Murrumbidgee to Googong Water Transfer Offset Delivery Plan

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	Name	Position	Date
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Acronyms

ACT	Australian Capital Territory
Cth	Commonwealth
DPI	Department of Primary Industries (NSW)
EIS	Environmental Impact Statement
EMZ	Erosion Management Zone
EPBC Act	Environment Protection and Biodiversity Act 1999 (Commonwealth)
ESP	Exchangeable Sodium Percentage
GPS	Global Positioning System
KPI	Key Performance Indicator
IMS	Integrated Management System
M2G	Murrumbidgee to Googong Water Transfer
MU	Management Unit
NSW	New South Wales
ODP	Offset Delivery Plan
OEMP	Operational Environment Management Plan
SLU	Soil Landscape Unit
WONS	Weeds of National Significance

1 Introduction

1.1 Background

The Murrumbidgee to Googong (M2G) Water Transfer is one of the projects implemented by Icon Water for delivering improved security to the water supply for the ACT and region. Under the activity approval conditions, Icon Water is required to provide compensatory habitat as an offset to compensate for vegetation and habitat disturbance associated with the construction of the M2G pipeline.

This Offset Delivery Plan (ODP) supports the M2G Operational Environmental Management Plan (OEMP) and has been designed to outline the actions required to deliver the environmental offset located at “The Angle” on Tuggeranong Block 1675, ACT, established in 2011.

1.2 Purpose

The purpose of the ODP is to describe the post-construction operational offset management to manage biodiversity values and conservation, improve overall site condition and enhance threatened species in perpetuity.

This plan serves as a high level document to inform a number of theme based management sub-plans (**Appendices A – G**).

1.3 Objectives of the ODP

The objectives of the ODP are to:

- outline baseline monitoring methodology and findings of original vegetation monitoring plots
- meet the statutory conditions of approval and biodiversity offset commitments outlined in the M2G Environmental Impact Statement (EIS) and Public Environment Report (**Appendix H**)
- comply with the Crown Lease and Land Management Agreement with ACT Government.

1.4 Offset location

Icon Water owns the land parcel Tuggeranong Block 1675 in the southern ACT (‘the property’). The property is located south of Williamsdale and is bounded by the Monaro highway to the east; the NSW border to the south; Angle Crossing road to the north; and the Murrumbidgee river corridor to the west (**Figure 1**). The property was previously used for stock grazing. The property currently supports conservation areas set aside for offset habitat and a number of utility infrastructure facilities.

The M2G offset site, within the greater property (as shown highlighted in purple in Figure 1) comprises two non-contiguous land parcels totalling approximately 110 hectares. The offset site has been set aside for conservation due to its high biodiversity value; including *Environment Protection Biodiversity Conservation Act 1999 (Cth)* (EPBC) listed Box-Gum woodland, threatened flora and fauna species and/or threatened species habitat (**Figure 2**). The majority of the offset site is dominated by a diversity of native understorey species with an overstorey mixture of old growth and rejuvenating Eucalyptus species. Rocky outcrops are widespread throughout the study area and contain habitat for the *Aprasia parapulchella* (Pink-tailed worm lizard).

Figure 1: Williamsdale offset property (M2G offset shown in purple)

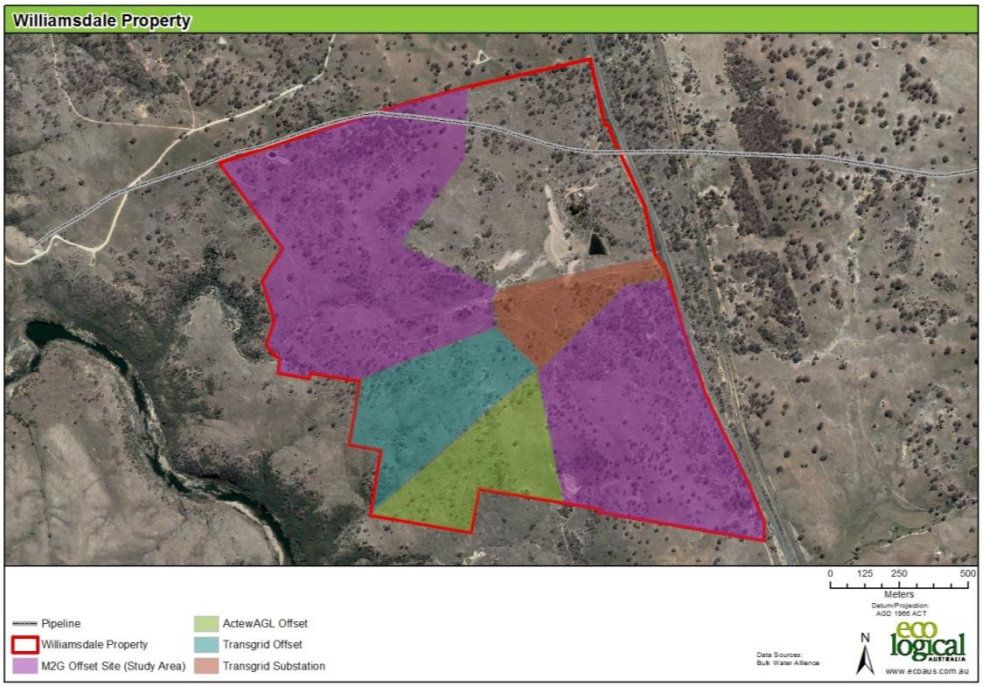
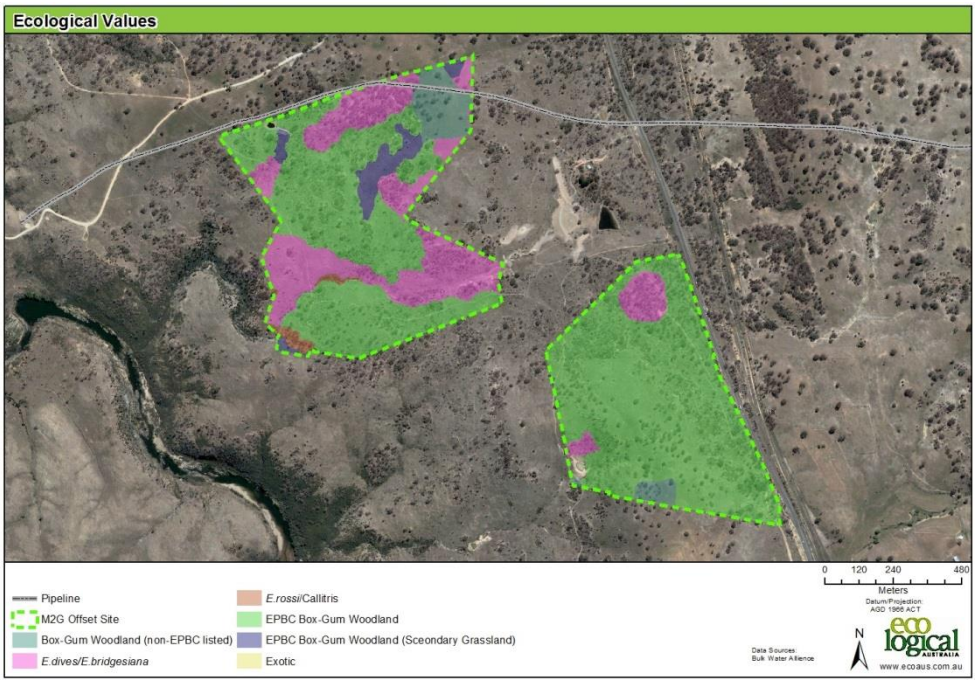


Figure 2: Ecological values of offset area

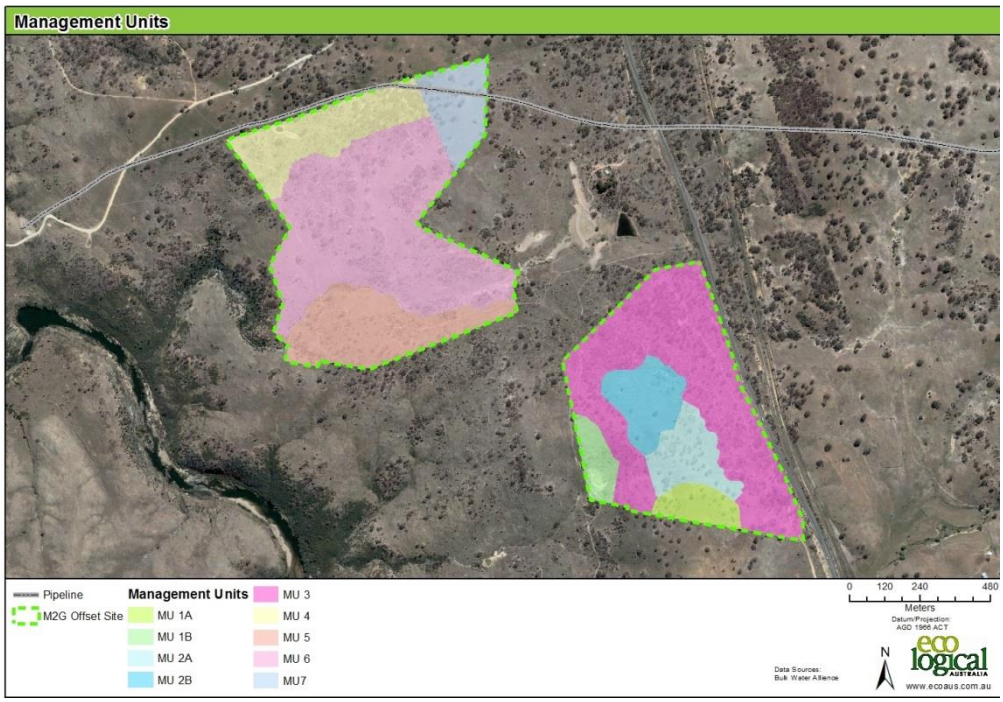


2 Monitoring framework

2.1 Management units

The offset site has been divided into Management units (MUs) for the purposes of managing the site and assist with location of on-ground actions included in a number of management sub-plans. MU's are assigned according to the vegetation community present and subsequently require similar management actions. The MU's are used to monitor the condition of the vegetation to evaluate the success of a range of management actions onsite.

