been impacted upon by development.

Gibbons and Lindenmeyer (2007) discuss the intricacies and implications of measuring quality versus quantity in vegetation offsetting noting that many offset schemes allow the destruction of established habitat (one type of quality) for planting of new vegetation (different and probably lower quality, at least in the short run). They note that although new vegetation is beneficial, it does not have the same function (habitat) as established native vegetation. They also suggest that metrics in vegetation offset markets need to indicate a preference for securing, improving and building upon existing remnant vegetation before planting new vegetation (a preference for established vegetation also overcomes some of the uncertainty issues raised further on in metric discussion).

Endangered species habitat banking offsets are conducted with a variety of measures for quality. The majority of schemes (91% of banks) rely completely on quantity rather than

quality measures (area), three percent use measures more inclusive of quality (e.g. number of breeding pairs present as a proxy for quality) and a small proportion (6%) use a combination of quantity and quality (Fox and Nino-Murcia, 2005).

4.2.2 Baseline for improvement – what is eligible as an offset?

An important component of an offset measure is describing the baseline biodiversity provision of the offset supplier. There are usually three broad options available in considering baseline service provision in offset schemes:

1. Improvement from current provision at a specified future point in time. This approach ensures that the offset is a net gain over *current* biodiversity provision but neither accounts for potential improvements that may occur in any case, nor for the potential for a site to lose biodiversity due to permissible activities;
2. Improvement at a specified future point in time given continuation of existing activities (or in some cases permissible activities). This approach ensures net gain at a future point in time but may not guarantee overall biodiversity provision. This approach allows the gain from the assumption of a continuation of current management to be considered an offset; or
3. Improvement from a duty of care baseline at some future point in time. This essentially assumes that the landholder will only manage to the minimum standard and may allow for significant benefits without change to management.

NSW BioBanking applies Option 1, Victorian vegetation offsetting Option 2, and to the extent that Queensland offsets apply to regrowth that would not be cleared, Option 3 is applied. Option 2 is most efficient from a market perspective but may not account for other social or political drivers in policy selection. The baseline that is selected will affect estimation of the available offset benefits. To illustrate consider a numeric example in which, for simplicity, the number of trees is considered the appropriate offset unit. Today there are 20 trees on the site. With best biodiversity management we expect 30 trees (say in 20 years' time). Option 1 would allow for the gain from the current 20 trees to be considered an offset (i.e. 10 trees being 30 minus 20). Option 2 allows for the difference between continuing current practice and best practice to be considered an offset. If we assume current practice would lead to just 10 trees remaining (say in 20 years time for consistency) then the potential offset under Option 2 would be 20 trees (i.e. 30 minus 10). Finally, if we assume duty of care requires 15 trees to be present then option three would allow 15 trees to be considered an offset (i.e. 30 minus 15).

A related issue is whether the removal of threats to biodiversity can be considered offsets as part of Option 2 or 3. For example, legal options to clear land may remain, due to timber harvesting for example. In this case the prospective offset is the change to probability of clearing which is removed by permanent protection (using a conservation covenant) (Beckessy *et al.* 2010). Careful attention to the likelihood of the threat will prevent offsets which do not deliver benefits over the chosen baseline.

4.2.3 Offset specificity

Seldom will an exact offset match be available, rather there is always likely to be some trade-off in terms of equivalency between the existing asset and the proposed offset. The focus in this section is on strategies to address quality-quantity equivalency where there have been two strategies suggested: trading up, and separation of biodiversity assets. Trading up essentially allows biodiversity damage to be offset either by an equivalent improvement to the same asset OR an equivalent improvement to a biodiversity asset of greater value (usually a more scarce asset). For example, damage to a common vegetation type could be offset by improvements to a similar vegetation type or improvements to endangered or

threatened vegetation communities. Asset specificity rules usually relate to specific components of the biodiversity such as endangered species and require that any damage to these be directly and equally offset (mitigation activities are not highly substitutable). Species offsets are one form of asset specificity rules.

These rules have different objectives. Trading-up rules are intended to enhance market liquidity by facilitating a larger number of potential trades. It is also intended to increase the likelihood of investment in these more desired communities. Asset specificity rules are designed to protect specific, high value biodiversity attributes which may be lost through a more general habitat offsetting approach.

4.2.4 Spatial relativity and complementarity

The relative location of the offset to the impact site (relativity) and to other sites of environmental value (complementarity) can influence the value of the offset and affect the offset scheme outcome.

BenDor and others (2009) assessed the landscape scale outcomes of wetland and stream offsetting in North Carolina, concentrating particularly on outcomes depending on the spatial proximity between the impact and the offset. The study found that the average displacement distance between impact and offset was 177+/-173km. They also found three spatially related ecological implications of mitigation programs with loose spatial rules for trades:

1. Movement of mitigation upstream in watersheds (function is lost in areas that perhaps need this the most;
2. Defragmentation (numerous small sites are offset by one large site (this may actually be positive depending on the function of the site); and
3. Loss of place specific function (like storm water filtration and protection from storm surge).

There are some means to overcome the negative landscape scale impacts of mitigation programs. One common solution is the use of geographic service areas.

The issue of space also includes the spatial complementarity of the offset. That is, a management option that provides connected (corridors) or clumped (banks) outcomes may have greater value to one that has disconnected and scattered outcomes. Bruggeman and Jones (2008) demonstrate the importance of space in offset programs with reference to the red cockaded woodpecker noting that the spatial distribution of mitigation across the landscape will affect the aggregate ecological function of offsets. The importance of spatial complementarity has been noted in other literature on offset design for example Austen and Hanson (2008) and the Business and Biodiversity Offset Program (BBOP). However it should be noted that measures which effectively encompass spatial complementarity in dynamic landscapes are difficult to quantify or implement and are at the cutting edge of ecological thinking.

