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Offset monitoring report 2017

LAKE WALLACE 5 YEAR MONITORING PLAN

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1 INTRODUCTION

This report presents the findings of the 2017 vegetation condition monitoring survey conducted in offset sites established for the Lake Wallace water supply dam development. The Lake Wallace block and southern blocks offset sites are located on Pigring Creek, around and upstream of the new dam and approximately 6 kilometres south of Nimmitabel. The survey follows earlier monitoring surveys conducted in 2014 and 2015.

Snowy Monaro Regional Council is responsible for establishing, managing and monitoring the offset sites in accordance with the Lake Wallace Offset Management Plan (NGH Environmental 2014a) and the Conservation Property Vegetation Plan. State and Commonwealth Government approval conditions require a monitoring program to measure change in vegetation condition and evaluate management. The NSW approval also requires the annual monitoring of the Small Snake Orchid (*Diuris pedunculata* sens lat) colony at the Lake Wallace offset site.

2 MANAGEMENT CONTEXT

2.1 BACKGROUND

The Lake Wallace block and southern blocks offset sites originally formed part of an 860 hectare freehold property used for commercial grazing. The results of ecological surveys conducted at the sites are provided in the flora and fauna assessment (Eco Logical Australia 2011), Preliminary Offset Assessment (Eco Logical Australia 2012), Review of Environmental Factors (NGH Environmental 2013a), Species Impact Statement (NGH Environmental 2013b) and the Offset Site Assessment report (NGH Environmental 2014b) prepared for the Lake Wallace dam project.

Two Endangered Ecological Communities (EECs) were affected by the Lake Wallace project:

- NSW Tablelands Snow Gum, Black Sallee, Candlebark and Ribbon Gum Grassy Woodland in the South Eastern Highlands, Sydney Basin, South East Corner and NSW South Western Slopes Bioregions EEC ('Snow Gum - Candlebark Woodland EEC')
- Commonwealth Natural Temperate Grassland of the Southern Tablelands of NSW and the Australian Capital Territory EEC (Wet Tussock Grassland).

A Preliminary Determination has been made to upgrade the Snow Gum - Candlebark Woodland listing to a Critically Endangered Ecological Community in NSW. The offset sites are specifically selected and managed to maintain and improve biodiversity values, including the condition of these communities at the sites.

2.2 SMALL SNAKE ORCHID MONITORING

The Lake Wallace offset site contains a colony of the Small Snake Orchid (Diuris pedunculata *sens lat*), which was listed as threatened in NSW at the time of dam approval.

As a condition of State Government approval, Council is required to protect and monitor the orchid colony during and following construction:

> ***Condition 42***
>
> *The colony of Small Snake Orchids identified in the Species Impact Statement must be protected through all stages of the project, including temporary fencing during construction.*
>
> *The Site Environmental Officer must make personnel aware of the location and significance of the colony.*
>
> *The colony must be monitored during the flowering period each year from project approval until the dam has been constructed and operating for 5 years.*
>
> *Monitoring results must be provided to OEH within 2 months of the fieldwork. Monitoring must include the number of individuals present, photographs of the colony and an assessment of whether there have been any impacts to the colony.*
>
> *Any new Small Snake Orchid records at the site must be submitted to OEH and Bionet.*

These requirements have been included in the Offset Management Plan (refer below).

The Small Snake Orchid taxon present at the Lake Wallace site was originally included in the Commonwealth threatened species listing but has been removed following taxonomic revision of the species. The revision splits *Diuris pedunculata* into the new species *D. subalpina* (found in southeast NSW, ACT and north-east Victoria) and *Diuris pedunculata* (*sens strict.*) which is confined to the New England area of NSW (Jones 2008 in DSEWPAC 2012). The revision has been accepted by the NSW Herbarium.

At the time of project approval, southern *D. subalpina* had been excluded from the Commonwealth listing but the NSW Scientific Committee had not recognised the revision, and the southern taxon remained part of the NSW listing for *D. pedunculata* (A. Treweek OEH pers comm 24 May 2013). The NSW Scientific Committee has since advised that the taxon is now considered to be different to the listed species and is not covered by the NSW *Diuris pedunculata* listing (Dr Mark Eldridge, Chairperson, NSW Scientific Committee pers comm 30 June 2017).

2.3 OFFSET MANAGEMENT PLAN

The Offset Management Plan (OMP) identifies the following management objectives for the offset sites:

- protect and enhance the condition of Snow Gum – Candlebark Woodland (secondary grassland and structural woodland) and Natural Temperate Grassland (Wet Tussock Grassland) at the offset sites
- manage herbaceous groundcover biomass to the optimal level necessary to protect and enhance habitat values, native species richness and resilience
- protect and enhance soil stability, landscape function and water quality
- protect and enhance woodland fauna habitat values
- control and minimise the impacts of threatening processes including soil erosion, invasive weeds and pest animals.

The conservation of biodiversity values is the over-riding management priority for the sites. Stock grazing is being used as a management tool to control grass biomass in Snow Gum – Candlebark Woodland secondary grassland areas.