Figure 3: Management Units



2.2 Monitoring

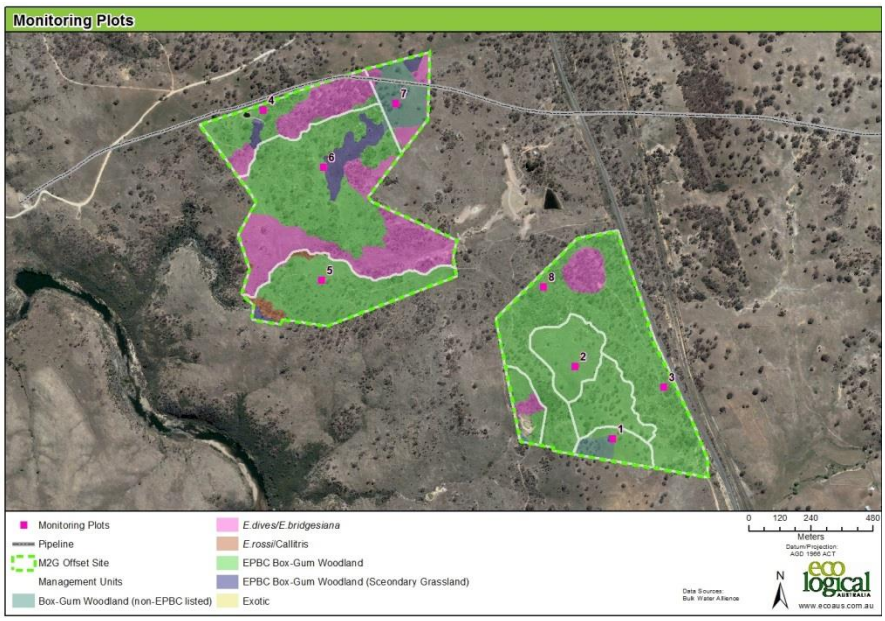
Monitoring of the offset site will occur using two approaches:

1. Icon Water staff will undertake biannual inspections in accordance with *FO3.01d M2G Biodiversity Offset Inspection Checklist* in the Integrated Management System (IMS) to inform adaptive management consistent with the objectives of the ODP.

2. Detailed biennial vegetation condition assessment surveys will be undertaken by external ecologists using eight permanent monitoring plots to assess performance against the ODP using a NSW Biobanking methodology.

Details of the condition and vegetation composition within each monitoring plot are provided in ODP version 1 with a summary provided in **Appendix I**. Monitoring plot locations within the MUs are shown in **Figure** 4 with GPS co-ordinates provided in **Appendix J**.

Figure 4: Monitoring plot locations in relation to offset site ecological values



2.3 Monitoring methodology

The vegetation surveys aim to collect the following data:

- Species diversity, including native and exotic species
- Cover abundance of native and exotic species
- Identification of any threatened flora
- Condition of vegetation community

2.3.1 Quadrat surveys

Monitoring will be undertaken through vegetation surveys in permanent 20m by 20m quadrats (8 plots) across the offset site using the modified Biobanking methodology proforma (**Appendix K**). Quadrats should be surveyed by walking back and forth in transects approximately 2m apart.

2.3.2 Transect surveys

A 50m transect (50m length of tape) compliments the quadrat surveys to determine the projected foliage cover. The 50m transect is surveyed as follows:

- At every 1m along the 50m tape, the understory layer is assessed (50 survey points per transect) as native grass, native shrub, native other or exotic species.
- At every 5m along the 50m tape, the foliage cover of the mid and over-storey layer is recorded (10 survey points per transect). The foliage cover is recorded as a percentage for each layer.

2.4 Reporting

A Biennial Offset Monitoring and Management Action Report will be prepared summarising the outcomes of the monitoring and management actions described in the sub-plans of this document (ODP). The biennial report will identify any management actions or interventions that are recommended. The biennial report will be published on Icon Water's website.

3 ODP management sub-plans

The ODP sub-plans outline approaches for ongoing adaptive land management to protect offset biodiversity values and conservation, improve overall site condition and enhance threatened species:

- Weed management sub-plan (**Appendix A**)
- Rehabilitation management sub-plan (**Appendix B**)
- Erosion management sub-plan (**Appendix C**)
- Bushfire management action plan (**Appendix D**)
- Pest and feral animal management sub-plan (**Appendix E**)
- Grazing management sub-plan (**Appendix F**)
- Fencing management sub-plan (**Appendix G**)

Appendix A: Weed management sub-plan

Introduction

Purpose of document

The purpose of the Weed management sub-plan is to provide a high-level management framework for the control and suppression of weeds at the offset site. This plan is to include management actions and mechanisms for the monitoring of program efficacy, reporting evaluation and improvement.

Background

As at 2011, most of the M2G offset site was in moderate to good condition with the dominant vegetation being the listed ecological community, Box Gum woodland. There were large tracts of derived (EPBC Act listed) grassland as well, with significant areas of woodland and grassland showing natural regeneration.

Two Weeds of national significance (WONS) and six declared pest plants in the ACT were recorded on-site during surveys carried out in December 2011 as identified in **Figures A1 and A2**. The most widespread and abundant species being *Hypericum perforatum* (St John's wort), *Rosa rubiginosa* (sweet briar) and *Rubus fruticosus* (blackberry). Other noteworthy but undeclared weeds recorded during this time were *Marrubium vulgare* (white horehound) and *Prunus* sp. (stone fruit).

Figure A1: Weed distribution northern offset

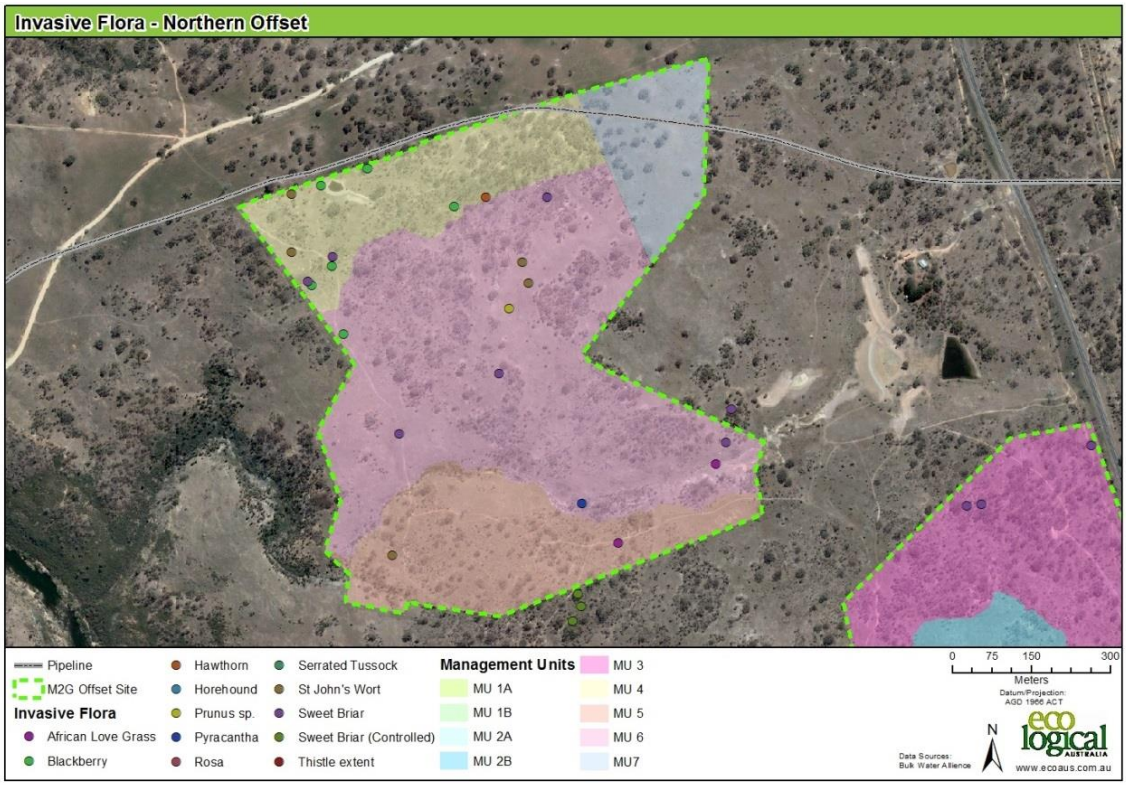
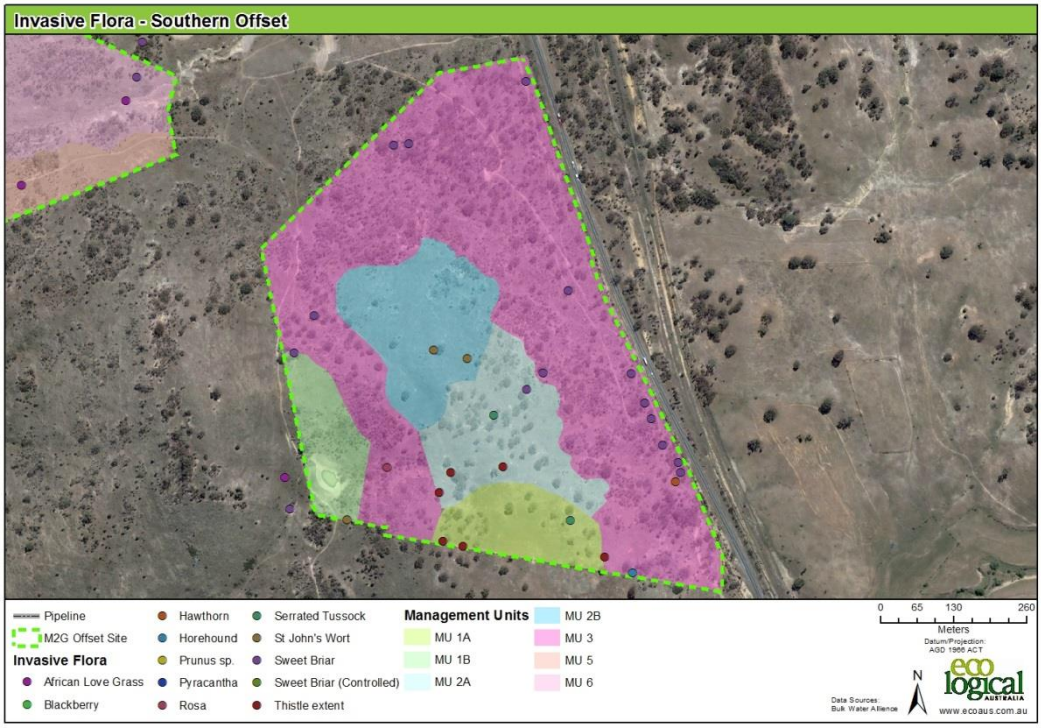