4.2.5 Temporal relativity

All things equal, earlier outcomes are preferred over more temporally distant outcomes.

BenDor (2009) analyses the lag effect for wetland mitigation with different styles of wetland mitigation – permitee responsible mitigation (PRM), third party mitigation (banks) and in lieu fees in Chicago from 1993 and 2007. In this simulation it was shown that a continuous string of impacts followed by delays in achieving functional equivalence in the offset site (even when the offset activity is started straight away) can result in an extended period of functional loss across the landscape. In BenDor's (2009) simulation, impacts were not completely offset for 79 years.

Gibbons and Lindenmeyer (2007) note that vegetation offsets can also take a long time to achieve equivalence of the impacted value. For example, hollow bearing trees can take more than 120 years to establish and therefore a long time to offset if the objective of the offset is functional equivalence.

4.2.6 Accounting for risk

Related to the discussion of measures and definitely affecting the quality of the outcome of an offset is the uncertainty associated with the biodiversity performance of an offset. Outcome uncertainty occurs at two levels in offsets – transaction and performance risk. Transaction risk is the risk that payments are made and the offset work requirements are not subsequently undertaken. Management of transaction risk falls within the organisational domain and is discussed there. Performance risk is the risk that the agreed offset activities occur on the ground but the expected change in biodiversity outcome just does not happen. Performance risk can be quantified and managed through the design of the offset measures. For example, do you need a greater ratio of offsets to impact (more trees to accommodate the fact that some trees will die).

4.2.7 Discussion

The relative importance of each of the components to the measurement domain will differ depending on the particular offset context. Quality / quantity issues will always be present in some form for either offset demand or supply. Offset specificity will depend on heterogeneity and whether there are particular biodiversity attributes which have high value separate to the ecological community as a whole (such as endangered species). Acceptable spatial relativity may vary dramatically between offsets and so on. The degree to which each element of the measurement domain is important will need to be considered for each offset scheme, and potentially within schemes (via zoning or other measures).

From identifying what to measure, policy design proceeds to how to measure it – the metric. Sound measurement is highly complex and effective metric can be very expensive to develop and implement as acknowledged by Salzman and Ruhl (2000) and Walker *et al.* (2009). The cost of metric development is likely to vary considerably depending on the degree of complexity and detail incorporated within the metric. A fully quantified metric which describes biodiversity units in a robust and repeatable way will require considerable investment but once developed may require relatively low costs in repeat use. Alternatively, designing a transparent process requiring applicants to demonstrate that the biodiversity offset is of greater value than that damaged may be relatively cheap but involve high participant costs for each offset. For example, Salzman and Ruhl (2000) suggest that processes of ‘exchange’ and ‘review’ can be effective if metrics are expensive to develop. There are of course mixed options that might be employed if biodiversity is relatively low value and vice versa.

This discussion suggests that a single standardised form of offsetting is not likely to work in all circumstances, and instead, individual and local circumstances need to be taken into account at all times (Austen and Hanson, 2008). Salzman and Ruhl (2000) highlight this in wetland trading, where good metrics have been developed for heavily traded coastal wetlands, but less so for other wetlands. In some situations overlapping or combined offset schemes, or variance in rules, may be required to adequately protect biodiversity values. For example in NSW where the voluntary BioBanking approach incorporates both species and vegetation offsets while mandatory vegetation regulations allow offsets under Property Vegetation Plans in the agricultural sector. On the other end of the spectrum are offsets for very specific goods where there is never likely to be many trades or traders. This is likely to be the case for offsets under the EPBC Act. In this market, the costs of developing a standardised repeatable metric are likely to far outweigh the benefits. In this circumstance,

investment in the development of exchange and review adequacy rather than a complete stand-alone metric is recommended.

4.3 Transferring legal obligation (institutional domain)

An offset is all about the transfer of legal obligation for a specific biodiversity outcome as described by the required offset from the first party (those generating the impact) to a third party (those providing compensation for the impact). In order to transfer responsibility, it is essential to have clearly defined property rights around the good or service being transferred and how this will be maintained through time as well as institutions that facilitate the offset transfer. The institutional domain is in many ways the legal domain and there are undoubtedly numerous legal complexities which need to be addressed. In the subsequent discussion we limit ourselves to an institutional economics perspective of the required institutions to underpin an offset market. We define the institutional domain as the property rights and legal environment required to support offsets.

4.3.1 Legal obligations to protect biodiversity

The starting premise for any biodiversity offset program is an obligation to avoid damage and protect or manage biodiversity in some way. It is this right or obligation that is transferred to another site, potentially under the management of a third party, in an offset transaction. Unfortunately, what developers can and cannot do with respect to biodiversity and endangered species tends to be poorly described and limited to preventative or restrictive actions. For example, pre-existing obligations are often limited to native vegetation laws, complemented in some cases by threatened species laws. These laws usually prevent active damage (land clearing) but allow continuation of existing use (such as grazing).[5] The obligations which are transferred must be described in sufficient detail to avoid the inadvertent loss of biodiversity through poor translation of obligations.

The metric development process described previously encompasses the measurement aspect of what is to be offset (along with where offsets sit in the mitigation hierarchy). For a successful offset transaction there is also the requirement for a legal aspect to the process which is the codification of the required offset into a legally defined obligation – usually via a formal permitting process. The trigger to enter a permitting process is usually some form of economic development or land use change. The permitting process codifies the legal obligation with respect to biodiversity management which may then be transferred to another.