The Offset Management Plan divides the sites into three management zones based on vegetation communities and management focus:

Zone 1 – the Lake Wallace riparian buffer and catchment forest, managed for biodiversity conservation and water quality protection (stock grazing is excluded)

Zone 2 – the Pigring Creek riparian buffer and tributary Wet Tussock Grassland area, managed primarily for biodiversity conservation (stock grazing is generally excluded)

Zone 3 –middle and upper slope areas managed primarily for biodiversity conservation, where rotational stock grazing may be used to control grass biomass.

The three management zones are shown on Figure 3-2 and Figure 3-3.

The OMP details a condition monitoring program, including timeframe, indicators, targets and methodology. The plan provides for condition monitoring at the establishment of the offset sites (2014), subsequent monitoring after one year (2015), and then every two years until 2025. The Small Snake Orchid monitoring and reporting take place annually. Both orchid and condition monitoring are conducted in mid-November each year.

The Small Snake Orchid and condition monitoring reports are prepared for Council and sent to the Office of Environment and Heritage (OEH) and the Commonwealth Environment Department. A draft condition monitoring report is initially provided to OEH to allow an opportunity for input to the interpretation of results. South East Local Land Services are also sent a copy of the final monitoring report, as party to the Conservation Property Vegetation Plan agreement. Under the Lake Wallace project approval, Council is required to provide the Small Snake Orchid monitoring results to OEH within 2 months of the fieldwork and any new Small Snake Orchid records at the site must be submitted to OEH and Bionet.

Monitoring scope, methods and frequency may be adjusted depending on monitoring results, the observed rate of change or following any alteration to the management regime. Any change to the monitoring program would require written approval from the Commonwealth Environment Minister and OEH.

2.4 VEGETATION CONDITION TARGETS

The scope and methods of monitoring at the offset sites are selected to measure change in the condition of grassy groundcover in the Snow Gum - Candlebark Woodland and Natural Temperate Grassland (Wet Tussock Grassland) communities. Quantitative and comparative condition targets have been identified in the OMP to assess management effectiveness; refer Table 2-1 below. The baseline status of the sites and progress against the targets are discussed in sections 5 and 6.

Note that the 2017 targets were originally intended for achievement in 2015, but were pushed back because of delays in the implementation of some elements of the Offset Management Plan (seasonal stock exclusion, riparian zone fencing, pest control).

Table 2-1 Vegetation condition targets for the offset sites in the Offset Management Plan

Condition indicator	Condtion target	Achievement target
Live native groundcover	≥80%	December 2017
Bare ground cover	≤10%	December 2017
Average sward height (secondary grassland)	5-10 cm	December 2017
Kangaroo Grass cover (secondary grassland)	≥50%	December 2019

Condition indicator	Condtion target	Achievement target
Floristic richness	SR637 Snow Gum - Candle Bark woodland benchmark- 20 SR610 River Tussock - Tall Sedge - Kangaroo Grass moist grasslands benchmark - 16	December 2019
Floristic Value Score	≥ high floristic value category (scores ≥20)	December 2019
Pest animal scat count	No occurrences	December 2017
Noxious weed count	No occurrences	December 2017
Grazing-sensitive flora species	Abundance maintained or increased between years	Continuing
Small Snake Orchid	Abundance and area maintained or increased between years	Continuing

2.5 STOCK GRAZING

2.5.1 Stock Management Plan

The offset sites are leased for grazing to manage grassland areas, subject to a Stock Management Plan contained in the OMP. The plan includes the following grazing rules (summarised):

- stock grazing is permitted between 1 February and 30 September
- stocking rates will not exceed 4 DSE per hectare of pasture
- grazing will not commence, and stock will be removed from the paddocks, when:
  - the live pasture cover falls below 80%, or
  - the average grass sward height is ≤50mm.

The leaseholder is to monitor live pasture cover and sward height on a fortnightly basis using a methodology and reporting checklist provided by Council. Council monitors compliance with the plan using monthly inspections.

2.5.2 Stock grazing 2015-2017

In the 2016 grazing period, the leaseholder grazed 45 heifers, each weighing around 250kg and each representing 6.5 DSE (refer NGH Environmental 2017). The maximum stocking rate prescribed in the Offset Management Plan is 4 DSE/ha.

There was a one week delay in the removal of stock in October 2016. Slight overstocking occurred during the 2016 grazing season due to delays calculating paddock areas and maximum stocking rates. 45 stock were grazed in the southern blocks site rather than the maximum of 43 permissable under the grazing rules (NGH Environmental 2017). The South and West paddocks have been considered as one paddock for the purposes of maximum stocking rate because the gates between them have been left open (there is no water in the West paddock).

Stocking during the 2017 season is summarised in Table 2-2. All paddocks were grazed during the season and the maximum stocking rate was exceeded on 7 occasions, in the North and West-South paddocks.