Figure A2: Weed distribution southern offset



Sub-plan objectives

The Weed management sub-plan provides a mechanism to achieve ODP objectives by outlining:

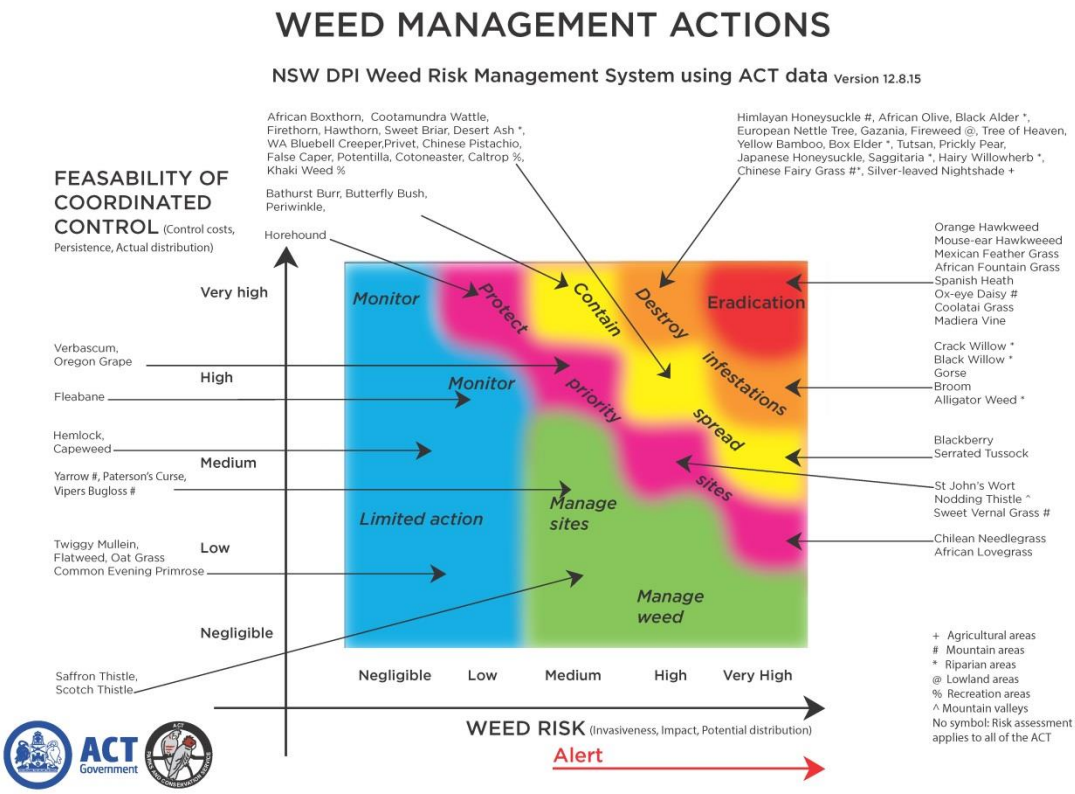
- weed control activities to be undertaken within the offset site
- monitoring programs to monitor weed abundance and success of weed control activities
- a method to develop future management actions based on monitoring and reporting.

Principles of weed management

Weed management will be consistent with and prioritised according to the ACT and NSW Weed Risk Management System (**Figure A3**), particularly the treatment of Weeds of national significance (WONS) and declared species under the *Pest Plants and Animals Act 2005 (ACT)*, and seasonal considerations to maximise the biodiversity benefits for the study area.

Icon Water will ensure that only suitably experienced, qualified and licensed personnel carry out the weed assessment and control management actions recommended in this sub-plan.

Figure A3: NSW DPI Weed Risk Management System using ACT data



Adaptive management approach

Icon Water will take an integrated approach to weed management. This approach recognises the need for sustained treatment over a long period of time using a combination of control measures (e.g. chemical, mechanical, biological), to reduce herbicide resistance occurring.

The length of time of treatment is highly variable and dependent on the weed species present and climatic conditions.

As part of the integrated weed management approach, Icon Water will:

- refer to and apply best practice guidelines for individual species (where available);
- ensure correct plant identification – there are many native species that look like weeds and vice versa (e.g. *Poa sieberiana* (snow tussock) and serrated tussock);
- record locations of new infestations;
- limit the creation of bare patches of soil and soil disturbance in general;
- as a first option for weed control, consider methods that do not use herbicide (e.g. hand pulling and crowning) and which create little soil disturbance;
- when using herbicides, use the least toxic chemical whenever possible and follow the instructions;
- when working on or near drainage lines, use an approved herbicide for this environment (e.g. roundup biactive);
- where woody weeds are providing habitat for native birds and animals, use the drill and fill technique to enable the structure to remain *in situ* while the tree or shrub dies – this will enable

the plant to provide shelter for a period of time, while giving the birds and animals a chance to move on of their own accord;

- revegetate treated areas by direct seeding local provenance grasses using a mix of fast growing (e.g. *Austrodanthonia* sp. (wallaby grasses) and *Bothriochloa macra* (red-leg grass)) and slow growing (e.g. *Themeda australis* (kangaroo grass)) species. Alternatively, mulch the area to provide an immediate cover to prevent soil erosion and suppress weed growth;
- if necessary, coordinate weed control with adjoining landholders. This may be especially useful for wind dispersed WONS, such as serrated tussock; and
- if necessary, coordinate feral animal control with adjoining landholders – feral animals can disperse weeds and can cause disturbances which create bare ground, thus enabling weed species to colonise an area (see **Appendix E**).

Targeted weed management

A range of actions have been included in the Weed management sub-plan for consideration. **Table A1** provides a summary timeline of actions for the implementation of this management sub-plan.

Table A1: Weed management options

SPECIES	CONTROL METHODS		TIMING
	RECOMMENDED	NOT RECOMMENDED	
Blackberry	Foliar (high and low volume) spraying Cut stump Hand pulling Slashing Brushcutting	Grubbing Scalping Cultivation Grazing by goats Large earth moving equipment Granules and gels Aerial spraying	October-April (high and low volume spraying)
St John's Wort	Competition with dense native groundcover Spot spraying	Hand pulling Chipping Grubbing	November-February (spot spraying)
Sweet Briar	Foliar spraying Basal barking Cut stump Competition with dense native groundcover	Grazing by domestic livestock	October-December and March-April (spraying) All year cut stump and basal barking
Serrated Tussock	Competition with dense native groundcover Chipping Spot spraying	Hand pulling Broadacre spraying with flupropanate Forestry	April-October (spraying) February-October (chipping)

SPECIES	CONTROL METHODS		TIMING
	RECOMMENDED	NOT RECOMMENDED	
Saffron Thistle	Competition with dense native groundcover Hand pulling Foliar (high* and low volume) spraying Slashing Brushcutting	Any method resulting in soil disturbance	April-May and September-October (spraying) April-October (hand pulling, slashing and brushcutting)
Hawthorn	Hand pulling Cut stump Drill and fill		All year for hand pulling, cut stump and drill and fill
African Lovegrass	Competition with dense native groundcover Crowning Chipping spot spraying high volume spraying* slashing brushcutting	grazing by domestic livestock	November-March (spraying)**
White Horehound	hand pulling		April-May and September-October (spraying)
	Crowning Chipping Spot spraying		April-October (hand pulling, crowning and chipping)
***Prunus* sp.**	Cut stump Drill and fill Hand pulling Spot spraying	large earth moving equipment	September-December and March-April (spraying) All year for hand pulling, cut stump and drill and fill***
***Pyracantha* sp.**	Hand pulling Cut stump Drill and fill Spot spraying	large earth moving equipment	October-December and March-April (spraying) All year for hand pulling, cut stump and drill and fill***

*high volume spraying should not occur in woodland areas or in grassland areas where there is a high cover of native species

**African Lovegrass is dormant during the cooler months but can be sprayed with flupropanate during this time (typically from July to October) (ACT Parks and Conservation Service (2011)

***chemical uptake during winter is likely to be slow and less effective so follow-up applications during the summer months will be needed to boost this treatment. Ideally, all chemicals will be applied during an active growth phase.