A corresponding legal process is also required to codify the obligations of the offset supplier with respect to biodiversity provision, given that net gain requires that the offset supplied provides biodiversity outcomes which are in addition to existing outcomes in some way. Offset supplier legal obligations are usually secured via some combination of permanent legal protection for biodiversity via a legally binding covenant or equivalent on land title[6], and contractual arrangements to provide biodiversity management or enhancement services. The biodiversity benefits of the offered obligations must be at least equivalent to the permitted damage (via the measurement domain). This is usually termed biodiversity crediting though it may or may not involve creation of legally separable biodiversity benefit units. If separable benefit units are desirable (see further discussion below) then there will normally need to be specific legislative support to provide legal security to the property right which is created.

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[5] We do not suggest that these biodiversity rights and obligations are too weak as the cost of further codification may well outweigh any benefits that would result. However, where pre-existing biodiversity management requirements are poor then action may be required to avoid perverse incentives to damage biodiversity prior to converting landuse.

[6] Note that some covenants only incorporate restrictive actions designed to prevent damage to biodiversity while others also include a requirement for pro-active management.

Credit requirements are usually linked directly to the measurement domain in terms of a consistent methodology for estimating damage and offset.

Just as development offsets can only occur once the mitigation hierarchy has been exhausted, the supply of offset credits should also be bounded by a starting minimum (also discussed in measures section). This is often referred to as additionality (McKenney and Kiesecker, 2010). It is inefficient to purchase offset credits for actions that landholders should have been doing anyway or are already being paid to do. Current legislation (eg vegetation management act) and individual offset policies can assist in defining property rights on supply sites. For example, in Queensland, only non-remnant vegetation (and therefore vegetation that is currently unprotected) can be used as an offset.

4.3.2 Facilitating transfer of obligations

The two separate legal obligations for offset buyers and sellers must be formally linked in a way that allows the requirement to offset defined via the permitting process to be cancelled out by the biodiversity benefits represented by the crediting process. While the process by which this occurs comprises part of the organisational domain there are also a set of legal checks which are required to avoid fraud and ensure that net gain of biodiversity is delivered. That is, there needs to be a formal process which confirms that the permit requirements have been met (via the crediting process) and which then releases the permit holder from their offset obligation. This process can be centralised via an exchange regulator in a formalised market setting with many buyers and sellers or undertaken case by case where there are few and disparate offsets. The steps in this process are likely to be broadly similar irrespective of the scale of the offset market envisaged.

A related area is the cost and difficulty of the legal formalities associated with exchanging contracts in offset markets. To reduce these costs governments or other parties have sometimes developed model contracts for use by offset parties.

4.3.3 Supporting institutions

The formalisation of rights and obligations relating to offsets requires or may benefit from several supporting institutions. Required institutions relate to the legal ability to enforce compliance where offset service provision is not adhered to. Offset compliance requires a more active system of monitoring and enforcement because there are often pro-active management requirements that are necessary to protect and enhance the biodiversity offset through time. Generally government acquires the responsibility to undertake monitoring and compliance and requires the relevant institutional backing to facilitate access, reporting and enforcement (even if costs of this process are recovered as part of the offset institutional process). Government takes on these roles because offsets are intended to protect public good values associated with biodiversity and therefore there is no obvious private party with the necessary incentives (or institutional support) to undertake these roles.

In order to be valuable, offsets need to be maintained through time. Offsets do tend to have a high risk of partial failure; because of this, some form of enforcement process is required. Because of the high risk and uncertainty associated with management actions and offsets, a staged enforcement process may be best. Non-performance provisions could provide a range of ‘make good’ opportunities ahead of punitive penalties. For example, minor infringements resulting from technical or unforseen factors rather than deliberately rorting the system per se, may simply require new offsets to make good for those that were not provided. An alternative approach may be for offset providers to prepare contingency plans in case of offset failure. This process could set out triggers that indicate the under performance of an offset. When these triggers are hit, contingency plans are activated. While the key goal of the offset is to manage the risks of losing environmental services, the level of penalties for offset failure must be considered with reference to the need to

encourage market participation (penalties perceived as too harsh will discourage participation).

Supporting institutions can also help to manage the delivery risk by spreading payments through time to encourage continued management. For example, some operators within offset markets, such as brokers, have developed innovate ways to manage for the risk of offset failure. For example some brokers require the developer to pay the agreed offset price (which includes compensation and management cost) into a trust fund, the interest from this fund is used to manage under performing offsets (no one party bears the risk of offset failure). The NSW BioBanking approach institutionalises this approach providing for a payment in perpetuity while the BushBroker scheme in Victoria provides for up to ten years of payment.

4.3.4 Discussion

The anticipated number of offset trades is an important factor in the extent to which institutional support is necessary for effective offset markets. The pre-requisites for offset trade are institutions which facilitate the codification of the offset obligation and the ability to transfer the obligation to an offset supplier. Investment in institutions to support offset trading generally reduces the cost to individual parties in the long run at the expense of upfront investment by government and can only be justified where there are likely to be sufficient trades. For example, there is little need for legal separability of biodiversity units via a crediting framework (units are assigned to each value of the offset supply such that these can be broken up and sold as individual units potentially to more than one buyer) where relatively few trades are expected, or trades are expected to be highly heterogeneous. Where there are few trades a process of matching up and cancelling out offsets in individual trades is likely to be the least cost approach (as is the case with offsets using PVPs under the NSW framework). In contrast, applying an equivalent matching and cancelling out approach (through a crediting framework or other means) in a relatively liquid market creates an artificial impediment to supply (one offset, one project) and effectively prevents the formation of offset banks (see later). Similarly, creation of specialised offset approval mechanisms, compliance programs and so on is only likely to be cost effective in relatively liquid markets with a perhaps several hundred trades per year. When fewer trades are expected then combining these responsibilities with other similar tasks is likely to be more cost effective.