Table 2-2 Stocking records 2017 (exceedances shaded)

Date	Paddock (max stocking rate - DSE, 250kg heifers)				Reported by
	North (164, 25)	East (94, 14)	West (99, 15)	South (159, 24)	
28/03/2017	18	9	50	16	SMRC
9/04/2017	23	12	17	16	Leaseholder
22/04/2017	23	12	17	16	Leaseholder
27/04/2017	20	11	20	0	SMRC
13/05/2017	23	12	17	16	Leaseholder
23/05/2017	11	12	12	0	SMRC
28/05/2017	18	-	17	32	Leaseholder
11/06/2017	17	-	18	32	Leaseholder
14/06/2017	12	0	0	5	SMRC
24/06/2017	17	-	18	32	Leaseholder
13/07/2017	35	0	0	34	SMRC
14/08/2017	0	0	25	18	SMRC
12/09/2017	32	0	0	20	SMRC
19/10/2017	0	0	0	0	SMRC

2.6 WEED INSPECTION AND CONTROL

Council's Noxious Weeds Officer inspected the offset sites for weeds listed under the *Noxious Weeds Act 1993* and other weeds on 27 March 2017 (SMRC 2017). Weeds recorded during the inspection are listed in Table 2-3 and shown on Figure 2-1.

Table 2-3 Noxious weeds at the offset sites 2017

Common name	Scientific name	Category	Degree of infestation	Approx. area (ha)
Serrated Tussock	*Nassella trichotoma*	4	Isolated plants	0.1
African Lovegrass	*Eragrostis curvula*	4	Isolated patches	0.5
Sweet Briar	*Rosa rubiginosa*	4	Scattered plants	2.0
Black Thistle	*Cirsium vulgare*	4	Patches with individual plants	4.0

The inspection found the property to be relatively clean and well managed. A handful of scattered, juvenile Serrated Tussock plants were identified. African Lovegrass is the main emerging threat with small patches along the length of the boundary with the Monaro Highway. Black (or Spear) Thistles (**Cirsium vulgare*) and Lambs Ear (**Verbascum thapsus*) have germinated in disturbed areas, with the bulk occurring around the dam wall in the Lake Wallace block (neither are classified as noxious weeds).

At the time of inspection, African Lovegrass near the MacLaughlin River had been controlled (in 2016) and some thistles around the dam wall had been chipped. An outlying African Lovegrass plant was chipped out and bagged during the inspection. The report indicated that Council's weeds staff would control Serrated Tussock and African Lovegrass in the weeks following submission of the report.

Sweet Briars are growing mainly in semi-timbered areas and are entering winter dormancy. Their control is not a priority until the next growing season. If Council wishes to control Thistle and Lambs Ear, weed staff could make suitable arrangements with a local weed spraying contractor. A Quikspray unit with 100+ metre retractable reels is recommended to avoid driving on disturbed areas.

