
Potential biodiversity offset actions and sites for the Australian Capital Territory

Advice for the ACT Office of
the Commissioner for
Sustainability and the
Environment

Dr. Philip Gibbons
The Fenner School of Environment
and Society
The Australian National University
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Summary

Background

Population growth and poor housing affordability have combined to create strong demand for urban development and attendant infrastructure in the Australian Capital Territory (ACT). Several jurisdictions in Australia attempt to mitigate the impacts of development on biodiversity by employing biodiversity offsets. Biodiversity offsets are actions that compensate for the adverse biodiversity impacts arising from development. Offsets are currently employed in the ACT as part of development approvals under the Commonwealth *Environment Protection and Biodiversity Conservation (EPBC) Act 1999*.

This paper represents independent advice to the Office of the Commissioner for Sustainability and the Environment (OCSE) on potential biodiversity offset management actions and sites for the ACT. This advice is provided in the context of the OCSE's investigation into the Canberra Nature Park (nature reserves), Molonglo River Corridor (nature reserves) and Googong Foreshores.

Potential biodiversity offset management actions for the ACT

Biodiversity offset management actions should be additional to the duty of care that a manager has to a site. In this advice I considered the statutory duty of care only. However, not all legislation, action statements, management plans, land management agreements or other policy documents made under legislation in the ACT are specific enough to determine the exact level of activity that is expected of a land manager. This applies within and without nature reserves. This level of activity must be explicitly defined before offset management actions can be determined for a site.

In this report I have provided a full set of potential biodiversity offset management actions that are relevant for the ACT. I have then recommended a subset of these actions for use within a biodiversity offset policy in the ACT based on available information. These are actions that: (a) are likely to be beneficial to biota most affected by development in the ACT, (b) deliver in-kind outcomes (i.e. improvements that are broadly equivalent to impacts), (c) are most likely to achieve timely and certain conservation gains and (d) are additional to the statutory duty of care. The recommended list of offset management actions for the ACT is provided in Table 1. Monitoring and adaptive management should be a mandatory management action on all offset sites. Combinations of these actions will often yield the greatest biodiversity outcomes and there is scope to include some higher-risk and out-of-kind management actions (e.g., research) into a broader package of management actions for an offset site.

Table 1. Recommended biodiversity offset management actions for the ACT.

Management action	Circumstances in which applicable
Removal of livestock grazing	Areas where livestock grazing is practiced principally for production (rural leases, freehold in NSW, Travelling Stock Reserves in NSW)
Strategic livestock grazing	Areas where livestock grazing is practiced principally for production (rural leases, freehold in NSW, Travelling Stock Reserves in NSW) and areas where biomass reduction is required for conservation purposes. Not applicable where already employed for conservation purposes (e.g., nature reserves)
Small-scale fencing to exclude or greatly reduce predators (e.g., European Red Fox <i>Vulpes vulpes</i>) and abundant herbivores (e.g., Eastern Grey Kangaroo <i>Macropus giganteus</i> , European Rabbit <i>Oryctolagus cuniculus</i>)	All tenures
Culling of the Eastern Grey Kangaroo for ecological reasons	Only applicable in tenures where culling for ecological reasons is not required (e.g., freehold in NSW)
Control or eradication of exotic plants beyond the level required for the target species on the site (e.g., eradication of species for which the legal requirement under the ACT Pest Plant and Animal Declaration is containment)	All tenures
Cessation of firewood collection	Applicable on tenures where firewood collection is permitted (rural leases, freehold in NSW and potentially urban open space)
Import coarse woody debris from appropriate sites (e.g., impact sites)	All tenures
Cease fertilizer application and/or sowing of pasture plants	Rural leases and freehold in NSW
Relocate bush rock from appropriate sites (e.g., impact sites) to areas where it has been depleted	All tenures
Planting and/or direct seeding of indigenous plant species	All tenures except nature reserves (where the objective is to revegetate with a mix of groundcover species then applicable on all tenures)
Create or re-create wetland habitat	All tenures

Potential sites for biodiversity offsets in the ACT

Existing nature reserves in the ACT provide limited opportunities for offsets because the statutory duty of care to biodiversity in these sites is high relative to other land tenures and nature reserves contain only 29% of remaining lowland woodland in the ACT, which is the area most affected by development. Nevertheless, there are some offset actions that can be considered above duty of care for existing nature reserves and meet the other principles of offsets; and therefore may be appropriate offset actions (i.e., fencing to exclude introduced predators or over-abundant herbivores, control of exotic plants above duty of care, importing coarse woody debris and bush rock from impact sites and creating wetland habitat).

Rural leases in the ACT, urban open space in the ACT and freehold land adjacent to the ACT represent the most suitable tenures or zones for biodiversity offsets because they contain a large proportion (>50%) of remaining lowland woodlands and the statutory duty of care to biodiversity conservation in these tenures is relatively low compared with nature reserves.

However, offset actions undertaken outside nature reserves will be beneficial to existing nature reserves where they: (a) mitigate existing, or future, threats to existing nature reserves and (b) improve the functionality of existing nature reserves (e.g., increase the representativeness of the existing reserve network). It is also appropriate to site offsets so they enhance connectivity between nature reserves. However, offsets outside areas identified as being strategic for connectivity are still important because current research indicates that the area and condition of habitat is more critical for biodiversity conservation than the configuration of habitat.

1. Introduction

This document represents independent advice requested by OCSE on biodiversity offset options with respect to OCSE's investigation into the Canberra Nature Park (nature reserves), Molonglo River Corridor (nature reserves) and Googong Foreshores.

The terms of reference were to provide advice to the Commissioner which includes the following:

- consider relevant current law, policy, practice and status of biodiversity offset management in other States or Territories in Australia that may be applicable to the ACT;
- identify options for potential biodiversity offset management actions in the ACT;
- identify potential biodiversity offset sites; and
- consider the role of corridors and connectivity to the nature reserves when providing this advice.

This advice was provided under a short contract. Additional information, where required, to inform this issue are highlighted.