Timing

The timeline of actions to implement this management sub-plan will need to be co-ordinated with other management sub-plans such as the Pest and feral animal management sub-plan (**Appendix E**), Erosion management sub-plan (**Appendix C**) and Grazing management sub-plan (**Appendix F**) as well as seasonal constraints and local availability of seed and tube stock.

Weed monitoring and reporting

Monitoring

Weed monitoring will be:

- undertaken on a biannual basis in autumn and spring as part of the inspections in accordance with *FO3.01d M2G Biodiversity Offset Inspection Checklist*
- Undertaken on a biennial basis as part of the vegetation condition assessment survey.

Weed maps will be updated following weed monitoring and an estimate of cover will be recorded to enable comparisons between years.

Reporting

Weed monitoring will be included in the Biennial Offset Monitoring and Management Action Report. The report will include:

- A description of the weed survey methodology
- Detailed monitoring results, including maps highlighting areas of weed invasion and general observations
- A detailed description of the weed management actions undertaken, including any actions proposed that were not undertaken and the circumstances preventing the action being taken (e.g. climatic conditions)
- Suggested management actions for weed control based on adaptive management (if required).

Appendix B: Rehabilitation management sub-plan

Introduction

Purpose of document

The purpose of the Rehabilitation management sub-plan is to provide a high-level plan to rehabilitate and improve the condition of Box-gum woodland communities in the offset site.

Sub-plan objectives

This sub-plan provides a mechanism to achieve ODP objectives by:

- targeting specific activities to be undertaken within the offset site
- measuring the success of rehabilitation actions through a monitoring and reporting program
- developing future management and/or rehabilitation actions as necessary.

Rehabilitation techniques

Rehabilitation of the offset site is likely to require a combination of restoration techniques that range from natural regeneration over time through to more intensive management approaches, such as seeding and tube stock plantings.

Local provenance and seed collection

All revegetation activities at the offset site should use local provenance material. This means that all seed and plants required for rehabilitation actions should be sourced from the site or as close to the offset site as possible, such that the seeds and plants are collected from similar vegetation communities, landforms, soil landscapes, soil types and weather.

This approach will require seed collection, which needs to be supported by a license, or alternatively, material can be sourced from a supplier if it is of local provenance. If seed collection is carried out, the best practice standards of Flora Bank (2011) should be used.

Tube stock planting

The use of local provenance tube stock is suggested for areas where the overstorey or shrub layer is considered to require additional rehabilitation. Suitable overstorey and shrub layer species for tube stock planting in the offset site are outlined in **Table B1.** It is important to note that the tube stock planting is only proposed in Box-gum woodland communities where there is a typically reduced shrub layer and dominance of only two eucalypt species.

Table B1: Suitable native rehabilitation species

SCIENTIFIC NAME	COMMON NAME
Shrubs	
Bursaria spinosa	Blackthorn
Trees	
Eucalyptus melliodora	Yellow Box
Eucalyptus blakelyi	Blakely's Red Gum

The tube stock planting technique is labour intensive so will be utilised in isolated areas only. Ideally, revegetation should take in early spring to avoid local frost conditions.

Tube stock should be hardened off before planting and tree guards should be used to prevent herbivores such as rabbits and hares from grazing on the young plant. Water crystals should also be used to promote drought tolerance while the tube stock are developing and the plants should be soaked in a plant tonic (e.g. Seasol) for at least an hour before they are planted to reduce root shock.

Tube stock should be planted at the following densities:

- Canopy species for Box-gum woodland: One tree within a circle of 20 m diameter (314 m^2).
- Shrub species: One shrub every 10 x 10 m (1 per 100 m^2).

Rehabilitation actions

Management unit 1A

Management unit (MU) 1A has been identified as requiring targeted rehabilitation works. The area has been rehabilitated using the tube stock planting technique to achieve an increase in native species diversity and cover.

The aims of the rehabilitation efforts in this area are to simulate regrowth of the canopy layer through the planting of suitable canopy species, and the promotion of increased native species diversity and abundance in the ground layer through weed control. The weed control and rehabilitation actions are designed to enhance in-perpetuity conservation management outcomes.

Management unit 7

A sector of MU7 has been identified as an area that may require rehabilitation following monitoring of weed control management actions. MU7 is dominated by non-EPBC Act listed Box-gum woodland. It is adjacent to moderate to good condition Box-gum woodland as well as moderate to good condition dry Sclerophyll forest communities.

The majority of the low condition woodland within MU7 occurs within an overhead power line utility corridor that must remain clear of overstorey trees to avoid conflict with infrastructure on site. This prevents overstorey planting rehabilitation actions that would enhance the regeneration and condition of the vegetation community present.

Monitoring and reporting

Monitoring

Rehabilitation monitoring will be undertaken:

- on a biannual basis in autumn and spring as part of the inspections in accordance with *FO3.01d M2G Biodiversity Offset Inspection Checklist*
- on a biennial basis as part of the vegetation condition assessment survey to determine the success of the tube stock plantings in MU1A and to determine whether rehabilitation activities are required.

A key performance indicator (KPI) has been established for the tube stock plantings rehabilitation works.

KEY PERFORMANCE INDICATOR (KPI)
Native planted species (planting success) – all species listed for seeding and planting are present and an overall 85% success rate for tube stock is achieved.

Reporting

Rehabilitation monitoring will be included in the Biennial Offset Monitoring and Management Action Report. The report will include:

- a description of the rehabilitation survey methodology
- detailed monitoring results
- a detailed description of the weed management actions undertaken, including any actions proposed that were not undertaken and the circumstances preventing the action being taken (e.g. climatic conditions)
- suggested management actions for additional rehabilitation based on the KPI's (if required).

Adaptive management actions

If any current management actions are observed to be ineffective or detrimental a review of the management actions will be undertaken.

Appendix C: Erosion management sub-plan

Introduction

Purpose of document

The purpose of the Erosion management sub-plan is to provide a high-level plan of management for the control of erosion and sediment within the offset site.

Sub-plan objectives

The Erosion management sub-plan provides a mechanism to:

- identify and implement specific on-ground works for erosion and sediment control
- monitor the effectiveness of erosion and sediment controls.

Factors affecting erosion

Site specific conditions such as climate and rainfall, landform, soils and ground cover affect erosion impact.

Soils and geology

Two soil landscape units (SLUs) underlay the offset site (**Figure C1**). The northern offset is entirely within the Burra SLU, while the southern offset is comprised of the Burra SLU (in the north) and the Campbell SLU in the south.

A summary of soil characteristics of these SLUs is presented in **Table C1**.

Figure C1: Soil landscape units

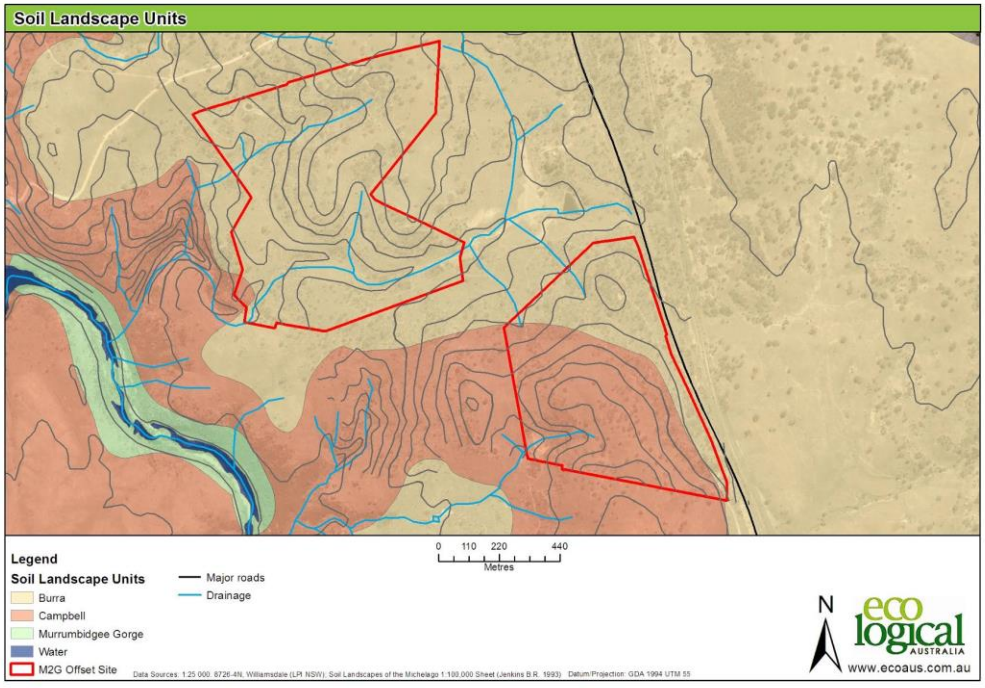


Table C1: Soil landscape units of the offset site

SLU	Soil profile thickness (m)	Common constraints
Burra (ba)	0.2 – 0.6 m on crests and upper slopes Up to 1.0 m on drainage lines / lower slopes	High water and wind erosion hazards, mass movement of steeper slopes Moderate erodibility at surface. Highly to moderately erodible below the topsoil Minor sheet erosion is common Sediment type F (i.e. significant proportion of fine grained materials that require longer 'residence' time for settling out)
Campbell (ca)	Less than 0.3 m on crests. Up to 1.2 m along drainage lines	Moderate erodibility at surface. Highly to moderately erodible below the topsoil Sheet erosion and gully erosion along drainage lines is common Sediment type F (see above) and D (significant proportion of fine dispersible materials)

Reference: Landcom 2004; Water Security 2009

Both soil landscapes are characterised by 'moderate' erodibility at the surface which increases to 'moderate to high' erodibility of subsoils.