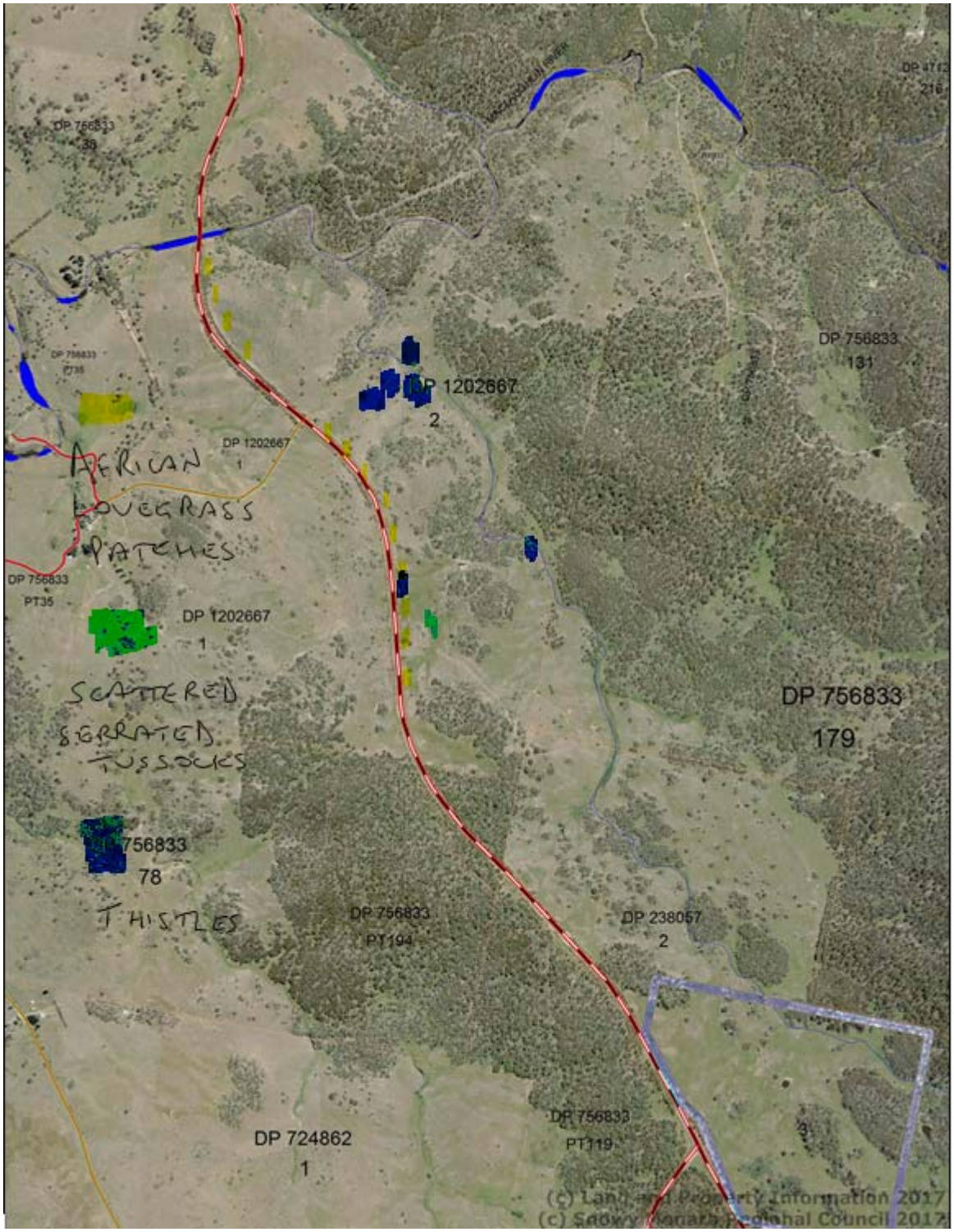

Figure 2-1 Localised noxious and other weed occurrences at the offset sites (SMRC 2017)

It is noted that the *Biosecurity Act 2015* has since repealed the *Noxious Weeds Act 1993*. The new Act and regulation provide for Local Control Authorities (Local Government or County Councils), and weed control obligations on public and private land. The Act provides specific legal requirements for State level priority weeds. The South East Regional Strategic Weed Management Plan 2017-2022 (South East Local Land Services 2017) prioritises weeds based on risk, impact and feasibility of control. Under the plan, Serrated Tussock is a State priority weed and African Lovegrass is a Regional priority weed. These species must be managed in accordance with published weed management plans.

3 MONITORING METHODS

The monitoring methods are based on the NSW BioBanking Assessment Methodology (BBAM) (OEH 2014a), with additional data collection relevant to the OMP condition targets. The 2017 monitoring survey was conducted on 12 and 14 November by one ecologist over 17 hours.

3.1 PLOT LOCATION

Twelve representative monitoring plots have been established in the EEC vegetation units:

- Snow Gum – Candlebark Woodland structural woodland (SW)
- Snow Gum – Candlebark Woodland secondary grassland high quality (GH)
- Snow Gum – Candlebark Woodland secondary grassland low quality (GL)
- Natural Temperate Grassland (Wet Tussock Grassland) (NG).

The locations of the plots are shown on Figure 3-2 and Figure 3-3. Areas available for grazing (management zone 3) and stock exclusion areas (management zones 1 and 2) are both sampled. Areas with localised and atypical stock impacts such as fencelines, watering points and stock camps were avoided. Map references for the transect posts recorded using a handheld GPS are provided in Table 3-1. The orientation of the transect line was recorded using a compass.

Table 3-1 Map references for the monitoring transects

Monitoring site	Transect end post (quadrat end)	Orientation[1]	Management zone
SW1	706790 5951052 (south end)	327°	1
SW2	707320 5949829 (north end)	235°	3
GH1	706462 5951594 (north end)	141°	1
GH2	706837 5950531 (south end)	324°	3
GH3	707026 5950116 (north end)	192°	2
GH4	707590 5949021 (north end)	202°	3
GL1	706435 5951086 (north end)	122°	3
GL2	707578 5949785 (north end)	216°	3
GL3	706937 5949562 (north end)	126°	3
GL4	707847 5948460 (north end)	168°	2
NG1	707844 5949780 (north end)	118°	2
NG2	708054 5949069 (north end)	117°	2

[1] from floristic quadrat end, magnetic north

For efficiency, floristic plot data collected during the 2013 offset site assessment survey was used to provide baseline data for the 2014 monitoring. The original assessment survey sites were recorded with GPS map references and photographs, but were not permanently marked. The location of the permanent sites established for the monitoring program may vary slightly (by up to 5 metres) from the original assessment sites, however the sites were located in relatively uniform vegetation away from vegetation boundaries and this discrepancy is unlikely to greatly affect the monitoring results. Sites SW1, SW2, GH1, GH4 and GL1 were established and surveyed for floristics during the 2014 survey.

The number of sites was reduced from 14 to 12 for the 2017 survey to minimise redundancy and allow more time for the orchid survey and general site inspection over the two-day monitoring period. The sites

referenced in past reports as SW1 and GH4 have been removed in 2017. Sites previously referred to as SW2 and SW3 are now SW1 and SW2, and the former GH5 becomes GH4. The change affects the monitoring of the NSW Snow Gum – Candlebark Woodland EEC, and approval for the reduction in monitoring sites was sought and received from OEH in March 2016. The monitoring sites continue to provide an appropriate representation of communities, condition classes and grazed/ungrazed management status.