2. Context

Population growth and poor housing affordability have combined to create strong demand for urban development and attendant infrastructure in the ACT. The 2010-11 budget for the ACT signalled a 33% increase in residential land release over the previous budget (ACT Government 2010). The most suitable areas for urban development in the ACT contain remnant native grassy woodlands dominated by Yellow Box (*Eucalyptus melliodora*) and Blakely's Red Gum (*E. blakelyi*) and temperate grasslands. These are ecological communities listed as Critically Endangered and Endangered in the Commonwealth *Environment Protection and Biodiversity Conservation (EPBC) Act 1999* and Endangered in the *ACT Nature Conservation (NC) Act 1980*. These threatened ecological communities also contain several threatened plant and animal species listed on the EPBC and NC Acts.

Several State Governments (e.g. Parkes et al. 2003, Department of Environment and Conservation (NSW) 2005) and the Commonwealth Government (DEWR 2007) in Australia (and internationally) (ten Kate et al. 2004) employ biodiversity offsets in an attempt to achieve no net loss, or net gain, in biodiversity outcomes while continuing to make new areas available for development. A definition of "biodiversity offsets", as provided by the Business and Biodiversity Offsets Program (BBOP) (a non-government body that is developing international standards for biodiversity offsets), is provided in Box 1.

Because considerable housing development in the ACT impacts on species and ecological communities listed in the EPBC Act, biodiversity offsets in the ACT are principally informed by the Commonwealth's Draft Policy Statement on biodiversity offsets (DEWR 2007), although there have been discussions about a formal biodiversity offset policy that applies more broadly to habitats and biota in the ACT. In this report I explore activities and sites that are appropriate for offsets in the ACT, with particular reference to the OCSE's investigation into Canberra Nature Park (nature

reserves), Molonglo River Corridor (nature reserves) and Googong Foreshores and the principles in the Commonwealth's Draft Policy Statement on biodiversity offsets (DEWR 2007).

Box 1. A definition of biodiversity offsets.

Biodiversity offsets are measurable conservation outcomes resulting from actions designed to compensate for significant residual adverse biodiversity impacts arising from project development and persisting after appropriate prevention and mitigation measures have been implemented. The goal of biodiversity offsets is to achieve no net loss, or preferably a net gain, of biodiversity on the ground with respect to species composition, habitat structure and ecosystem services, including livelihood aspects. Source: <http://bbop.forest-trends.org/index.php>.

3. Potential biodiversity offset management actions in the ACT

In this section I identify potential biodiversity offset management actions for the ACT. There are several issues that should be considered when identifying potential biodiversity offset actions. These are discussed below and inform the list of recommended biodiversity offset actions provided at the end of this section.

(a) Biodiversity offsets should deliver outcomes that are like-for-like (DEWR 2007, BBOP undated).

The Commonwealth Government's position is a preference for direct, "like-for-like" offsets where impacts occur on species and ecological communities listed in the EPBC Act (DEWR 2007). That is, offsets must result in gains that are broadly equivalent to losses. However, the Commonwealth's draft offset policy does not present an operational methodology for calculating offsets. The NSW Department of Environment, Climate Change and Water's Biobanking methodology (DECC 2008) is the most applicable existing methodology to the ACT and is comparable to other methods currently employed in Australia (Parkes et al. 2003, Gibbons et al. 2009). This methodology has two parts: a section that focuses on impacts at the level of the ecological community and a section that focuses on the impacts at the level of individual species. The first part includes several habitat variables that are combined into a single metric. To make this metric operationally feasible there can be substitution between habitat variables within parts of the metric so impacts at the level of the ecological community can be effectively offset with a broad range of actions at the offset site. Thus, the range of management actions that is likely to be acceptable as offsets in the ACT are broad. The draft Commonwealth offset policy does allow for "a package of offsets incorporating direct and indirect actions" (DEWR 2007), although direct, like-for-like actions are considered preferable (DEWR 2007, BBOP undated).

(b) Biodiversity offsets should be for actions that deliver conservation outcomes that would not otherwise occur (DEWR 2007, BBOP undated).

Biodiversity offsets should be actions that are additional to the duty of care that a manager has to a site (Figure 1). For the purposes of this paper, duty of care refers to a requirement that is explicit in statute law. Any duty of care that may exist in common law that is relevant for defining management actions is not considered because this duty of care is still evolving, remains imprecise (Bates 2001) or

where a duty of care under common law with respect to stewardship of land appears to be well defined (i.e., trespass, private nuisance, negligence) (Raff undated), it does not appear to be informative in the context of explicitly defining required management actions. Identifying explicitly the duty of care in the context of biodiversity offsets is important for two reasons. First, actions undertaken to offset development that are below an existing duty of care will not result in gains additional to the status quo and therefore will result in a net loss of biodiversity. Second, if actions to conserve biodiversity that are required of a land manager under statute law are funded or enabled via biodiversity offsets, then biodiversity conservation becomes dependent on the destruction of habitat. In the ACT, management plans for nature reserves, Land Management Agreements for rural leases and action statements for species and ecological communities reflect requirements of the *Planning and Development Act 2007* and *NC Act 1980*, so their contents are considered part of the statutory duty of care in this advice.

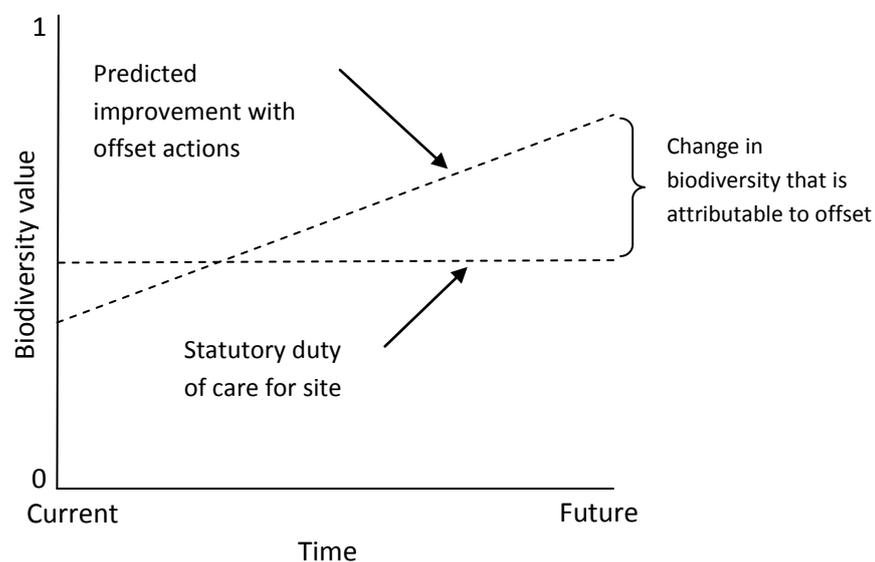


Figure 1. Biodiversity offsets should be restricted to outcomes above the duty of care for a site.