Climate

The region experiences a relatively dry continental climate with warm to hot summers and cool to cold winters. The average annual rainfall is 610 mm with an average of 66 rain days per year (> 1 mm/day). Rainfall is slightly summer dominant with the wettest month being November (76.5 mm) and the driest being May (22.53 mm). The average annual evaporation (at the Canberra Forestry Station 070015 1927-1980) is 1301 mm. Mean monthly evaporation exceed mean monthly rainfall for all months with the exception of the three months over winter (June - August).

Maximum summer temperatures are experienced in January with an average maximum of 29.5˚C (daily) and minimum of 14.3˚C (nightly). Winter minimums are experienced in July with an average maximum of 12.2 ˚C (daily) and minimum of -0.1˚C.

Drainage

The northern offset site drains to an unnamed creek which flows west to the Murrumbidgee river. The northern portion of the southern offset site drains to a tributary of this creek. The remainder of the southern offset site drains to another unnamed creek in the south-west corner. This second creek also drains to the Murrumbidgee river.

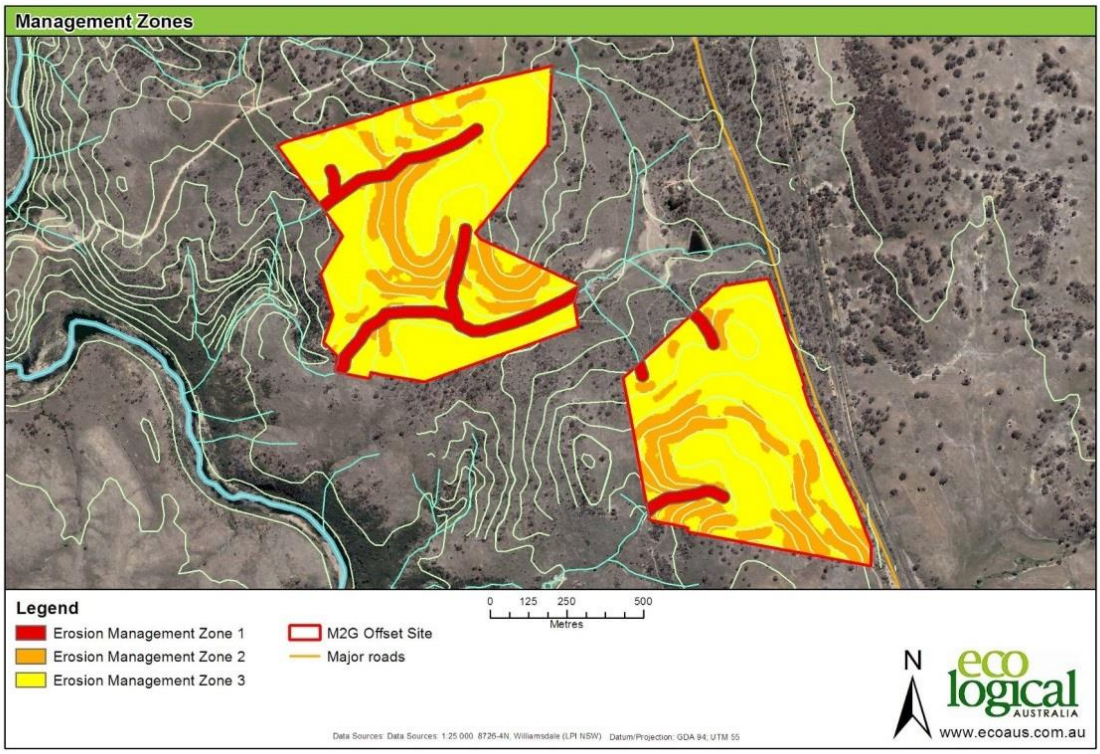
Overall the site has a low erosion potential, however there are areas that are more susceptible to erosion.

Erosion management zones

The offset sites have been divided into three Erosion management zones (EMZ) based on erosion potential and priority for on-ground works (**Figure C2**):

- EMZ 1 encompasses drainage lines and areas of active erosion with formation of gullies and bank erosion which are unlikely to stabilise over time without active management. This zone is a priority area for on-ground works.
- EMZ 2 encompasses steep slopes that potentially have a high erosion hazard. This land is generally stable with adequate ground cover and no soil disturbance. This zone requires monitoring.
- EMZ 3 has low potential for erosion and only requires monitoring.

Figure C2: Erosion management zones



As part of the adaptive management process, zones should be reviewed according to monitoring information and the Erosion management zones map updated.

Management actions

Management actions, including landscape management, maintaining good groundcover, removing stock access to drainage lines, and revegetation will be applied to assist the overall condition of the site.

No control of grassy or herbaceous weeds will occur along the creek line until there is greater than 50% cover of native vegetation, to ensure the stabilisation of the creek line as per the Weed management sub-plan (**Appendix A**).

The planting of trees and shrubs as per the recommended actions in the Rehabilitation management sub-plan (**Appendix B**), will assist in stabilising soils.

Management actions relevant to each EMZ are summarised in **Table** C **C2**. Specific details of works to stabilise gullies is provided in **Table C3**.

Care should be taken during any on-ground works to limit disturbance to soils, given the erodibility of the soils within the offset site. Any works on a defined waterway will be subject to a *Waterway Works*

Licence (ACT) application prior to any works commencing. Any construction works required in the offset site will be undertaken in accordance with the *Environment Protection Guidelines for Construction and Land Development in the ACT 2011* (EPA 2011).

Monitoring

Regular erosion monitoring will be undertaken:

- on a biannual basis in autumn and spring as part of the inspections in accordance with the *FO3.01d M2G Biodiversity Offset Inspection Checklist*
- on a biennial basis as part of the vegetation condition assessment survey.

Reporting

Erosion monitoring will be included in the Biennial Offset Monitoring and Management Action Report. The report will include:

- a description of any erosion control works undertaken since the last report
- a map indicating where works took place
- a description of the monitoring undertaken (including timing and survey locations)
- detailed monitoring results, including GPS located photographs
- any recommendations for addition management actions for erosion control, including additional monitoring (for example, a control site for creek erosion may be established).