4.4 Facilitating effective offset processes (organisational domain)

Offset markets are always designed to some extent and there are numerous opportunities for design to influence the costs and benefits to both participants and to government as well as influencing welfare consequences to the wider community. The focus in this section is to discuss additional opportunities where active attention to design may offer potential to reduce the cost of participation or increase participant benefits. As we have suggested previously, a key consideration in investment in supporting organisational frameworks is their cost (usually to government) compared to the benefits to other participants in the offset market, noting that generally the greater the number of expected offset transactions, the stronger the case for public investment in organisational support (whether or not costs are recovered).

4.4.1 Focus on transparent and efficient process

Process complexity is a known source of transaction costs in offset transactions (including to government as arbiter). Evaluations of many existing offset schemes reveal that approval and transfer of offsets rarely occur at low cost. In fact, many market participants report incurring high time and effort costs when engaging in the offset market. For example, participants in endangered species habitat banking report high participation transaction costs related to interactions with the policy administrator through duplication of paper work, the continual need to re-engage and re-inform agency staff (due to high staff turn over) and

delays when contracts required both state and federal sign off (Fox and Nino-Murcia, 2005). Similar drivers of transaction costs were reported by developers conducting offsets under EPBC Act obligations and participants in vegetation offset schemes across Australia (Coggan, 2010; Coggan *et al.* 2010b). Attention to transparent and clear process can help to minimise such transaction costs by:

- Avoiding repetitious approval or documentation processes;
- Clearly identifying the information required at each stage of the process; and
- Creating clear expectations of the options available and approvals at each stage in the process.

Attention should be given to situations where one development activity triggers more than one offset requirement (for example, offsets required by local, state and federal government). At least, the offset requirements should not be conflicting. At best the offset negotiation and approval process could be coordinated and strategic.

The process of negotiating and approving offsets is not cost free for the buyers and sellers of offsets or the policy administrator. Some offset schemes in Australia require buyers and sellers to pay for the cost of administration throughout the policy engagement process (e.g. in stages such as expression of interest, assessing sites for potential offset credits, and registering as a potential offset buyer or supplier). This often occurs without any guarantee that an offset exchange will eventuate and the costs are recouped. High upfront costs will discourage entry of potential offset providers. An alternative approach may be to subsidise the initial engagement process with cost recovery occurring at the point of commitment of an offset sale. With this approach, risk and upfront cost is worn by the policy administrator in the short term, but market liquidity, especially on the supply side, could be significantly enhanced.

4.4.2 Supporting offset markets

Participants in offset markets also incur high costs separate to those incurred in the process of engaging with the policy administrator. These transaction costs are reported as being incurred in the process of finding buyers or sellers of offsets (Fox and Nino Murcia, 2005; Coggan *et al.* 2010b). In Australia, the high cost of offset transfer has seen the rise of brokers in both state based vegetation offsets and federally operated endangered species offset markets. Brokers include private companies that have emerged into this space for commercial benefit and offset markets constructed with 'built in' brokers, such is the case for vegetation offsetting in NSW (BioBanking), Victoria (BushBroker) and Queensland (EcoFund).

The relative benefits from a central exchange mechanism compared to distributed offset markets will be dependent on a range of factors including the uniformity of offsets (i.e. the degree to which different offset requirements and offset supplies are interchangeable), the number of transactions in total, and the strength of economies of scale or similar factors from a centralised exchange. The greater any of these factors the stronger the case for a centralised market. In contrast where there are few, highly specific offsets a competitive private market through individual brokers may be more effective than a government oriented solution. Coggan and others (2010b) highlight some of the advantages that emergent private brokers may have over constructed public brokers in offset markets. For example, private brokers do not have a legacy of government policy influencing the way landholders engage with them.

A second area in which governments can support offset markets is via a quality assurance and certification role while facilitating competition in actual service provision. The complexity of ecological information required in permitting and supplying biodiversity offsets requires

detailed ecological information to be supplied about specific biodiversity attributes as prescribed in the measurement domain. Because all parties (buyers, sellers and government) need confidence in the quality information, there is a role in training and certifying specialist information providers (individuals, firms and government employees).

4.4.3 Managing transaction risk

A task related to administrative support in offset markets is ensuring that the agreed offset activities occur. This is referred to as transaction risk. Approaches to manage transaction risk include clear performance auditing requirements and performance incentives such as withholding payment until it is known that offset works have been completed or outcomes achieved. The exact arrangement by which performance auditing and incentive payment is best facilitated will depend on the scale and scope of the offset market. It may be more efficient to centralise some of these roles in large scale markets, such as the NSW BioBanking framework is designed to facilitate. It is also more incentive compatible for the regulator to undertake these tasks.

4.4.4 Encourage offset banking

In the United States, the high cost of transferring offsets as well as poor outcomes of initial site by site offsets has seen the rise of mitigation banks for wetlands and endangered species habitat. Offset banking refers to the management of offset credits by one body with the supply of offset credits generally occurring before demand. An offset bank has a number of benefits:

1. Banks are specialist offset providers which are able to use their specialist knowledge to reduce the transaction costs in securing offsets and to capture economies of scale in offset transactions and in the production of biodiversity benefits;
2. Reduced scientific uncertainty because credits are often supplied before demand (but not eliminated as there will be cases where the supply is not appropriate for a demand). The scale and specialisation of offset banks may also reduce the risk of failure in environmental restoration projects; and
3. The larger scale of offset banks can allow them to be more strategic in the generation of offset credit supply. For example, an offset bank can secure credits that generate a connected landscape and thus gain exponentially beneficial environmental outcomes.