One important consequence of this principle of duty of care—or additionality—that is often ignored in the application of biodiversity offsets is that a simple set-aside of existing habitat is not an appropriate offset action (Figure 2) unless active management of the offset is sufficient to realise gains above the existing duty of care that are equivalent to losses from development. For example, it is not sufficient on its own to convert an existing remnant to nature reserve as an offset, even if it can be demonstrated that this is above normal government commitments. Converting a site to a nature reserve does not automatically confer on that site greater biodiversity conservation values. There must be actions also undertaken on the site that yield gains above the existing duty of care to that site that are sufficient to compensate losses as a result of development.

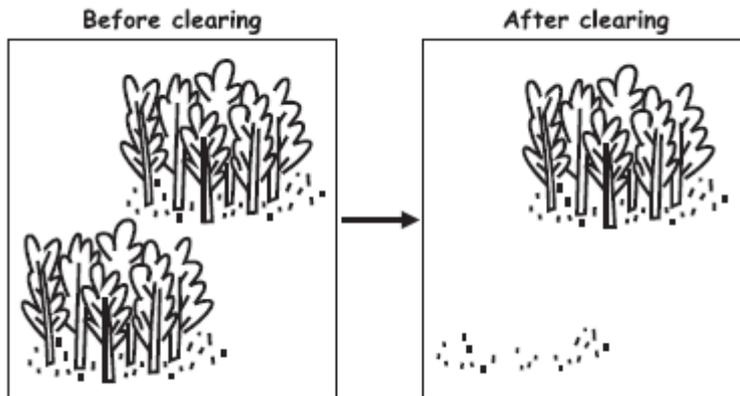


Figure 2. An illustration of a simple offset strategy in which an area is cleared provided an equivalent area of existing vegetation is set aside as an offset. This strategy will lead to a net loss equivalent to the area cleared unless there are sufficient gains on the offset site and is therefore not an appropriate offset activity (Source: Gibbons and Lindenmayer 2007).

- (c) Biodiversity offsets should achieve timely, long-term and certain conservation gains (DEWR 2007).

One criticism of biodiversity offsets is uncertainty surrounding the ability to achieve many of the gains promised at offset sites, especially since offset policies typically permit impacts to proceed well before the required gains have been realised (Gibbons and Lindenmayer 2007, Bekessy et al. 2010). This criticism is compounded by the fact that compliance in offset schemes, where this has been examined, has been poor (Quigley and Harper 2006). Thus, feasibility and likelihood of success are important criteria by which to judge potential offset actions.

Offset actions undertaken under the EPBC Act must be secured for a period consistent with the duration of the impact (DEWR 2007)—which should generally be in perpetuity (BBOP undated). Offsets established on public land should therefore be zoned appropriately for their long-term security, which may involve variation to the Territory Plan in the case of land managed by the ACT Government. A formal covenant, binding agreement or restriction that runs with the lease (e.g., through a Land Management Agreement) or title must apply to offsets established in rural leases in the ACT, or freehold land in NSW. A site that cannot be secured for a period that is consistent with the duration of the impact (usually in perpetuity) should not be used as an offset site. In the NSW BioBanking program annual payments are made to the manager of the offset contingent upon compliance with the offset plan of management. If adopted in the ACT, this requirement should apply equally to public, leasehold and freehold land in which offsets are established.

- (d) Biota likely to be affected by an offset policy in the ACT.

Offset actions should also be those that are beneficial to the biota affected by development at the impact site. Most urban development in the ACT occurs in the lowlands. Thus, the communities that will be predominantly affected—and for which offset actions should be devised—are lowland woodlands and secondary grasslands derived from this ecological community (i.e. where over-storey

has been removed) and natural temperate grasslands. This is confirmed by recent developments assessed under the EPBC Act which included clearing and fragmenting existing remnants of Box Gum Grassy Woodland and Natural Temperate Grassland (OCSE pers. comm. 2011). In the NSW Biobanking Methodology additional offset actions are stipulated for threatened species likely to be affected by development and the Commonwealth also requires offsets for individual species listed under the EPBC Act. Thus, it is feasible that an offset policy in the ACT will apply to species listed in the EPBC Act and the NC Act that are affected by development in the ACT lowlands. Species and ecological communities that may be affected in these habitats are listed in Table 2. Direct damage to drainage lines and wetland habitats and potential downstream effects of these actions is a clear consequence of urban development within the ACT lowlands and for which offset actions could also be imposed, but are not considered in detail here.

Table 2. Ecological communities and species listed on the EPBC and/or NC Acts that are potentially directly impacted by urban development in the ACT and for which offset actions may be relevant.

Species or ecological community	Common name
<i>Eucalyptus melliodora/E. blakelyi</i>	Box Gum Grassy Woodland Natural Temperate Grassland
<i>Diuris pedunculata</i>	Golden Moths
<i>Lepidium ginninderrense</i>	Ginninderra Peppergrass
<i>Leucochrysum albicans var. tricolor</i>	Hoary Sunray
<i>Prasophyllum petilum</i>	Tarengo Leek Orchid
<i>Rutidosis leiolepis</i>	Monaro Golden Daisy
<i>Rutidosis leptorrhynchoides</i>	Button Wrinklewort
<i>Swainsona recta</i>	Small Purple Pea
<i>Thesium australe</i>	Austral Toadflax
<i>Delma impar</i>	Striped Legless Lizard
<i>Tympanocryptis pinguicollis</i>	Grassland Earless Dragon
<i>Aprasia parapulchella</i>	Pink-tailed Worm Lizard
<i>Lathamus discolor</i>	Swift Parrot
<i>Polytelis swainsonii</i>	Superb Parrot
<i>Climacteris picumnus</i>	Brown Treecreeper
<i>Melanodryas cucullata</i>	Hooded Robin
<i>Grantiella picta</i>	Painted Honeyeater
<i>Xanthomyza phrygia</i>	Regent Honeyeater
<i>Daphoenositta chrysoptera</i>	Varied Sitella
<i>Lalage sueurii</i>	White-winged Triller
<i>Synemon plana</i>	Golden Sun Moth
<i>Perunga ochracea</i>	Perunga Grasshopper