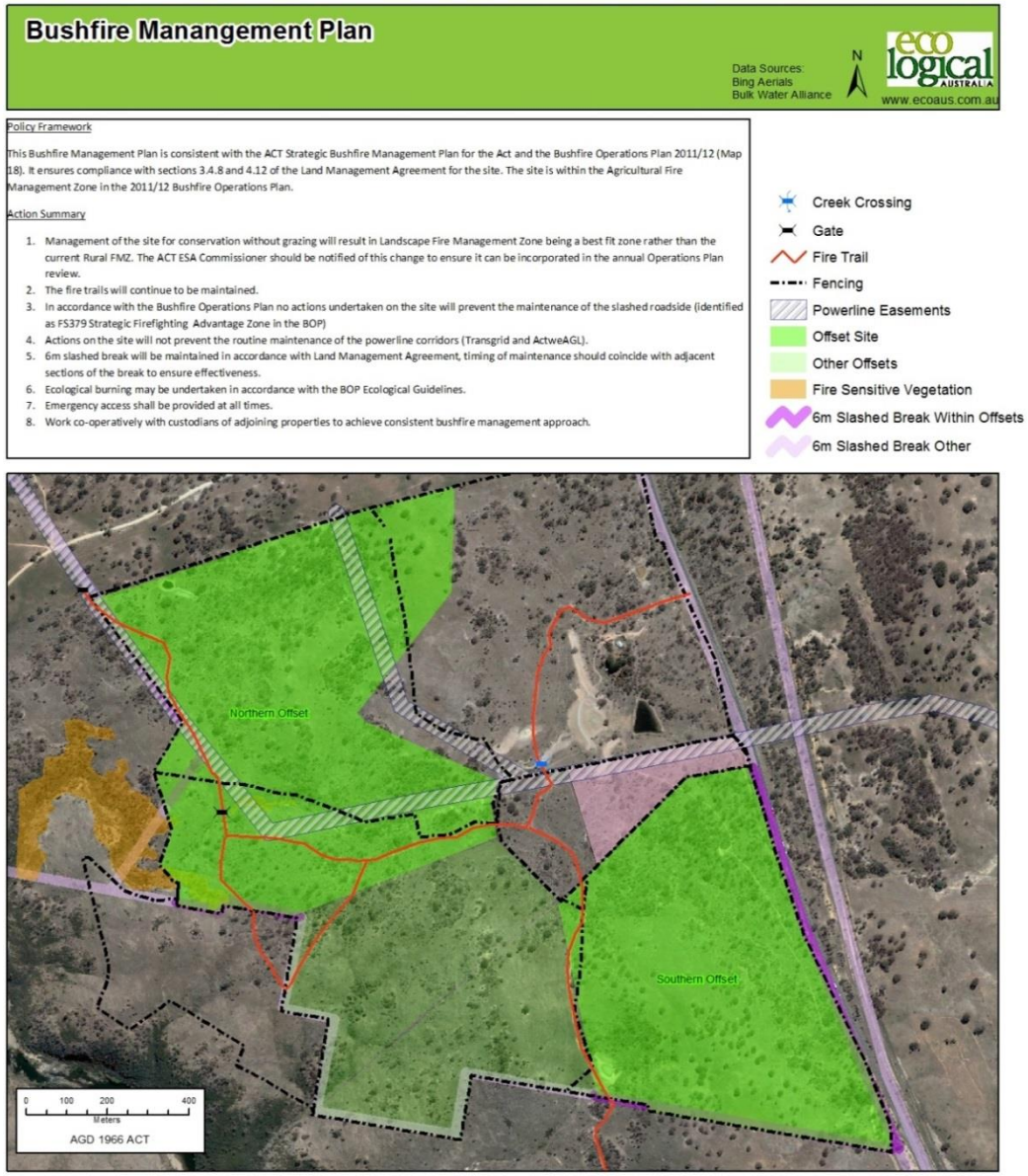
Table C2: Erosion management actions

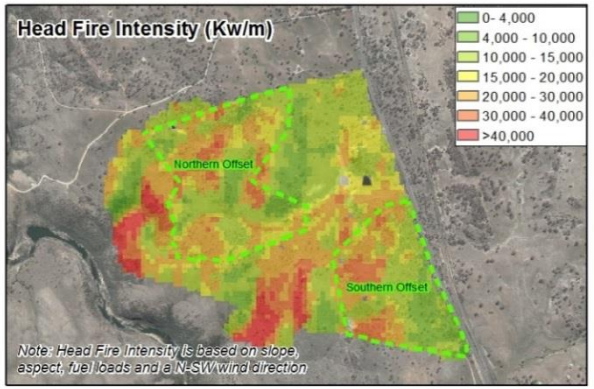
Erosion Management Zone	Management Action/Monitoring	Performance Measure	Timing
EMZ 1	Stock exclusion from offset site	Maintenance on boundary fence	Biannually
Gullies	Identify actively eroding gullies Select and implement appropriate gully control measure/s from this plan Regular visual inspection of rehabilitated sites and other unformed drainage lines	Actively eroding gullies identified Gullies stabilised according to this plan Adequate groundcover established No new nick points or headcuts forming No evidence of erosion	Biannually
Creek lines	Regular visual monitoring (including photographs from permanent monitoring locations during biennial vegetation monitoring survey) Consult qualified geomorphologist if significant on-going erosion of creek line is evident after two years of control measure implementation to determine appropriate works to manage erosion.	Comparison of photos from previous monitoring	Biannually
EMZ 2	Regular visual inspections	Bare ground not to exceed 30% (ground cover, including vegetative matter, leaf litter, rocks and coarse woody debris, maintained above 70% No evidence of erosion	Biannually
EMZ 3			

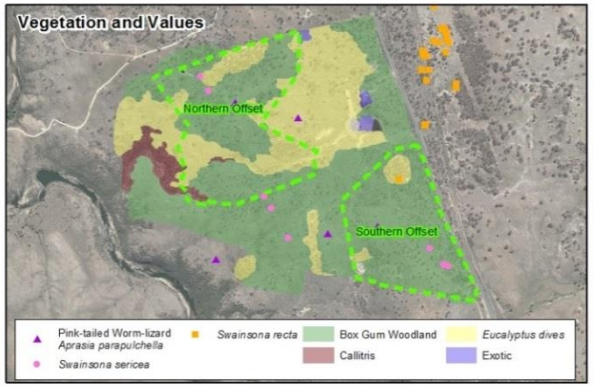
Table C3: Gully stabilisation methods

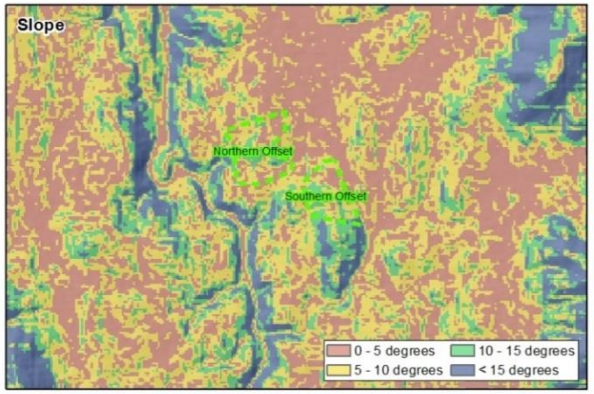
Reshaping gullies with minor earthworks	• The gully head shall be graded back to a gentle and consistent grade (less than 10%) to meet the natural slope. • Batter gully side walls back to meet the natural grade. The batters of the gully walls should not exceed a slope of 3(H):1(V). • The final cross-sectional shape should be parabolic or trapezoidal. • Gypsum should be incorporated into the subsoil project where required. The application rate of gypsum will vary depending on the exchangeable sodium percentage (ESP). As a guide: ▪ 6% < ESP < 10% apply gypsum at 2.5 t/ha ▪ ESP > 10% apply gypsum at 5 t/ha.
Erosion and sediment controls must be installed prior to undertaking any works	• Minimise the area to be disturbed to retain maximum vegetation cover. • Silt fences (constructed from geotextiles) should be established in series downstream of any areas to be disturbed, and constructed parallel to the contours of the site. • Sub-soils shall be tested to identify any dispersive soils through pre-construction testing. Any soils identified as dispersive must be treated prior to placement of any erosion control measures. • Hay bales shall not be used for sediment control.
Strip topsoil and stockpile outside of any drainage line	• Stockpiled topsoil shall be respread across exposed soil surfaces and lightly compacted. A minimum of 75 mm topsoil is required. Where necessary, any imported topsoil shall be clean sandy loam topsoil.
Seed topsoil with a grass mix using a combination of the native species outlined in the Rehabilitation Management Sub-Plan	• A sterile nurse crop such as Cereal Rye (*Secale cereale*) (10-15 kg/ha) or Japanese Millet (*Echinochloa crus-galli*) can be beneficial.
Plant tube-stock of canopy and shrub species upslope	• As outlined in the Rehabilitation Management Sub-Plan
Add temporary diversion measures for runoff water	• Berms formed from sandbags • Straw bales
Where appropriate add temporary degradable erosion control blankets (ECBs) across all exposed surfaces to provide temporary protection	Jute matting (~350gsm) or similar is to be installed as per manufacturer's instructions
Visually inspect gullies after the first major rainfall event. If there is evidence of ongoing erosion or new erosion, further treatment measures may be required	Further works include stabilizing the gully with a grade reduction structure or rock fill

Appendix D: Bushfire management sub-plan









Ecological Considerations

Ecological burn regimes are considered to have a high potential for impact on the range of threatened species known to occur in the offset site. Where possible slashing should be adopted to lessen the potential impact on these values and their habitats. Where ecological burns are adopted they should be implemented in accordance with the Bushfire Operations Plan Ecological Guidelines detailed below. Considerations are likely to include timing, intensity and frequency of burns which should only be undertaken with prior approval of the site manager/OEH

The northern and southern offset sites provide habitat for threatened species including endangered ecological communities. Any burning plan must consider these environmental values. All ecological burns must consider the BOP Ecological Guidelines (extract below).

Species	Fire Ecology
Black Cypress Pine (*Callitris endlicheri*)	• Fire sensitive and as far as possible, should not be burnt.
Button Wrinklewort (*Rutidosis leptorrhynchoides*)	• Endangered under ACT and Federal listings. • Bright yellow button flowers (2 cm wide) from December to April. • Recovery Plan calls for the suppression of fire in Button Wrinklewort populations however low intensity fires of low frequency, outside of the flowering season (December-March) may be acceptable. • High intensity or high frequency fires are specifically identified as a threatening process.
Pink-tailed Worm Lizard *(Aprasia parapulchella)*	• Slashing is preferable to burning in Grassland Lizard habitat • It is crucial that any prescribed burns are low-intensity and patchy. • Burns should be conducted in early spring (Sept/Oct) to avoid summer breeding season, or early autumn (March/April) to avoid removing all vegetation during winter. • Where possible burn during the middle of the day or evening rather than early morning when lizards might be cold and slow moving.
Golden Sun Moth (*Synemon plana*)	• Fuel reduction by slashing is preferable to burning in Golden Sun Moth habitat. • If burning is required; it is important for prescribed burns to be very patchy (up to 50% unburnt if possible). • Burns should not be conducted between November and February to avoid the adult flying season.

Reference: TAMS Bushfire Operations Plan, Ecological Guidelines and Fuel and Fire Suppression Guidelines
http://www.tams.act.gov.au/__data/assets/pdf_file/0005/176135/Golden_Sun_Moth_Synemon_plana.pdf
http://www.tams.act.gov.au/__data/assets/pdf_file/0007/176128/Pink-tailed_Worm_Lizard_Apraisia_parapulchella.pdf
http://www.tams.act.gov.au/__data/assets/pdf_file/0007/232297/BOP_2011-12_Ecological_Guidelines_A3_.pdf

Appendix E: Pest and feral management sub-plan

Introduction

Purpose of document

The purpose of the Pest and feral animal management sub-plan is to provide a high-level management plan for the monitoring and management of feral animals within the offset site.

Sub-plan objectives

The objectives of the Pest and feral animal management sub-plan are to:

- implement feral animal management as required
- co-ordinate with regional pest management programs.

Target species

Pest animals previously observed on the offset site include the European red fox, the European rabbit, the European hare and feral goats. Potential pest animals that have been observed in the local region include the feral pig, feral cat, wild dog, feral deer, Indian myna, common starling and European wasp.

The principal threats that pest animals present to the natural ecological values of the site can be categorised into grazing, predation and competition (they can also present a threat to neighbouring rural enterprises):

- grazing influences the structure and composition of vegetation and presents the greatest threat to the natural ecological values of the site
- Box-gum woodland fauna in general may be impacted upon by pest animal predation
- competition from pest animals does not appear to be a current concern at the offset site, but competition for tree hollows could occur if Indian mynas or starlings move into the area.

Feral animal management

The most common options for management include exclusion barriers (fences), biological control, habitat manipulation and culling. The feasibility of control options for each species is site dependent and influenced by the biology and behaviour of the species.

Based on the threats that pest animals present to the natural values of the site, priorities of pest animal management are to:

- minimise grazing pressure from pest animals
- minimise predator pressure from pest animals
- minimise competition for tree hollows from pest animals.

If feral animal control and/or management are required, potential actions could include:

- fence revegetation works, to prevent grazing on new seedlings and promote the establishment of rehabilitated areas
- co-ordinated rabbit control and fox control programs with adjacent land managers
- monitoring of the site for incursions by pest animals including overabundance of kangaroos
- reporting the presence of goats, pigs, deer, wild dogs and excessive populations of kangaroos on the site to ACT Parks and Conservation Service.