Another potential form of banking is one which we have named designer banks. At present offset markets are designed to encourage individual suppliers to put forward the least cost offsets and individual buyers to seek out the cheapest way of fulfilling their offset obligations. This least cost approach may result in some benefits from an exchange (such as connected landscape scale outcomes) being missed – there may be market failure on the supply side. A designer bank is an organisational solution to this market failure. A designer bank may operate whereby corridors of land may be designated green zones (so can not be developed) but are given the first priority to be supplied into an offset market. Alternately the designer bank may draw on some powers of eminent domain to assemble larger scale offset projects in highly fragmented peri-urban and urbanising landscapes.

4.4.5 Identify opportunities to structure market to protect environmental outcomes

Because offset markets are constructed, Salzman and Ruhl (2000) suggest that there may be opportunities to modify market rules to avoid potential market failures due to factors such as poor metrics (amongst others). For example, who can trade, when they can trade (to manage time issues), where they can trade (to overcome spatial weaknesses or to achieve spatial complimentarity) and factors such as required offset ratios, can all influence the type of trades that occur when and where.

Salzman and Ruhl (2000) suggest a number of process orientated rules which are intended to avoid inadequate offset arrangements including: regular review processes at the scale of the offset program; retaining the right to review and veto individual transactions; and inclusion of rules intended to protect specific outcomes. The degree to which individual transactions require review is likely to be related to the adequacy of the metric. The greater the concerns about metric adequacy the larger the advantages of review processes. Exchange review, while perhaps getting closer to guaranteeing an ecological outcome, does have some disbenefits. The primary disbenefit is that an additional review layer adds administration expense, uncertainty and delay thereby generating additional transaction costs to the policy administrator and traders (this has been observed in a number of point / non-point water quality trading markets). Salzman and Ruhl suggest that one way to overcome this is tailoring the review process to the size of the impact (for example a large potential impact corresponds to a comprehensive, all inclusive review where as a small potential impact corresponds to a scaled down review). The use of existing development approval and management processes is another way of reducing the transaction costs of review. An example of this is the strategic assessment process employed by the Australian Government's EPBC Act whereby development approval and offsets are made by the local or state government if the local or state government's development approval and management plan has been approved by the Federal Government.

4.4.6 Discussion

Which of the supporting processes described above (and new processes not described here) are appropriate will depend on the specific parameters of particular offset markets. A simplistic conclusion is that the larger the number of offset participants the more likely that investment in support processes will be cost effective. Which of the relevant options are appropriate will require a closer examination of the features of the particular offset market. For example offset banks will only be viable where there is a sufficient pool of contiguous offsets required to make a commercially viable business opportunity. Similarly, conditions under which market support is likely to be cost effective are set out above.

A key conclusion relating to all designer markets relates to the necessity of considering where market (or government) failures are likely to emerge and, where cost effective, design options to minimise or avoid adverse outcomes are available. Those tasked with offset market design should always identify likely market (and government) failures and potential design solutions. As an example, consider a scenario where a significant source of biodiversity loss (eg large old trees) results from small isolated developments for which inclusion individually in an offset scheme may be difficult (due to the uniqueness of the offset requirement). An in-lieu-fee approach may be appropriate to facilitating specific and difficult offsets while minimising participant costs.

5. Principles for offset design

Based on the conceptual and empirical discussion of the previous section we have identified the following core and supporting principles that can be used to guide offset policy design (Table 1). The core principles are the requirements that any offset scheme will need to attend to while the supporting principles are presented as a means to inform the core principles. Keep in mind the overarching knowledge need is a problem description identifying the sources of biodiversity loss linked to an evaluation of offset demand and supply in terms of the number of participants and the biophysical potential for offsets.

Finally, unlike traditional markets where additional participation is generally desired on efficiency grounds, additional participation in offset markets can only result from greater destruction of biodiversity. While we are confident that well designed offsets avoid net biodiversity loss it is hardly an activity that society wishes to further encourage. Therefore it is

important to identify design options that deliver overall efficient outcomes rather than seeking efficiency via greater market liquidity.

Table 1: Core and supporting principles for biodiversity offsets.

Core principle	Supporting principle
1. Measurement domain: It is essential to have a well crafted measure or process for describing value equivalency between impact and offset. Equivalency should at least reflect.	1.1 Quality and quantity parameters of biodiversity values – Include a clear definition of the baseline for offset supply (additionality)
	1.2 Set out limits of offset specificity / interchangeability – Identify the degree to which heterogeneous biodiversity is interchangeable – Set out any specificity requirements (such as species offsets)
	1.3 Consider spatial relativity and complementarity implications
	1.4 Consider implications of time between impact and offset outcome
	1.5 Account for performance risk
2. Institutional domain: An offset scheme should be supported by clear institutions supporting definition and transfer of the offset obligation comprising.	2.1 Defined, legally binding requirements setting out the rights and obligations of offset parties with respect to biodiversity including: – A permit process which sets out the rights and obligations for biodiversity management which would the proposed development would incur; and – A binding process obligating offset suppliers to deliver the described biodiversity management or outcome (which may or may not include a biodiversity crediting framework).
	2.2 A process linking the permit and offset process and which removes the obligation on receipt of the approved offset. – Usually this process will be via a designated exchange regulator. – The process may be assisted by model contracts or similar instruments.
	2.3 Creation or designation of supporting institutions including: – A compliance and enforcement process relating to (permitted and un-permitted) biodiversity destruction and offsets. – Trusts and other arrangements designed to give landholders incentives to deliver the agreed offsets.
3. Organisational domain: Actively design the offset market to support the desired biodiversity objective subject to cost-effectiveness of support measures.	3.1 A focus on transparent, efficient and potentially coordinated process in order to minimise transaction costs to participants
	3.2 Consider whether offset markets should be actively supported: – Is a centralised exchange likely to deliver benefits over emergent processes (including the likely