Potential biodiversity offset actions should be those that are most likely to result in gains to the ecological communities and species affected by development. To achieve these gains, the manager must reduce and preferably reverse the original cause(s) of decline of the target community or species at the offset site. Potential offset actions are therefore those actions that address the key

causes of decline of ecological communities and species that are most likely to be impacted by development in the ACT lowlands (Table 2).

A list of potential biodiversity offset actions for the ACT is provided in Table 3. In-kind and out-of-kind offset actions are considered consistent with the draft Commonwealth offset policy (DEWR 2007). Appropriate circumstances in which to apply each action is discussed, including whether the action is appropriate for nature reserves. I have also subjectively rated each action in terms of feasibility, given the resources (money, expertise, time) that are likely to be available for offset activities, likelihood of success of the action and measurability, which is also recommended to be a key requirement of offsets (BBOP undated).

Table 3. A list of potential biodiversity offset management actions for the ACT. These are grouped to address key causes to the decline of biota that are likely to be affected in the ACT. The appropriate circumstances in which the actions may apply, the feasibility of implementing the action, the probability of success and potential to measure outcomes from the actions are noted. Note that this is not the recommended list of biodiversity offset management actions.

Cause of decline to lowland biota in ACT	Potential offset action	Appropriate circumstances in which to apply action (including whether actions are suitable for nature reserves)	Feasibility of implementation	Probability of success	Potential to measure outcomes
Livestock grazing (Lunt 2005)	Removal of livestock. Complete removal of livestock can have positive benefits for this ecological community (e.g. Briggs et al. 2008).	Should apply to areas that are regularly grazed with livestock and for which the principal aim is production. This is predominantly rural leases within the ACT and rural freehold in adjacent land within NSW. Livestock grazing in nature reserves is typically employed for environmental reasons, so is not a relevant offset action in these areas.	High	High	High
	Strategic livestock grazing. Can be tailored to the specific habitat requirements of certain plant or animal species where these are known.	Should apply to areas that are regularly grazed with livestock and for which the principal aim is production, which is typically rural leases within the ACT and rural freehold in adjacent land within NSW. Unlikely to be above duty of care in nature reserves because already used as a management tool. Generally not appropriate for high quality sites because of risks such as introduction of weeds and generally not suitable for sites with low productivity (Lunt 2005).	High	Medium	High
European Rabbit and Hare (<i>Lepus europaeus</i>) (Environment ACT 2004)	Rabbit and Hare control by poison, fumigation of warrens and ripping of warrens.	Rabbit/Hare control is a stated management objective in nature reserves (e.g. Department of Urban Services 1999), rural leases and freehold land in NSW and therefore should not be a supported offset activity unless it can be demonstrated that the proposed level of control is above the duty of care.	High	Medium	High
	Localised exclusion with fencing or modification to existing fences.	Appropriate for small areas (e.g., localised populations of threatened flora) and would be above the duty of care for all tenures.	Medium	High	High

Cause of decline to lowland biota in ACT	Potential offset action	Appropriate circumstances in which to apply action (including whether actions are suitable for nature reserves)	Feasibility of implementation	Probability of success	Potential to measure outcomes
Over-grazing by Eastern Grey Kangaroo (Parks Conservation and Lands 2010)	Localised control can be achieved with appropriate fencing or modification to existing fences.	Applicable where large reduction in numbers required over a small area. This is an action that is beyond expected management in all tenures.	High	High	High
	Culling by shooting (ongoing)	Applicable where reduction of kangaroos is required over large areas. Some level of control is practiced in nature reserves and some Commonwealth land supporting threatened species or communities within the ACT and therefore should not generally be supported as an offset action on these tenures. Is applicable as an offset action on tenures where the control of kangaroos for ecological reasons is not required by law (e.g., freehold land in NSW).	Medium	High	High
	Fertility control	Has been practiced in the ACT (e.g., Governor General's residence) and would be above expected management in all tenures. Most suited to populations isolated from immigration by fertile animals, but is a resource-intensive option at present.	Low	Medium	High

Cause of decline to lowland biota in ACT	Potential offset action	Appropriate circumstances in which to apply action (including whether actions are suitable for nature reserves)	Feasibility of implementation	Probability of success	Potential to measure outcomes
Exotic plants (Environment ACT 2004)	The use of herbicides, manual or mechanical control that aims to reduce the cover of exotic plants.	Offset activities should not be for the control of plant species for which some level of control is expected. These may include plants listed in the current ACT Pest Plant and Animals Declaration or Weeds of National Significance (WONS). Offsets are appropriate on any tenure (including nature reserves) for actions that seek to suppress (totally eliminate) exotic plant species that must only be contained under the ACT Pest Plants and Animals Declaration. Suitable as an action to control other exotic plants on land where their control is not required by law (e.g., rural leases, urban open space, freehold in NSW). Offset activities should not be for actions required under the terms of a Land Management Agreement for a rural lease.	Medium	Medium	High
Removal of coarse woody debris (Environment ACT 2004)	Halt collection of coarse woody debris for firewood	Suitable as an offset action in tenures where firewood collection is permitted by law (e.g., rural leases, freehold land in NSW) and where the removal of coarse woody debris cannot reasonably be controlled (e.g., roadsides and urban areas). Not an appropriate activity in areas managed for bushfire protection (although the Bushfires Royal Commission in Victoria recommends that bushfire-related impacts on native vegetation should be offset).	High	High	High
	Provide education targeting firewood collectors (e.g., signage in key areas) or users (e.g., public education campaigns). Education materials should dispel the myth that coarse woody debris represent a fire risk.	Signage is a potential offset action in areas where the risk of illegal firewood collection is high (e.g., urban forest, accessible parts of nature reserves, roadsides), although effective enforcement of firewood collection in such places is arguably an existing function of government and therefore not an appropriate offset activity.	High	Medium	High