Targeted species management options are provided in **Table E1**.

Key management issues

The key issues for achieving the pest animal management options at the offset site are:

- effective control of some pest animals requires co-ordination between land managers in the local region because new animals quickly recolonise the property after control and/or individuals range over a much greater area than just one property; and
- the cost and risks associated with control may outweigh the benefits.

Table E1: Targeted species management options (adapted from Draft ACT Pest Animal Strategy 2011-2021)

SPECIES	PRESENCE	THREAT	CO-OPERATIVE MANAGEMENT	FEASIBLE MANAGEMENT OPTIONS
European Red Fox	Present	• Predation of medium-sized native mammals • Possible predation on bird populations and some threatened species • Impact on lambing success for neighbouring properties	✓	• Involvement in any coordinated baiting programs
European Rabbit	Present	• Reduced seedling recruitment by browsing • Soil disturbance at warrens promotes erosion and weed invasion • Supports elevated populations of feral cats and foxes	×	• Involvement in any coordinated management programs • Fence revegetation works • Baiting and warren ripping may be feasible
Brown Hare	Present	• Browsing destroys planted seedlings in revegetation projects • May limit natural regeneration	×	• Fencing revegetation works
Feral Goat	Occasional	• Selective browsing of native shrubs • Damage to fences	✓	• If observed, notify ACT Government

SPECIES	PRESENCE	THREAT	CO-OPERATIVE MANAGEMENT	FEASIBLE MANAGEMENT OPTIONS
Feral Pig	Potential	• Ground rooting causes erosion and promotes weed invasion • Reduced abundance of favoured tuberous native plants • Damage to fences • Impact on lambing success for neighbouring properties	✓	• If observed, notify ACT Government
Deer (Fallow, Red & Sambar)	Potential	• Selective browsing of preferred species • Damage to trees from antler rubbing	✓	• If observed, notify ACT Government
Feral Cats	Unknown	• Predation of small mammals, reptiles and birds	✓	
Dingo/ Wild Dogs	Unknown	• Impact on neighbouring sheep and cattle enterprises	✓	• If observed, notify ACT government
Indian Myna	Potential	• Aggressively competes with native species for tree hollows	×	• Trapping if observed to be competing with native species may be feasible
Common Starling	Potential	• Competes with native species for tree hollows • Spread environmental weeds	×	• Trapping if observed to be competing with native species may be feasible
European Wasp	Potential	• Attack and sting animals • Public health risk	×	• Nest treatment and removal by qualified pest controller

Monitoring

Pest and feral animal monitoring of the offset site will be the critical component to ensure current and potential pest animal threats are maintained at an acceptable level. Monitoring will be undertaken biannually in autumn and spring, during the inspection in accordance with *FO3.01d M2G Biodiversity Offset Inspection Checklist*.

Opportunistic observations will also be undertaken while on site for other activities and will be actively incorporated into site management plans.

Reporting

Pest and feral animal monitoring results will be included in the Biennial Offset Monitoring and Management Action Report. The report will include:

- a description of the survey methodology
- detailed monitoring results, including location of feral animal sightings and likely presence
- a description of any actions and recommendations resulting from the previous monitoring survey
- suggested management actions based on an adaptive management philosophy or pest animal control programs (if required).

Adaptive management actions

If any current management actions are observed to be ineffective or detrimental effect, a review of the management actions will be undertaken.

Stakeholders

A key component of management in the offset site is the liaison and incorporation of stakeholders (neighbouring properties, local ranger, etc.) into control or management actions. As such, Icon Water will liaise regularly with the local ACT Ranger, to monitor feral animal activity in the broader area and obtain pest animal control advice.

Regular liaison with stakeholders will also be critical in the development and implementation of feral animal control programs, on a local and regional scale.

Appendix F: Grazing management sub-plan

Introduction

Purpose of document

The purpose of the Grazing management sub-plan is to provide a high-level management plan for grazing, including native and exotic animals within the offset area.

Sub-Plan objective

The objective of the Grazing management sub-plan is to exclude livestock from the offset area and monitor the grazing impact of other herbivores to maintain or enhance the biodiversity values within the offset site.

Background

Grazing of stock is known to limit natural regeneration of native species associated with Box-gum woodland and eliminate some grazing intolerant threatened species such as small Purple-pea (*Swainsona recta)* from the community. Grazing can also reduce habitat quality for threatened species known to occur in the offset site, such as Pink-tailed worm lizard, by increasing the diversity and abundance of weeds and altering the native ground layer favoured by that species.

Stock grazing was previously undertaken at the property. The Land Management Agreement (LMA) for the property specifies the obligations and responsibilities for land management consistent with the Territory Plan. Stock grazing is excluded from the offset area.

It should be noted that kangaroos and other native and non-native herbivores such as wombats and rabbits are also likely to influence the biodiversity values, biomass and species composition within the offset site.

Monitoring

Icon Water will undertake regular grazing monitoring of non-livestock grazing impacts within the offset site to determine if, in addition to stock exclusion, further grazing related management actions are required:

- on a biannual basis in autumn and spring as part of the inspection in accordance with the *FO3.01d M2G Biodiversity Offset Inspection Checklist*
- on a biennial basis as part of the vegetation condition assessment monitoring survey.

Reporting

Grazing monitoring will be included in the Biennial Offset Monitoring and Management Action Report. The report will include:

- a description of the monitoring methodology and detailed monitoring results
- suggested management actions for non-stock grazing related activities or control.

Appendix G: Fencing management sub-plan

Introduction

Purpose of document

The purpose of the Fencing management sub-plan is to provide a high-level management plan for the establishment and maintenance of fences around the border of the offset site.

Sub-Plan objective

The objective of the Fencing management sub-plan is to establish and maintain internal and external boundaries around the Williamsdale property for the management and protection of the offset site.

Existing fences

The existing external boundary fence was augmented upon establishment of the offset to prevent stock from entering the property. Specific internal property fences were realigned to prevent internal stock access to offset areas and allow passage of native animals.

Fencing design

Stock proof fence

The aim of a stock proof fence is to keep grazing stock out of an area (e.g. conservation area) where it is bordered by a private rural property. This type of fencing generally consists of a 4 or 5 stranded wire fence (including 2 or 3 barbed wire strands) with wooden posts and/or star-pickets, approximately 1.2 m high.

Wildlife friendly fence

Fences can be a hazard to wildlife, particularly barbed wire strands. Fences erected across habitat can also create physical barriers and obstacles to wildlife movement and impact on ecology and behaviour. As such, wildlife can benefit from wildlife friendly fencing improvements in areas where internal stock control is no longer required. Fencing that is generally considered to be wildlife friendly do not entangle or harm wildlife, allows free movement of wildlife across the landscape and may mean no fence at all.

Fencing actions

Management actions include:

- maintaining external Williamsdale property boundary fence and internal offset fences (see **Figure G1**);
- reviewing internal fencing to potentially reduce wildlife movement restrictions and injury risks; and
- investigating wildlife friendly improvements that could be implemented as part of general maintenance activities to the external fences.

Figure G1: Existing and proposed fence lines

Monitoring

Icon Water will undertake monitoring of the Williamsdale property boundary fence and internal offset fence to determine if any areas require repairs or modification for effective stock exclusion:

- on a biannual basis in autumn and spring as part of the inspection in accordance with the *FO3.01d M2G Biodiversity Offset Inspection Checklist*
- on a biennial basis as part of the vegetation monitoring survey.

Reporting

Fencing monitoring will be included in the Biennial Offset Monitoring and Management Action Report. The report will include:

- a description of the monitoring methodology
- detailed monitoring results
- suggested management actions for fence maintenance or other actions (such as wildlife friendly improvements), as based on an adaptive management philosophy.

Appendix H: Offset Conditions of Approval from ACT, Commonwealth and NSW

ACT Planning and Land Authority:

Condition B12 - A plan to implement the biodiversity offsets provisions of the EIS, developed in consultation with and endorsed by PCL TAMS is submitted to the Authority prior to the commencement of works on site.

Commonwealth Department of Sustainability, Environment, Water, Population and Communities:

Condition 3 - The person taking the action must submit a Biodiversity Management and Offset Plan to address impacts on listed threatened species and ecological communities to the Minister for approval prior to commencing construction. The Biodiversity and Offset Plan must include the following:

- *3.a - a description of the survey effort already undertaken for listed threatened species and ecological communities, and any extra surveys that may be required post-construction as described in condition 3.b);*
- *3.b - an outline of the methodology of additional flora surveys, by a botanist with expertise in surveying for the Small Purple-pea (Swainsona recta), Hoary Sunray (Leucochrysum albicans var. tricolour) and Button Wrinklewort (Rutidosis leptorrhynchoides). The surveys must be conducted at the correct time of year, and specifically target parts of the project area that are most likely to provide habitat for the species, particularly in areas that were not surveyed for the species previously;*
- *3.c - precise mapping showing the location of all known Small Purple-pea, Hoary Sunray and Button Wrinklewort plants in the project area, the location of the areas of greatest potential for having additional plants of these species in the project area and the precise location of the pipeline easement. These maps must be provided to the Department but must not be published at a scale that indicates individual plants;*
- *3.d - demonstrate how construction of the pipeline and associated activities will avoid removing any individuals of the Small Purple-pea, or, if removal is necessary, provide details of a Small Purple-pea land offset, management and planting programs to ensure no net loss to the population;*
- *3.e - describe how the alignment of the pipeline easement minimises impacts on the Small Purple-pea, Hoary Sunray, Button Wrinklewort and Pink-tailed Worm Lizard (Aprasia parapulchella);*
- *3.f - explain how the extent and condition of EPBC listed threatened ecological communities (TEC's) was determined;*
- *3.g - detailed mapping of TEC's, including habitat condition, including the project area and other areas proposed to be used as offsets;*
- *3.h - a description of how the Small Purple-pea, Hoary Sunray, Button Wrinklewort and Pink-tailed Worm Lizard will be managed during construction of the pipeline;*
- *3.i - a description of how native vegetation (including TEC's) will be rehabilitated after the construction of the pipeline;*
- *3.j - a description of how any threatened plants will be propagated and re-established;*
- *3.k - a description of how weed management and rehabilitation of native vegetation and threatened species habitat will be undertaken and funded in the long-term; and*
- *3.l - commitments to managing and protecting in perpetuity any parcel of land set aside as an offset.*