Core principle	Supporting principle
	emergence of brokers)? – What forms of information support or quality assurance are necessary for effective outcomes? – Do you need staged and supported entry
	3.3 Encourage offset banking in situations where it is likely to deliver improved outcomes (for biodiversity and participants).
	3.4 Identify where additional measures may be needed to protect biodiversity or improve market (transaction risk) outcomes (market and government failures). Examples include: rules of veto, delegation/certification of authority, and over-the-counter trading for small offsets.

Throughout this paper we have illustrated the importance of designing offset approaches to deliver the desired biodiversity outcomes and access the potential benefits from economic development that may result if offsets are allowed. We have emphasised the interaction between the attributes of biodiversity that are valued and the number and characteristics of potential offset market participants. In particular we note that offset design and operation can be costly but investment in good process can protect biodiversity outcomes and successful participation. For example, the more trades that are acceptable and likely, the greater the benefits from investment in a sophisticated market with well specified exchange rates with exchange coordinated through the price. In contrast, for highly specific biodiversity assets and few trades, a case by case offset process may be less costly and completely adequate. These approaches need not be exclusive. Trading zones, exchange limitations (such as trading up provisions) or other provisions can be used to separate regions or biodiversity attributes within markets.

We also note that despite our emphasis on offset design it is important to consider the opportunities (and costs) presented by existing approaches and institutions. There may be benefit in nesting with these existing institutions and structures. However, existing institutions and structures may also generate additional implementation or administration costs. Furthermore, offset schemes can evolve over time. If there is insufficient information to develop an offset scheme that can operate without constant government oversight, there may be opportunity to develop limited approaches and processes with the view to phasing in more comprehensive approaches in the future.

Offsets Workshop

'Horses for courses' in offset design: what offset type, when, where and why?

A workshop focussing on key principles of design for biodiversity offsets was held in Brisbane in November 2010. Workshop attendance was by invitation only with attendees from local government (focus on southeast Queensland), regional bodies (Terrain NRM), State Government (Queensland: DERM, DEEDI; NSW: DECCW; Victoria: DSE), Federal Government (SEWPaC), private sector and a number of Queensland based universities.

The purpose of the workshop was to hear from several levels of government about their offset experiences to date (a copy of the agenda is provided at Table 2) and to present and discuss practical biodiversity offset design and implementation (prompted by the discussion paper included in this report). Key themes of biodiversity offset design that emerged in discussion included:

- What exactly is an offset – is it like for like in its strictest sense, is it an impact allowed if something good happened somewhere else (with that something good not necessarily related to the impact but rather to broader objectives)? What it is then affects the other principles particularly the measurement.
- The level of coordination of offsets affects the costs to engage and manage offsets – at present we have offsets required from all levels of government with little formal coordination occurring and a tendency for requirements to conflict or duplicate.
- How do we better account for additionality in measurement?
- How can the cost of engagement (especially on the supply side) be reduced? What are the benefits of a staggered entry approach?

The authors would like to thank workshop attendees for their frank and informative discussions that further informed the discussion paper included in this report. We note that there is a strong appetite from participants for further efforts to communicate offset design, practice and practical experience into the future.

Table 2: Offsets Workshop agenda.

	Activity	Speaker
8.30-9.00	Arrival – Tea and Coffee	
9.00-9.15	Introduction to the day	Stuart Whitten (CSIRO)
Session 1: Offset experiences from the field and reflection on design principles		
9.15-9.30	Local Government (Queensland)	Stacey McLean (Brisbane City Council)
9.30-9.45	Federal Government	Brendan Allen (SEWPac)
9.45-10.00	Regional Body (Queensland)	Tony O'Malley (Terrain NRM)
10.00-10.30	Queensland Government (DERM/DEEDI)	Jean Claude Eono (DERM) Melissa Dixon (DEEDI)
10.30-11.00	Victorian Government (DSE)	Anne Buchan (DSE)
11.00-11.30	**Morning Tea**	
11.30-12.00	NSW Government (DECC)	Julie Ravallion (DECC)
Session 2: A preliminary set of offset design principles		
12.00-12.45	Preliminary design principles	Anthea Coggan (CSIRO)
12.45-1.30	**LUNCH**	
Session 3: Discussion on design principles		
1.30-2.30	Break into 3 groups of ~7 with mix of agencies. Discussion to focus on: 1) Overall comment on the overarching design principles; and 2) In depth comment on one of the overarching principles – to be allocated to groups	CSIRO to spread between groups and scribe back One member of group to report back
2.30-3.15	Feedback from each group	Facilitated discussion
3.15-3.45	Facilitated discussion on feedback from groups (everyone)	
3.45-4.00	**Afternoon Tea**	
4.00-5.00	Wrap up and close of workshop	

Offsets for landscape scale outcomes

The state of knowledge around offset design is still developing and even with best practice design of offsets there are still opportunities to improve design and avoid the risk that the intended biodiversity benefits of offsets may fail to realise. While there are many potential areas that research may prove productive, one critical are is the integration of offsets with landscape scale conservation objectives. The particular consideration is as follows. In most cases the measurement of offset loss and gain is either entirely related to the direct loss of biodiversity habitat, or at best a partial assessment of the impacts of the habitat damage on the landscape context in which it takes place. Only in very rare instances is there an assessment of the implications for the ecological persistence of either healthy ecological communities, or individual species that are endangered. That is, although there are often provisions for offsets to be located within a specified distance of the development site, there is little recognition for the finer spatial relationships between patches of land. These issues also apply to the benefits offered by potential offsetting sites. Without effective consideration of principles of spatial connectivity, patch size and patch edge to area ratios, offsets could facilitate the further erosion and fragmentation of the conservation estate and hence loss of biodiversity values.