Cause of decline to lowland biota in ACT	Potential offset action	Appropriate circumstances in which to apply action (including whether actions are suitable for nature reserves)	Feasibility of implementation	Probability of success	Potential to measure outcomes
	Provide alternative source of firewood.	The establishment of hardwood plantations specifically for firewood have been established in other parts of Australia, but this approach is inconsistent with government policy to reduce the use of firewood heaters in the ACT.	Low	Medium	Low
	Import coarse woody debris (from impact sites or other appropriate source).	This action is above the duty of care on all tenures, and is therefore a suitable offset action for all tenures including nature reserves and stream habitats.	Medium	High	High
Nutrient enrichment (Prober et al. 2005)	Ceasing the application of fertiliser. Discouraging stock from congregating in camps within areas of high conservation value.	Ceasing the application of fertiliser would be an appropriate offset action on rural leases and rural freehold in NSW, but the residence time for nutrients in the soil is long (circa. 30 years), so would only be suitable over the long-term. Discouraging stock from forming camps in strategic areas would be suitable in any land where livestock are presently grazed.	High	Medium	Medium
	Actions to reduce the level of existing nutrients in the soil such as the application of carbohydrate (Prober et al. 2005).	Reducing existing soil nutrients combined with establishment (e.g., direct seeding) of native groundcover species would be a suitable offset action in any tenure, but is an unproven treatment at an operational level.	Low	Low	Low
Pasture improvement (Environment ACT 2005)	Ceasing the sowing of pasture plants.	Suitable for rural leases in the ACT and freehold land in NSW where pasture improvement is practiced in areas dominated by native grasses and areas with no previous fertilizer application.	High	High	High

Cause of decline to lowland biota in ACT	Potential offset action	Appropriate circumstances in which to apply action (including whether actions are suitable for nature reserves)	Feasibility of implementation	Probability of success	Potential to measure outcomes
Feral predator control (e.g., European Red Fox)	On-going poisoning program using an appropriate protocol to avoid non-target fauna.	This suitable offset action in rural leases provided it is above any existing requirement in a Land Management Agreement. Fox control is a stated objective in nature reserves so is not an appropriate offset activity in these areas. Not a feasible action in areas where there are domestic dogs (e.g., urban areas). May be more appropriate if a coordinated activity over a large area.	Medium	Medium	High
	Local eradication using predator-proof fencing.	This action is above the expected duty of care for all tenures, including nature reserves.	Medium	High	High
Domestic dogs and cats	Education by signage and public education campaigns to alert individuals of the threats posed to native wildlife by domestic cats and dogs.	This is already practiced in nature reserves, but would be an appropriate offset action in urban areas adjacent to lowland habitat outside nature reserves and rural leases.	High	Medium	Low
	Confining domestic cats and dogs.	This is a potential offset activity in rural areas adjacent to important lowland habitats (e.g., nature reserves). Should not be supported where it is already government policy.	Medium	Medium	Low

Cause of decline to lowland biota in ACT	Potential offset action	Appropriate circumstances in which to apply action (including whether actions are suitable for nature reserves)	Feasibility of implementation	Probability of success	Potential to measure outcomes
Habitat loss	Planting or direct seeding using indigenous species	Appropriate for sites where plant propagules are absent or natural regeneration is unlikely to occur (e.g., due to competition of exotic groundcover). Can be used to rehabilitate structure and some function into highly modified sites or improve structure in partially modified sites. Revegetation by planting/seeding is an existing commitment within management plans for nature reserves in the ACT, so should not be an offset activity in these areas. However, planting/direct seeding a mixture of groundcover species is potentially an activity beyond duty of care on all tenures, although the success of this activity involves greater risk than planting/direct seeding of trees and shrubs and is likely to have greater success if integrated with ongoing weed control and/or nutrient management.	High	High	High
Insufficient knowledge	Research and a pathway for application of research results	The research must address a well-defined problem that relates to improving the conservation status of biota impacted by development. There must be a strong collaboration between researchers and land managers to maximise the likelihood that the research outcomes can be applied in practice. Applicable for all tenures.	High	Medium	High
	Monitoring and adaptive management	Should be a mandatory offset action on all tenures. Offset requirements should be sufficiently flexible so change can be made if monitoring indicates that objectives are not being met. This will mean that performance targets should be specified when offsets are established.	Medium	High	High
Loss of wetland habitat	Create new wetlands or slow water movement to re-create chain of ponds	Is an action that is above the duty of care in all tenures.	Medium	High	High

Cause of decline to lowland biota in ACT	Potential offset action	Appropriate circumstances in which to apply action (including whether actions are suitable for nature reserves)	Feasibility of implementation	Probability of success	Potential to measure outcomes
Small populations (e.g., Tarengo Leek Orchid) (Environment ACT 2004)	Translocation of individuals from the impact site to offset site	Is an action that is above the duty of care in all tenures, but has neither been successfully undertaken for all species nor is operationally feasible for all species. Is being trialled as part of research at Mulligans Flat Nature Reserve.	Low	Low	High
	Captive breeding	Is an action that is above the duty of care in all tenures and is not a planned activity as indicated by Action Statements for the endangered species listed for lowland woodlands and temperate grasslands in the ACT.	Low	Medium	High
Slashing and mowing (Environment ACT 2005)	This can be a legitimate action for reducing competition between native grasses (e.g., <i>Themeda triandra</i>) and other native plant species. However, this action can also promote the expansion of exotic plant species where they occupy the site and can inhibit recruitment of mid-storey and over-storey species in woodland, particularly if undertaken frequently.	Arguably an existing management action in Urban Open Space and nature reserves. May be appropriate as an offset activity in rural leases and freehold in NSW, but this function is more likely to be performed by strategic livestock grazing.	High	Medium	High
Competition from introduced and hyper-abundant native species	Culling populations of over-abundant species (e.g., Common Myna <i>Acridotheres tristis</i>). This issue is not restricted to introduced species.	Is above the duty of care in all tenures.	Low	Medium	High