NSW Department of Planning:

Condition 2.9 - Areas specified in Table 1 [of the approval package] that are expected to be cleared shall be offset utilizing the compensatory habitat offset package described in documentation represented by Condition 1.1 c). The package located on the Williamsdale Property in the Australian Capital Territory shall be implemented prior to commissioning of the project. The package shall offset in perpetuity the value of habitat lost as a result of the project. A final review of the compensatory habitat offset package shall be provided to the Director-General in the Operation Environment Management Plan. This version shall:

- *2.9a - demonstrate the implementation of the offset;*
- *2.9b - describe how the offset shall be guaranteed and monitored in perpetuity; and*
- *2.9c - demonstrate a post construction review has been undertaken that confirms the extent of clearing was not greater than predicted. If clearing was greater, then the package shall demonstrate how the offset was modified and increased to the value of the actual habitat lost.*

Appendix I: Baseline monitoring species lists

+ = few, small cover (<5%)
R = solitary, small cover (<5%)
1 = numerous (up to 5%)
2 = 5-25%
3= 25-50%
4= 50-75%
5=>75%

NATIVE SPECIES								
Plot Number	1	2	3	4	5	6	7	8
Species	MU1A	MU2B	MU3	MU4	MU5	MU6	MU7	MU3
Acaena ovina		+	+	+	+	r		1
Aristida ramosa		1						
Asperula conferta		r	1	1	+			+
Austrodanthonia carphoides					1			
Austrodanthonia sp.		2	1	4		1	2	+
Austrostipa bigeniculata	1	2	+	r		2	1	1
Austrostipa scabra	2	2	+	r	1	2		
Bossiaea buxifolia						r		
Bossiaea prostrata					r	r		
Bothriochloa macra	1	2	1	1		2		2
Bulbine bulbosa								
Bursaria spinosa			r					
Carex appressa								
Carex inversa	2		r	r	1	+	1	
Cheilanthes sieberi		1	+		+	+		1
Chloris truncata	r						r	
Chrysocephalum apiculatum		2	+		1	1		1
Clematis leptophylla		r						
Convulvulus erubrescens	r	1	+		r	+		1
Craspedia sp.		+		+				
Cryptandra spinescens					r			
Cymbonotus lawsonianus		1			r	1	1	r
Cymbopogon refractus		r				1		
Desmodium varians			1		+	+		1

Dichondra repens		1		r			1	
Einadia nutans	r					+		
Elymus scaber	+	+	r		+			
Erygium ovinum			r					
Eucalyptus blakelyi		r	1	2	2	r		2
Eucalyptus blakelyi (Juv)		+				+		
Eucalyptus dives								
Eucalyptus melliodora			r					
Euchiton sp.	+	+				r		r
Fimbristylis dichotoma		r						
Gallium gaudichaudi					r			
Geranium solanderi		+	+	+				
Glycine tabacina	1	1				1		
Gonocarpus tetragynus			+		+			1
Goodenia hederacea								r
Haloragis heterophylla				2	r			+
Hydrocotle laxiflora		1	+	+	1	+	+	
Hypericum gramineum							r	+
Juncus sp.		r	r	+			1	
Lachnagrostis sp.				+				
Leptorhynchus squamatus			+	+	1			1
Lomandra filliformis		+	r		r	1		r
lomandra filliformis ssp. *coricaea*				r				
Lomandra multiflora					r			
Melichrus urceolatus					+	r		r
Microlaena stipoides	+	1		+		1	3	
Microtis uniflora								r
Oxalis perennans		1		+	+			
Oxalis sp.	+		r					+
Panicum effusum	1			1		1	+	+
Pimelea sp.					r			
Poa sieberiana			1	r	+			
Ranunculus sp.								
Rumex brownii	r			r		r	1	
Schoenus apogon		1		2			+	1
Senecio quadridentatus		r			r			
Stackhousia monogyna								

Swainsona sericea			+		+			
Themeda australis			4	4	4	r		4
Tricoryne elatior								r
Vittadinia muelleri		1			+	+		
Wahlenbergia sp.		1	+		+	+		+

EXOTIC SPECIES								
Plot Number	1	2	3	4	5	6	7	8
Species	MU1A	MU2B	MU3A	MU4	MU5	MU6	MU7	MU3B
Acetosella vulgaris		+		r		+	1	
Aira sp.	+	+		r		+	1	r
Anagalis arvensis							r	
Briza minor				r				r
Bromus sp.	1			+			+	+
Capsella								
Capsella bursa-pastoris							r	
Carthamus lanatus	3							
Centaurium erythraea		r		r	+	+		+
Conyza sp.	r	+	r	r		r	r	r
Crataegus mongyna								
Cynodon dactylon							1	
Cynosurus echinatus		r						
Cyperus eragrostis							+	
Echium plantagineum								r
Eragrostis curvula				r			1	
Erodium sp.	+	r		+			1	
Geranium sp.	r				r	r	1	
Holcus lanatus								
Hordeum sp.	3						1	
Hypericum perforatum		+	1	1	+	1		r
Hypochaeris radicata	+	+		+	r	1	1	
Linaria arvense		+				+		
Malva sp.	r						r	
Marrubium vulgare							r	
Nassella trichotoma	r							+
Onopordum acanthium						r	+	
Oxalis corniculata							+	
Oxalis sp.						+	+	

Paronychia brasiliana	1	+				r	1	
Petrorhaugia nanteuilii	1		r					r
Plantago lanceolata	r	r	1	1	+	r	+	
Prunella vulgaris							r	
Rosa rubiginosa	+	r	2	1	+	+	2	r
Rubus fruticosus								
Solanum linnaeanum								
Solanum nigrans							r	
Sonchus sp.			r	r				
Tolpis umbellata		r				1		r
Trifolium arvense	+	1		r		r		1
Trifolium campestre				r	r			+
Trifolium repens	1						3	
Trifolium sp.			r		r	r		r
Verbascum thaspus	+	r				r	r	
Verbena bonariensis							+	
Vulpia sp.	r			+				

Appendix J: Monitoring plot coordinates

MONITORING PLOT	MANAGEMENT UNIT	EASTING	NORTHING
1	MU1	693669.493321867	6059272.51377754
2	MU2	693529.989705616	6059555.3430263
3	MU3	693872.060216125	6059467.43663788
4	MU4	692349.347803337	6060568.07406166
5	MU5	692559.97343706	6059906.51819571
6	MU6	692576.249030655	6060344.04500194
7	MU7	692860.593606171	6060583.39228746
8 (3b)	MU3	693414.373694811	6059863.01538471

Appendix K: Proforma – BioBanking

Eco Logical Australia – BioBanking / BioCertification plot data sheet	Site Sheet No.

Plot Information

Plot Number		Recorders		Date	
GPS datum		Easting *		Northing*	
Plot Orientation		Slope (degrees and direction)		Photo numbers	

* Record from Easting and Northing from the end of the 50m transect at the start of the 20m quadrat

Vegetation Zone Identification

Biometric Vegetation Type (Create a standard short version)			
Ancillary Code (Usually condition description)			
Condition (Low or Mod-Good)		Habitat Features (rocks etc)	
Comments			

Plot Statistics

20m x 20m Quadrat	Number of native plant species	Use species list over page (full Id is not required) Write no. natives here:	
50m Transect – 10 Points	Native over-storey cover (%)	Sum / 10	%
	Native mid-storey cover (%)	Sum / 10	%
50m Transect – 50 Points	Native ground cover (hits/50 points) – Grasses	Double score out of 50 to get %	%
	Native ground cover (hits/50 points) – shrubs	Double score out of 50 to get %	%
	Native ground cover (hits/50 points) – other	Double score out of 50 to get %	%
50m Transect – 10 points + 50 points	Exotic plant cover - Sum exotic cover (%) from (a) overstorey + (b) midstorey +	Overstorey (10 points) Sum / 10 Midstorey (10 points) Sum / 10	Sum exotic % cover %

	(c) ground cover	Ground (50 points) Double score	
20m x 50m Quadrat	Number of trees with hollows		
	Total length fallen logs >10cm width (m)		
Whole Veg. Zone	Over-storey regeneration	Species	Regenerating (ie. saplings)? Proportion

Vegetation Structure (OPTIONAL) (within 0.04 ha quadrat)

Stratum	Growth form	Species name	Cover	Abund	Height to crown min	Height to crown avg	Height to crown max	Field No.
Upper								
Upper								
Mid								
Mid								
Ground								
Ground								

Growth form: T = tree, M = midstorey, S = shrub, G = grass, O = other, E = exotic Cover: <1, 1,2,3,4,5, 15,20,25,30,35 etc foliage cover %

Form	Species	C-A	Field #	Form	Species	C-A	Field #

Form: T = tree, M = midstorey, S = shrub, G = grass, O = other, E = exotic,
Cover Abundance (C-A) + = few, small cover (<5%), r = solitary, small cover (<5%), 1 = numerous (<5%), 2 = 5-25%, 3 = 25-50%, 4 = 50-75%, 5 = >75%