There is a need for research in each of the domains identified above in order to support enhanced consideration of potential costs and benefits of offsets at the landscape scale. In the measurement domain the need is to develop practical and effective measures of landscape integrity with respect to clear biodiversity objectives that can be applied to damage and offset sites. These approaches are likely to draw on the principles of systematic reserve design (Margules and Sarkar, 2007) and on ecological concepts of meta-populations and meta-communities. The underlying construct is intended to measure the positive and negative relationships depending on what is the pre-existing *and critically* the likely landscape future (in terms of biodiversity assets). Because offsets are implemented in a piecemeal fashion, it is likely to be necessary to identity sets of sites of high priority that will form an integral part of the conservation estate, regardless of where they sit in the landscape or when they are acquired. A related consideration is the integration of different environmental benefit attributes in tandem to achieve multiple benefits across landscapes. For example we may want to increase the extent of native vegetation in one area, while maintaining the extent of endangered species habitat in another. In this case, knowing which offset to implement when and where to maximise the overall environmental benefit across a landscape becomes important. Recent developments in network theory and spatial optimisation (Chadès *et al.* 2011) can assist in solving this problem.

Within the institutional domain there is a need to develop effective institutions that are able to more effectively manage biodiversity assets that are reliant on the health of ecological communities or species populations that cross boundaries and which are unlikely to persist with the loss of integral component habitat or populations. Specifically there is a need to develop cross boundary recognition (rights and obligations) that promote the persistence of functional ecological communities that support the desired biodiversity asset. This need is not unique to biodiversity offsets and will be necessary to support effective biodiversity conservation into the future.

There is also a need for more effective incorporation of landscape context benefits of biodiversity in the organizational domain. In particular there are likely to be opportunities for ‘smart markets’ (McCabe *et al.* 1991) or improved ways of signaling potential conservation damage and benefit opportunities in landscapes. In particular there may be an opportunity to develop the concept of designer banks to support enhanced landscape ecological (or other ecosystem service) functionality within an offset and broader investment context.

Offsets will continue to play an important role in balancing the roles of development and conservation. In order to support their wider effectiveness as part of sustainable biodiversity management at the landscape scale we recommend the following research projects be supported in the beginning NERP round:

1. Development and field testing of landscape biodiversity metrics which incorporate robust measures of:
   - The contribution of the proposed development site to meta-community or meta-population persistence (or an equivalent approach) as relevant;
   - The implications of risks of offset non-performance at this scale;
   - The robustness of the metric to other threats to biodiversity at an equivalent scale in order to identify the contribution (or not) of development damage and offset provision; and
   - The potential for integrated multi-benefit approaches to out-perform single attribute approaches using a highly innovative network spatial optimization approach.
2. Investigation of more effective institutional frameworks for managing larger scale biodiversity objectives across property boundaries.
3. Development, testing and piloting of market organization support for landscape scale outcomes including:
   - Investigation and testing of computer assisted 'smart markets' supporting landscape scale biodiversity objectives to identify key design parameters and operational guidelines for implementation;
   - Enhanced market signaling approaches inclusive of landscape scale impacts of developments and potential offsets. The emphasis would be on ways to capture and present spatial information within offset markets; and
   - Creation of a pilot 'designer offset bank' inclusive of the information requirements, institutional and organizational supporting measures needed, and practical lessons from pilot implementation. Such a bank should target an environment where there are likely to be substantial offset requirements in the near future but limited opportunities for offset supply.

The approximate total funding required to support this portfolio of work is shown below in Table 3 (which would likely be cost-shared between NERP, stakeholders and research organisations).

Table 3: Estimate of funding required for future landscape scale offset research.

Projects (by domain)	Description	Salary + overheads	Operating	Total
1. Develop and test landscape biodiversity metrics	2 FTE, plus field experiment	**$**562,240	**$**168,000	**$**730,240
2. Institutional framework to support cross boundary offsets	0.5 FTE, expert workshop	**$**140,560	**$**15,000	**$**155,560
3. Develop and test market organization support (not including pilot funds)	2 FTE, expert workshop and field testing	**$**562,240	**$**90,000	**$**652,240
Total		**$1,265,040**	**$273,000**	**$1,538,040**

References

Austen, E., Hanson, A. (2008) Identifying wetland compensation principles and mechanisms for Atlantic Canada using Delphi approach. *Wetlands* 28(3): 640-655.

Australian Government (1999) Environment Protection and Biodiversity Conservation Act (1999). Available online at http://www.environment.gov.au/epbc/index.html

Australian Government (2007a) *Use of Environmental Offsets under the Environment Protection and Biodiversity Conservation Act 1999*. Discussion Paper, August 2007, Canberra. Available online at http://www.environment.gov.au/epbc/publications/pubs/draft-environmental-offsets-discussion.pdf

Australian Government (2007b) *Draft Policy Statement: Use of environmental offsets Under the Environment Protection and Biodiversity Conservation Act 1999*. August 2007, Canberra. Available online at http://www.environment.gov.au/epbc/publications/pubs/draft-environmental-offsets.pdf

Bauer, M., Fox, J., Bean, M. (2004) Landowners Bank on Conservation: The US Fish and Wildlife Services Guidance on Conservation Banking. *Environmental Law Reporter* 8-2004: 10717-10722.