Cause of decline to lowland biota in ACT	Potential offset action	Appropriate circumstances in which to apply action (including whether actions are suitable for nature reserves)	Feasibility of implementation	Probability of success	Potential to measure outcomes
Removal of bush rock (Environment ACT 2004)	Discourage removal of bush rock through signage, public education and/or improved enforcement.	May be relevant for offset actions that target individual species associated with bush rock on offset sites where bush rock removal has occurred. This is not an activity identified in management plans for the nature reserves in the ACT lowlands and therefore would represent an appropriate action in this tenure and other tenures.	High	High	High
	Relocate bush rock from impact sites to sites where it has been removed in the past.	As with moving coarse woody debris, this would be an action above expected management on all tenures.	Medium	High	High
Soil disturbance (Environment ACT 2004)	Restrict activities that cause soil disturbance (e.g., vehicles, mountain bikes, horse-riding) by fencing and/or signage.	Potentially applicable in all tenures except nature reserves where the management of soil disturbance should be a core aim of management. May be an existing condition defined in Land Management Agreements for rural leases.	High	High	High

Recommended offset management actions for the ACT

Biodiversity offset management actions that are identified in Table 3 **and** best meet the principles for offsets discussed above, that is, deliver outcomes that are: (a) like-for-like, (b) would not otherwise occur or are above the statutory duty of care, (c) have potential to achieve timely and certain conservation gains and (d) are likely to be beneficial to biota most affected by development in the ACT, are listed in Table 4.

A combination of management actions will often deliver greatest biodiversity outcomes on a site. There is scope to include some out-of-kind and higher-risk offset management actions (Table 3) when offsets are delivered as part of a broader package of actions. However, it is not possible to be prescriptive about the optimum combination of actions that should apply to a site. This will depend on the nature of the impact that must be offset, the capacity and willingness of the land manager to undertake actions and the starting condition and management history of the prospective offset site. Thus, flexibility in this respect is recommended. In a conservation index developed for the Commonwealth Government's Environmental Stewardship Program for Box Gum Grassy Woodland, Gibbons and Ryan (2008) developed a metric that predicted the appropriate management actions for a site based on: the starting condition of the site, the "state" of the site (as defined in a state and transition model by McIntyre and Lavorel (2007)) and the history of nutrient enrichment to the site. This may represent a useful guide for identifying the appropriate combination of management actions for offset sites in the ACT.

Table 4. Recommended offset management actions for the ACT. That is, actions that are like-for-like, would not otherwise occur (above statutory duty of care), have potential to achieve timely and certain conservation gains and are likely to be beneficial to biota most affected by development in the ACT.

Management action	Circumstances in which applicable
Removal of livestock grazing	Areas where livestock grazing is practiced principally for production (rural leases, freehold in NSW, Travelling Stock Reserves in NSW)
Strategic livestock grazing	Areas where livestock grazing is practiced principally for production (rural leases, freehold in NSW, Travelling Stock Reserves in NSW) and areas where biomass reduction is required for conservation purposes. Not applicable where already employed for conservation purposes (e.g., nature reserves)
Small-scale fencing to exclude or greatly reduce predators (e.g., European Red Fox) and abundant herbivores (e.g., Eastern Grey Kangaroo, European Rabbit)	All tenures
Culling of the Eastern Grey Kangaroo for ecological reasons	Only applicable in tenures where culling for ecological reasons is not required (e.g., freehold in NSW)
Control or eradication of exotic plants beyond the level required for the target species on the site (e.g., eradication of species for which the legal requirement under the ACT Pest Plant and Animal Declaration is containment)	All tenures
Cessation of firewood collection	Applicable on tenures where firewood collection is permitted (rural leases, freehold in NSW and potentially urban open space)
Import coarse woody debris from appropriate sites (e.g., impact sites)	All tenures
Cease fertilizer application and/or sowing of pasture plants	Rural leases and freehold in NSW
Relocate bush rock from appropriate sites (e.g., impact sites) to areas where it has been depleted	All tenures
Planting and/or direct seeding of indigenous plant species	All tenures except nature reserves (where the objective is to revegetate with a mix of groundcover species then applicable on all tenures)
Create or re-create wetland habitat	All tenures

4. Potential biodiversity offset sites in the ACT

Potential sites for offsets in the ACT should, as far as practicable, be consistent with areas identified as conservation priorities in conservation planning exercises for lowland habitats in the region. Conservation priorities for lowland habitats and threatened species that occur in these ecological communities can be found in the ACT Woodland Strategy (Environment ACT 2004), the ACT Lowland Native Grassland Conservation Strategy (Environment ACT 2005), the ACT Aquatic Species and Riparian Zone Conservation Strategy (ACT Government 2007), the ACT Nature Conservation Strategy (although this document lacks specific recommendations), the Canberra Spatial Plan (ACTPLA 2004) and the report on ecological connectivity by Manning et al. (2010). However, there is no comprehensive, spatially explicit, systematic conservation plan for the ACT lowlands that brings

these priorities together. Best practice systematic conservation planning is based on identifying sites with high irreplaceability, or complementarity, and threat (Pressey and Taffs 2001) at least cost (Fuller et al. 2010). A plan of this nature would: (a) identify areas that contain values that cannot be feasibly offset so they can be considered early in the planning process and (b) identify priorities for prospective offset sites.

In the absence of a comprehensive, spatially explicit systematic conservation plan that identifies priorities for biodiversity conservation in the ACT, it is not feasible within the scope of this consultancy to identify specific locations that should be priorities for offset activities in the ACT region. In this section I therefore identify the suitability of different zones and tenures, and general locations within these, for biodiversity offsets within the ACT and adjacent NSW lowlands.

In addition to meeting the principles of systematic conservation planning, sites for biodiversity offsets in the ACT should meet the following criteria:

(a) Be located in the same bioregional areas as the proposed activity.