The southern transect post at site GH2 was moved 7 metres upslope to increase distance from the newly constructed riparian zone fenceline. The GH3 plot was moved 3 metres to the south to avoid the new creek crossing laneway fenceline. The vegetation at these sites is relatively uniform and the slight adjustments are not likely to substantially affect monitoring results.

3.2 PLOT LAYOUT AND DESIGN

The layout of the BBAM plot and transect is shown in Figure 3-1 below.

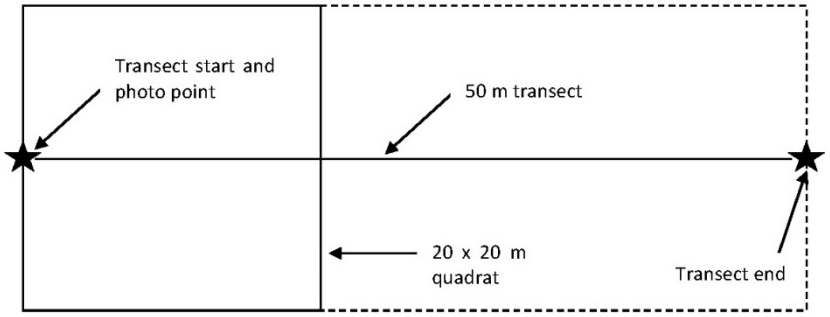

Figure 3-1 Survey plot and transect layout

3.3 SURVEY METHODS

General floristics and cover

Plot and transect surveys were used to measure 10 site condition attributes:

20 metre x 20 metre (0.04 ha) plot

- Native plant richness

50 metre x 20 metre (0.1 ha) plot

- Number of trees with hollows
- Total length of fallen logs (metres)

50 metre line transect

- Native overstorey cover (10 points)
- Native mid-storey cover (10 points)
- Native ground cover - grasses (50 points)
- Native ground cover - shrubs (50 points)
- Native ground cover - other (50 points)
- Exotic plant cover (50 points)
- Bare ground, rock and litter (50 points).

The survey sites were permanently marked using steel posts established at the floristic quadrat end of the 50 metre transect. Native plant richness was surveyed using relative cover/abundance based on visual estimates of foliage cover (Carnahan 1997), scored using a seven point Braun-Blanquet scale modified to allow the calculation of grassy ecosystem Floristic Site Value (Rehwinkel 2007). Native mid-storey and overstorey cover are recorded as foliage cover to the nearest 5%, expressed as average cover values for each transect. A 10cm long, 4 cm diameter plastic sighting tube was used to standardise the overstorey cover viewfield. The native ground cover categories are recorded as simple presence/absence; the number of 'hits' along the transect is divided by the number of transect points (50) to give a frequency score.

Live native groundcover and Kangaroo Grass cover

The BBAM transects were also used to collect data on total live native cover and Kangaroo Grass cover. Kangaroo Grass and River Tussock were identified to species when they were intercepted at one of the 50 cover transect points. For the 2015 survey, one hit was recorded per measuring point, being the first species intercepted by a vertical wire. The transect posts are 50 metres apart and the 50th record is taken 20 centimetres before the end post.

Average grass sward height

The BBAM transects were used to collect data on sward height every 5 metres along the transect. A ruler was used to measure the prevailing green sward height at each point (excluding flowering stems). The measuring points were moved on 0.5m when rock, temporary bare areas caused by local pig or cattle damage, cow pats, shrubs and the taller *Poa labillardierei* tussocks were encountered. The recorded heights were averaged for each transect to provide an indication of groundlayer biomass.

Floristic Site Value

The Floristic Site Value scores calculated from the 20 metre quadrat monitoring data for each site are based on number, type and cover/abundance of significant species which indicate site quality in grassy ecosystems in the Monaro sub-region (Rehwinkel 2007). It is noted that the Floristic Site Value method has now been revised to include scores for all native plant species present, rather than only 'significant species' (Rehwinkel 2015). The original method has been retained for this survey to allow comparability with earlier survey results. The scores are grouped into floristic value classes based on the categorisation in Mulvaney (2012).

Grazing-sensitive species

Grazing over a long period is likely to have reduced the abundance of grazing-sensitive flora species, particularly shrubs, legumes, geophytes and taller forbs. Candidate species from these groups occurring at the offset sites were selected as indicators to monitor the status and recovery of grazing-sensitive species. The selected species were not considered likely to be naturally rare at the offset sites. Cover/abundance scores recorded in the 20 metre floristic quadrats will be monitored for comparison between survey years.

Pest plants and animals

Pest animal scats and noxious weeds were recorded at all points where they intersected with the 50 metre transect tape at each BBAM monitoring plot. The cover/abundance scores of noxious weeds in the 20 metre floristic quadrats were extracted for weed abundance monitoring. Noxious weeds and pest animal sign were also recorded informally during the monitoring survey when moving between sites.