Beckessy, S.A., Wintle, B.A., Lindenmeyer, D.A., McCarthy, M.A., Colyvan, M., Burgman, M.A., Possingham, H.P. (2010) The biodiversity bank cannot be a lending bank. *Conservation Letters* 3: 151-158.

BenDor, T. (2009) A dynamic analysis of the wetland mitigation process and its effect on no net loss policy. *Landscape and Urban Planning* 89: 17-27.

BenDor, T., Sholter, J., Doyle, M. (2009) Landscape characteristics of a stream and wetland mitigation banking program. *Ecological Applications* 19(8): 2078-2092.

Bruggeman, D., Jones, M. (2008) Should habitat trading be based on mitigation ratios derived from landscape indices? A model based analysis of compensatory restoration options for the red cockaded woodpecker. *Environmental Management* 42(4): 591-602.

BBOP (2009) *Business, biodiversity offsets and BBOP. An overview.* Business and Biodiversity Offsets Program (BBOP), Washington DC.

Chadès, I., Martin, T.G., Nicol, S., Burgman, M., Possingham, H.P., Buckley, Y. (2011) General rules for managing and surveying networks of pests, diseases and endangered species. *Proceedings of the National Academy of Sciences of the United States of America* 108(20): 8323-8328.

Coggan, A. (2010) *Transaction costs in development offsets: Who bears what and why?* Paper presented at the 14th Annual Conference of International Society of New Institutional Economics, Stirling Scotland, 17-19 June 2010.

Coggan, A., Buitelaar, E., Whitten, S.M. (2010a) *Transferable mitigation of development impact: The case of development offsets at Mission Beach, Australia*. Conference paper funded by MTSRF and presented at the International Academic Association on Planning, Law, and Property Rights in Dortmund (Germany). Submitted to *Land Use Policy*.

Coggan, A., Buitelaar, E., Whitten, S.M. (2010b) *Third parties in offset markets: What brings them in?* Paper accepted and presented at the 4th World Congress of Environment and Resource Economists, Montreal, June 2010.

Dixon, M., Beumer, J. (2002) *Mitigation and Compensation for Works or Activities Causing Marine Fish Habitat Loss: Departmental Procedures, Fish Habitat Management Operational Policy*. Queensland Department of Primary Industries, FHMOP 005, 27 pp.

Fox, J., Nino-Murcia, A. (2005) Status of Species Conservation Banking in the United States. *Conservation Biology* 19(4): 996-1007.

Gibbons, P., Lindenmeyer, D. (2007) Offsets for land clearing: No net loss or the tail wagging the dog? *Ecological Management and Restoration* 8(1): April 2007.

Hallwood, P. (2007) Contractual difficulties in environmental management: The case of wetland mitigation banking. *Ecological Economics* 63(2-3): 446-451.

Margules, C.R., Sarkar, S. (2007) *Systematic Conservation Planning*. Cambridge University Press, New York.
McCabe, K.A., Rassenti, S.J., Smith, V.L. (1991) Smart computer-assisted markets. *Science* 254: 534-538.

McKenney, B., Kiesecker, J. (2010) Policy development for biodiversity offsets: A review of offset frameworks. *Environmental Management* 4: 165-176.

Moilanen, A., van Teeffelen, A., Ben-Haim, Y., Ferrier, S. (2009) How much compensation is enough? A framework for incorporating uncertainty and time discounting when calculating offset ratios for impacted habitat. *Restoration Ecology* 17(4): 470-478.

Norton, D. (2009) Biodiversity Offsets: Two New Zealand Case Studies and an Assessment Framework. *Environmental Management* 43(4): 698-706.

Parkes, D., Newell, G., Cheal, D. (2003) Assessing the quality of native vegetation: the 'habitat hectares' approach. *Ecological Management and Restoration* 4: S29-S38.

Race, M. Fonseca, M. (1996) Fixing compensatory mitigation: What will it take? *Ecological Applications* 6: 94-101.

ten Kate, K., Bishop, J., Bayon, R. (2004) *Biodiversity offsets: views, experience and the business case*. London, IUCN, Gland, Switzerland, Cambridge and Insight Investments.

Queensland Government (2008) Queensland Government Environmental Offsets Policy 2008.

Queensland Government (2009) Policy for vegetation management offsets. Available online at www.derm.qld.gov.au. Accessed 15 November 2010.

Queensland Government (2010) Offsets for net gain of koala habitat in south east Queensland Policy. Available online at www.derm.qld.gov.au. Accessed 15 November 2010.

Salzman, J., Ruhl, J. (2000) Currencies and the Commodification of Environmental Law. *Stanford Law Review* 53: 607-694.

USEPA (Undated) Wetlands Compensatory Mitigation. United States Environmental Protection Agency. Available online at http://water.epa.gov/lawsregs/guidance/wetlands/wetlandsmitigation_index.cfm.

Walker, S. Brower, A., Stephens, T., Lee, W. (2009) Why bartering biodiversity fails. *Conservation Letters* 2: 149-157.

Wheeler, D., Strock, J.M. (1995) *Official policy on conservation banks*. Californian Resource Agency, Sacramento. Available online at http://ceres.ca.gov/wetlands/policies/mitbank.html