In addition to the principle of “like-for-like”, the draft Commonwealth offset policy (DEWR 2007) states that offsets should occur in the same bio-region or sub-region as the impact site. The NSW Biobanking methodology (DECC 2008) also requires offsets to occur in a comparable (pre-European) vegetation type, landscape context and remnant size. These would restrict most offsets to lowland woodland originally dominated by Yellow Box (*Eucalyptus melliodora*) and Blakely’s Red Gum (*E. blakelyi*) and Natural Temperate Grassland because these will be the ecological communities most affected by development in the ACT. However, there is an ecological justification to locate offset sites anywhere within the South Eastern Highlands Bioregion where these ecological communities occur, which includes areas in NSW.

(b) Deliver conservation outcomes that would not otherwise occur.

As discussed in the previous section, biodiversity offsets should be actions that are additional to the duty of care that a manager has to a site (Figure 1). This principle means that sites with a relatively high duty of care to biodiversity conservation (e.g., existing nature reserves) have limited capacity for gain relative to sites where the duty of care to biodiversity conservation is lower (e.g., rural leases managed for agricultural production). However, it is difficult to make a definitive judgement on the required actions in each land use category or zone. The extent to which these actions must be taken are often not explicitly defined in legislation, management plans, land management agreements and policy documents. This means that some judgement must be employed when identifying the level of actions that are expected on each land use, zone or tenure. However, the degree to which a management action is expected on a site must be explicitly defined before offset gains can be calculated using a methodology of the type used for Biobanking in NSW (DECC 2008).

In the remaining part of this section I discuss the potential for different land tenures and zones in lowlands within, and adjacent to, the ACT to support offset actions given these considerations. Dr. M. Mulvaney (Department of Environment, Climate Change, Energy and Water, pers. comm.) advised that there is sufficient area of lowland habitat available to offset approximately 6,000ha of lowland woodlands at a ratio of 4:1.

Existing nature reserves

Existing nature reserves include those parts of the Canberra Nature Park, Googong Foreshores, and Molonglo River Corridor managed principally for nature conservation, which is a specific focus of the OCSE inquiry. The opportunity for offsets in these nature reserves is limited for two reasons. First, the duty of care to biodiversity conservation in nature reserves is high relative to other land uses. Second, these nature reserves are predominantly on hills and ridges and therefore are not dominated by lowland habitat, which contains the ecological communities most likely affected by future development in the ACT. Data from the Lowland Woodlands Strategy (Environment ACT 2004) indicates that nature reserves contain 29% of remaining lowland woodland in the ACT (Figure 3), so most opportunities for offsets lie outside nature reserves. Nevertheless, some actions are not required in the normal course of managing nature reserves and therefore could be supported as offset actions (i.e., fencing to exclude introduced predators or over-abundant herbivores, control of exotic plants above duty of care, importing coarse woody debris and bush rock from impact sites and creating wetland habitat) (Table 4).

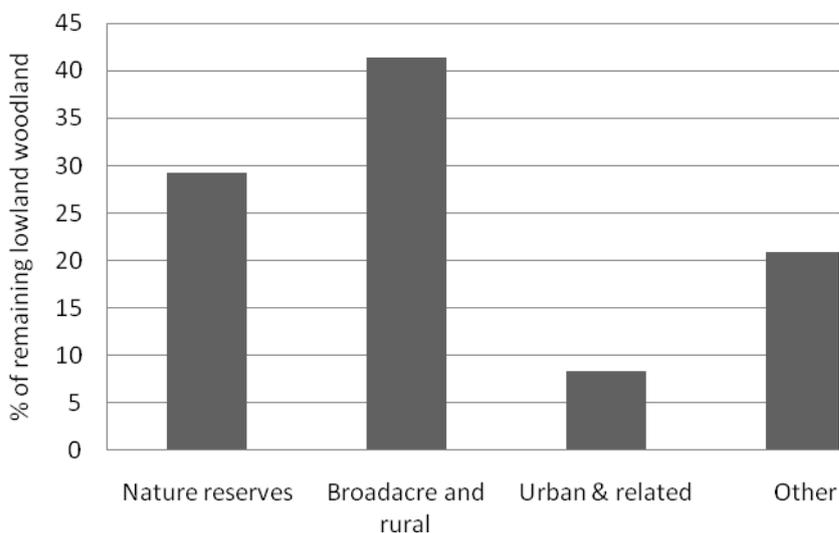


Figure 3. Representation of remaining lowland woodland in different land uses within the ACT. Data taken from Environment ACT (2004).

Existing nature reserves supporting lowland habitat in the ACT would greatly benefit from offset actions that seek to minimise threats to these nature reserves. In the ACT a major threat is the proximity of urban development and associated impacts (e.g., domestic dogs and cats, the spread of garden plants, firewood collection and hyper-aggressive native species associated with suburban gardens) (Environment ACT 2004). Thus, offset activities adjacent to nature reserves where there are existing pressures such as potential urban development (both within the ACT and areas adjacent to nature reserves outside the ACT) should be a high priority as offset sites.

Broadacre & Rural

Broadacre and Rural are zones identified in the Territory Plan that seek to preserve predominantly rural land uses, although the Territory Plan states that development in the Broadacre Zone must not undermine future possibility of urban development. The Rural Zone also includes objectives relating to biodiversity conservation. These zones represent the greatest potential for biodiversity offsets in the ACT for several reasons. First, these zones contain the greatest area (41%) of lowland woodland in the ACT (Figure 3). Second, the duty of care to biodiversity is relatively low because the majority of remnant lowland woodland in these zones is managed principally for agricultural production. For example, large areas of scattered mature Yellow Box and Blakely's Red Gum in these zones contain no regeneration and therefore will continue to decline and ultimately be lost without a change to management (Gibbons et al. 2008) that can potentially be supported via offsets. Finally, areas within these zones have been identified as strategically important to conservation in the ACT lowlands (Environment ACT 2004, Manning et al. 2010).