Soil erosion

Four soil erosion sites are monitored using photographs. The erosion sites were initially identified during the offset site assessment. Two of the sites have been remediated although some active erosion continues at all of the sites. The property was not systematically searched, and there may be other erosion sites which will also need remediation. The locations of the monitored erosion sites are provided in Table 3-2.

Table 3-2 Locations of monitored erosion sites

Erosion site	Map reference	Offset site	Management unit
E1	706491 5950589	Lake Wallace block	3 (fenced)
E2	706839 5949709	Southern blocks	3
E3	706884 5949711	Southern blocks	3
E4	707730 5949096	Southern blocks	2 (moving into 3)

Photopoints

Photopoint photographs were taken along the transect line from the floristic quadrat end of the plot (usually the northern end). Photographs were taken approximately 1.5 metres back from the transect post, with the top of the post in the lower foreground (1/3 of the way up the frame) and with the camera angled parallel to the ground.

Informal observations

In addition to plot-based monitoring, a field checklist was used to record informal observations of key condition attributes and potential management issues. The checklist includes:

- noxious weeds
- pest animals sign
- significant species
- soil erosion sites
- excessively dense tree or shrub regeneration (evidenced by thinning groundcover)
- damaged or incomplete infrastructure (such as fencing, gates, tracks).

These observations were made while moving between vegetation condition and erosion monitoring sites. The observations were used to extend the areal coverage of the monitoring program and supplement the plot data to evaluate management at the offset sites. Condition and management factors are also noted during regular Council compliance inspections, outside the condition monitoring cycle.

Small Snake Orchid monitoring

COLONY CENSUS

Search transects 2 metres wide were used to search for and census flowering Small Snake Orchid plants. The search covered the fenced area and a radius of approximately 20 metres surrounding the fence.

The number of individual plants and each plant's reproductive status (bud, flowering or spent) were recorded. Non-flowering plants have not been included in the survey because of difficulty finding and reliably identifying orchid leaves among the grass sward.

Incidental observations regarding associated species, habitat, area of occupancy and any impacts or threats to the colony were also made and updated as required.

The 2014 survey, prior to the construction of the fence, involved 5 metre wide search transects applying a 50 metre buffer around the point location recorded by Eco Logical Australia (2011) to determine the visible extent of the colony.

GROUNDCOVER SURVEY

Groundcover monitoring using the quantitative and repeatable step point method was initiated for the 2016 survey. A line transect was run between the south-east and north-west corner posts of the fenced plot. 54 points were sampled at 0.5 metre intervals, starting from the 1 metre point at the south-east corner and ending at 27 metres at the north-west corner. Live cover recording categories included native tree, native shrub, native grass, native herb (other), exotic grass and exotic herb (other).

PHOTOGRAPHS

Photographs were taken in and around the orchid colony, including comparative shots of groundcover inside and outside the orchid fence. The photographs are provided in section 4.9 of this report.

Figure 3-2 Lake Wallace offset site monitoring sites

Figure 3-3 Southern blocks offset site monitoring sites

4 MONITORING RESULTS

4.1 BIOMETRIC BENCHMARKS

Monitoring data collected during the survey is provided in Appendix A.

The Snow Gum – Candlebark Woodland at the offset sites corresponds to the following Biometric vegetation types (OEH 2014b):

SR637 Snow Gum - Candle Bark woodland on broad valley flats of the tablelands and slopes, South Eastern Highlands

SR610 River Tussock - Tall Sedge - Kangaroo Grass moist grasslands of the South Eastern Highlands.

A comparison of the monitoring results against the condition benchmarks for the communities is provided in Table 4-1 below. Scores which fall outside the benchmark range are shaded.

Table 4-1 Summary of condition attributes against Biometric benchmarks 2017

Site	Richness	Overstorey cover	Mid-storey cover	Grass cover	Shrub cover	Cover other	Trees with hollows	Fallen logs (m)
SR637	**20**	**15-30**	**0-15**	**5-70**	**0-10**	**5-30**	**2**	**25**
SW1	44	35.5	0	36	2	8	1(?)	23.5
SW2	33	40	0	12	4	2	1	78.5
GH1	22	0	0	68	0	4	0	0
GH2	29	0	0	68	2	8	0	0
GH3	39	0	0	62	0	12	0	0
GH4	25	0	0	76	0	6	0	0
GL1	24	0	0	48	2	8	0	0
GL2	25	0	0	42	0	4	0	0
GL3	20	0	0	50	0	10	0	0
GL4	26	0	0	58	0	8	0	0
SR610	**16**	**0-5**	**0-0**	**30-80**	**0-5**	**5-40**	**0**	**0**
NG1	22	0	0	26	0	28	0	0
NG2	18	0	0	20	0	44	0	17

All sites continue to meet richness benchmarks, although richness scores are well down on 2015 records for most sites. The sites also generally meet or are close to benchmark for mid-storey, grass, shrub and other native cover.

Much of the offset site area has been cleared for stock grazing and is below benchmark for overstorey cover, tree hollows and fallen logs. Two woodland monitoring sites (SW1 and SW2) are above benchmark for overstorey cover because the vegetation comprises younger regrowth trees.

4.2 NATIVE GROUND COVER

The monitoring results obtained from the 50 metre transects for total live native groundcover, Kangaroo Grass cover and bare ground are presented in Table 4-2.

Native cover has declined since 2015, with most sites well below the 80% cover target. This is likely to have been the result of total grazing pressure and a dry winter-spring period.

Kangaroo Grass declined at 2 sites (GH1, GH3) increased at 3 sites (GH2, GL3, GL4) or remained fairly stable. Kangaroo Grass cover remains below target for all sites except GH2.

Conversely the frequency of bare ground reduced and all sites meet the ≤10% condition target.

Table 4-2 Native groundcover, Kangaroo Grass cover and bare ground results

Site	Native groundcover (%)			Kangaroo Grass cover (%)			Bare ground		
	2014	2015	2017	2014	2015	2017	2014	2015	2017
Target	**≥80**			**≥50**			**≤10**		
SW1	62	52	46	0	2	2	10	6	0
SW2	44	46	18	0	2	2	0	0	0
GH1	68	74	72	20	16	6	0	0	0
GH2	86	66	78	60	44	56	0	0	0
GH3	92	84	74	48	36	20	10	0	0
GH4	78	88	82	44	48	48	4	2	0
GL1	64	68	56	4	16	14	0	4	4
GL2	76	64	46	16	10	10	0	0	6
GL3	64	58	60	0	4	8	0	0	2
GL4	88	76	66	14	12	16	2	12	2
NG1	100	88	54	NA	NA	NA	2	2	8
NG2	94	86	64	NA	NA	NA	0	6	0

4.3 AVERAGE SWARD HEIGHT

The average sward heights calculated for the secondary grassland monitoring sites are presented in Table 4-3. These data are used to indicate grass biomass. The target range for sward height at the offset sites is 5-10 centimetres. The Meat and Livestock Australia Pasture Ruler indicates that this range roughly equates to 1.4 - 2.2 tonnes/hectare of green dry mass.

The offset sites (management zone 3) were grazed by cattle during the 2017 grazing season (refer section 2.5).

Grass height is down on 2015 records for all sites, grazed and ungrazed. This suggests lower grass growth rates and/or heavier total grazing pressure. The stock-grazed GL sites were all below target height. The ungrazed GH1 site was also below target height (and was also subject to a reduced Floristic Site Value score – refer section 4.4). The scat counts indicate an increase in macropod grazing pressure, and increased rabbit impacts at one site (refer section 4.6).

Table 4-3 Average sward height at the monitoring sites 2014, 2015 and 2017

Site	Average sward height (cm)		
	2014	2015	2017
Target	**5-10cm**		
SW1	NA	NA	NA

Site	Average sward height (cm)		
	2014	2015	2017
SW2	NA	NA	NA
GH1	2.7	7.9	5.45
GH2	8.3	6.4	5.4
GH3	4.3	5.5	5.4
GH4	2.8	4.3	3.9
GL1	2.6	4.3	2.85
GL2	4.8	4.7	2.25
GL3	6.4	2.9	2.85
GL4	5	3.8	3.65
NG1	NA	NA	NA
NG2	NA	NA	NA

4.4 FLORISTIC SITE VALUE

The Floristic Site Value scores calculated from the 20 metre quadrat monitoring data for each site for the 3 monitoring years are presented in Table 4-4 below. Table 4-4 also provides the corresponding floristic value class for each site, based on the categorisation in Mulvaney (2012):

<5	little floristic value, and dominated by exotic species and/or common native species
5–9	low floristic value
10–14	moderate floristic value with a few significant species
15–19	moderate to high floristic value
20–24	high floristic value, many significant species present
25–35	very high floristic value
35+	exceptional floristic value, site of very high diversity with numerous significant species.

The Offset Management Plan sets the condition target of at least the high floristic value class (Floristic Value Score ≥20) for all sites.

Floristic Value Scores have declined compared to 2015, and in many cases compared to 2014 scores. Two ungrazed sites - SW1 and GH3 – with low macropod scat counts maintained good FSV scores although these sites also showed reduced abundance in some significant species (refer section 4.5).