Urban open space

This Zone occurs within or adjacent to urban areas of the ACT. According to the Territory Plan, this Zone has a range of objectives and uses which include flora and fauna conservation, ecological connectivity and water quality. It contains approximately 8% of remaining lowland woodland in the ACT (Figure 3). Areas in this Zone with remnant native vegetation (e.g., mature trees), areas planted with predominantly indigenous species, areas where planting and direct seeding can be undertaken and open storm water drains are potential offset locations within this zone provided risks to the public (e.g., falling limbs, fuel load) can be managed effectively. Open storm water drains have considerable potential to support biodiversity if converted to riparian habitat. The duty of care to biodiversity conservation is arguably relatively low in this Zone providing considerable opportunity for biodiversity gains. Another benefit is the proximity of parts of this Zone to impact sites, which is consistent the like-for-like principle of offsets. The creation of wetlands around existing open storm water drains is an offset activity that is particularly suited to this Zone. This Zone represents an opportunity to mitigate threats to natural areas posed by the urban interface. These include: invasion of native vegetation by exotic plants such as garden escapes; impacts on wildlife by domestic cats and dogs; control of hyper-aggressive native species (e.g., Noisy Miner *Manorina melanocephala*) and introduced species (e.g., Common Myna); and changed flow regimes, sedimentation and eutrophication of waterways caused by urban development. This Zone represents a potential opportunity to educate the Canberra urban population, so offset actions that would benefit from community involvement (e.g., monitoring), out-of-kind offset actions based on

education (e.g., activities with school groups and signage) should be a feature of actions undertaken in these zones.

Suburban

This is the lowest density housing zone in the Territory Plan. Individually, suburban blocks are of limited value for offsets because of their size and transaction costs of dealing with individual lessees. However, the option of suburban lessees cooperating to form a biodiversity bank should not be discounted in an offset policy for the ACT if administratively feasible. Many suburban blocks abut nature reserves in the ACT so they represent potential threats to those nature reserves (e.g., domestic dogs and cats, weeds, firewood collection, illegal removal of vegetation, dumping of garden waste). Collectively, suburban yards in these areas could: form a buffer of native vegetation, a buffer of weed control, a zone of control for domestic animals or introduced species (e.g., Common Myna), a location for biodiversity monitoring and/or a “neighbourhood watch” function (e.g., illegal firewood removal, illegal dumping of garden waste).

National land managed by the Commonwealth within the ACT

Some areas of Commonwealth Land within the ACT (e.g., Majura Firing Range) contain significant areas of lowland habitat and therefore should be considered for biodiversity offset activities.

Freehold land (NSW)

Freehold land is land managed privately in lowland areas adjacent to the ACT. As indicated previously, freehold land outside the ACT represents legitimate sites for biodiversity offsets because it contains comparable lowland habitats that would enhance biodiversity conservation in the region, the duty of care to biodiversity on freehold land in NSW is relatively low, particularly in modified native vegetation (i.e., “low condition” as defined in the NSW Native Vegetation Regulation), and further development of freehold land adjacent to the ACT could pose threats to significant areas of lowland woodland in the ACT that meets the definition of the endangered ecological community under the NC Act (Environment ACT 2004). This includes areas in NSW that abut the Mulligans Flat and Goorooyarroo Nature Reserves. Actions in freehold land in NSW that contribute to biodiversity conservation within the ACT should be priorities for offset actions.

Crown land (NSW)

Areas of crown land in NSW such as roadsides and travelling stock reserves represent potential offset sites. These sites contain lowland woodland in variable quality and are often subject to ongoing threats such as livestock grazing, invasion by exotic plants and firewood collection.

5. The role of corridors and connectivity to the nature reserves

The role of corridors and connectivity to the nature reserves in the ACT has been considered comprehensively in Manning et al. (2010). As highlighted in the previous section, the functionality of existing nature reserves in the ACT would benefit from actions that mitigate ongoing threats to these nature reserves. Reduced connectivity between existing nature reserves poses two potential threats to nature conservation in the ACT. The first is isolation of nature reserves from other areas of

suitable habitat thus inhibiting movements between populations of certain species. Over time this can isolate populations genetically. It can also lead to the permanent loss of local populations after events such as bushfires and disease because replacement individuals of these species can no longer migrate into the affected habitat. The second emerging threat to biodiversity in the ACT is climate change. Connectivity is often recommended as a way to enable native species to adapt to a changing climate, as they can potentially move with a shifting climatic envelope (Manning et al. 2010).

While functional connectivity is generally considered to be a sound aim of conservation biology, the best way to configure a landscape to achieve this remains uncertain (Hodgson et al. 2009). In the latest comprehensive review of landscape ecology Turner (2005) concluded that “evidence is mounting for a primary effect of composition (area and condition of habitat) and a secondary effect of configuration (how habitat is spatially arranged).” It would therefore seem that identifying offset actions that improve the quality of habitat in the existing nature reserves, reduce threats that originate outside nature reserves and increase the area of lowland habitats managed for conservation that are complementary to the existing reserve system (e.g., increase the representativeness of the reserve system) in the region should be the principal consideration for offset actions in the ACT. Maintaining connectivity between nature reserves (e.g., by locating offset actions in areas identified as priorities for connectivity) is an important, but secondary, consideration. That is, offset activities should not be discounted in areas that are not identified as priorities for connectivity in the region.

6. Conclusions

A biodiversity offsets policy seeks to compensate for the immediate removal of biodiversity at impact sites with actions that provide a comparable amount of biodiversity at one or more different offset sites. To achieve this the policy should seek to: (a) confine the loss of biodiversity to values that can feasibly be offset, (b) focus on actions that are likely to be of greatest benefit for affected biota, (c) focus on actions with a high likelihood of providing measurable biodiversity gains that are comparable to losses and (d) restrict offsets to actions where the gains are additional to those already required under the existing duty of care.

Existing nature reserves will only have a limited role as locations for biodiversity offsets in the ACT because they have a high duty of care relative to other comparable sites in the ACT and they represent a small proportion (29%) of lowland woodland in the ACT, which is the ecological community most likely to be affected by ongoing urban development. Nevertheless, there is scope for some offset actions to be undertaken in existing nature reserves (Table 1). However, there is a greater scope for offsets to improve the functionality of nature reserves—and biodiversity conservation generally—by focusing on actions and sites outside nature reserves. This is because the duty of care is lower at these sites and most lowland habitats occur outside nature reserves. Offsets located outside existing nature reserves will be beneficial to nature reserves if they: (a) mitigate existing, or future, threats to existing nature reserves and (b) improve the functionality of existing nature reserves (e.g., increase the representativeness of the existing reserve network, or increase connectivity between existing reserves).

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