Table 4-4 Floristic Site Value (FSV) scores for the monitoring plots

	2014		2015		2017	
Site	**FSV score**	**Value class**	**FSV score**	**Value class**	**FSV score**	**Value class**
Target	**≥20**	**≥ High**	**≥20**	**≥ High**	**≥20**	**≥ High**
SW1	45	Exceptional	62	Exceptional	53	Exceptional
SW2	23	High	44	Exceptional	29	Very high
GH1	26	Very high	30	Very high	16	Moderate to high
GH2	24	High	32	Very high	25	Very high

	2014		2015		2017	
Site	**FSV score**	**Value class**	**FSV score**	**Value class**	**FSV score**	**Value class**
GH3	37	Exceptional	52	Exceptional	53	Exceptional
GH4	29	Very high	43	Exceptional	17	Moderate to high
GL1	12	Moderate	21	High	20	High
GL2	17	Moderate to high	15	Moderate to high	11	Moderate
GL3	6	Low	15	Moderate to high	12	Moderate
GL4	10	Moderate	21	High	17	Moderate to high
NG1	21	High	31	Very high	20	High
NG2	17	Moderate to high	26	Very high	22	High

4.5 GRAZING-SENSITIVE SPECIES

Cover/abundance scores for grazing-sensitive species in monitoring plots measured in 2013/2014, 2015 and 2017 are provided in Table 4-5 below. Cover/abundance assessments are scored using a modified Braun-Blanquet 7-point scale:

Braun-Blanquet cover-abundance scale	
r	Solitary (1-3 individuals), <5% cover
+	Few (4-15), <5% cover
1	Numerous/scattered, <5% cover
2	5 - 25% cover
3	26- 50% cover
4	51 - 75% cover
5	76 - 100% cover

Grazing sensitive species generally maintained or improved their abundance category in 2015. *Discaria pubescens* at GH3 and *Swainsona monticola* at GL3 declined in 2015; both sites were subject to grazing at the time of survey.

The presence and abundance of indicator species was depressed in 2017. This occurred in sites which were grazed and ungrazed by stock, and in sites which recorded increased and relatively stable macropod scat counts. Against this pattern, the recorded abundance of *Discaria pubescens* had increased markedly at the ungrazed site GH3 in 2017. *Sorghum leiocladum* had also increased at this site.

In addition to the recorded indicator species, the low shrub *Mirbelia oxylobioides* was observed to have been heavily browsed at sites GH2 and GL1.

Table 4-5 Cover scores for grazing-sensitive indicator species

Species	Site	2013/2014	2015	2017
Target: abundance maintained or increased between years				
Shrubs, subshrubs				
Discaria pubescens	GH3	+	R	1 (21 plants)
Hovea heterophylla	SW1	r	R	r
	SW2	r	R	r
	GH3	r	R	+
	GH4	r	R	-
Forbs				
Calotis scabiosifolia	SW1	+	+	r
	SW2	-	R	-
	GH3	1	1	+
Craspedia canens	SW1	+	+	1
Dianella longifolia	SW2	r	R	r
Diuris monticola	GL4	-	R	r
Swainsona monticola	GH3	+	1	r
	GH4	+	+	-
	GL3	+	R	-

Figure 4-1 Mountain Golden Moths (*Diuris monticola*) recorded at site GL4 and near site GH1

Figure 4-2 Black-tip Greenhood (*Pterostylis bicolor*) recorded at site GH2

4.6 PEST PLANTS AND ANIMALS

4.6.1 Monitoring plots and transects

The percentage cover of noxious and invasive weeds and animal scats recorded using the 50 metre transect and 20 metre floristic plots are summarised in Table 4-6 and Table 4-7. The condition targets in the Offset Management Plan is zero occurrences for noxious weeds and pest animal sign.

The incidence of the weed *Rosa rubiginosa* had increased in 2017 at the ungrazed sites SW2 and GH3 and at the grazed site GL3.

All sites showed either relatively stable or reduced cattle scat counts, but a large increase in macropod scats. Site GL1 showed greatly increased rabbit scats, indicating an active warren nearby.

Table 4-6 Noxious weed data summary 2014 and 2015

Site	2014		2015		2017	
	Transect	Quadrat	Transect	Quadrat	Transect	Quadrat
Target	0	0	0	0	0	0
SW1	0	*Rosa rubiginosa* - r	0	*Rosa rubiginosa* - r	0	0
SW2	0	*Rosa rubiginosa* - r	0	*Rosa rubiginosa* - r	0	*Rosa rubiginosa* – + (6)
GH1	0	0	0	*Rosa rubiginosa* - r	0	0
GH2	0	0	0	0	0	0
GH3	0	*Rosa rubiginosa* - r	0	*Rosa rubiginosa* - r		*Rosa rubiginosa* - + (4)
GH4	0	0	0	0	0	0
GL1	0	0	0	0	0	0
GL2	0	0	0	0	0	0
GL3	0	0	0	*Rosa rubiginosa* - r	0	*Rosa rubiginosa* - + (4)
GL4	0	0	0	0	0	0
NG1	0	0	0	0	0	0
NG2	0	0	0	0	0	0

Table 4-7 Animal scat data summary 2014, 2015 and 2017

Site	2014	2015	2017
Pest animal target	0	0	0
SW1	0	Cow - 2	Macropod – 4 Wombat - 1
SW2	0	Cow – 4, Macropod - 3	Cow – 2 Macropod - 10
GH1	0	Macropod - 2	Macropod - 15
GH2	0	Cow – 2, Macropod - 1	Cow – 3 Macropod - 10
GH3	0	Cow – 2, Macropod - 2	Macropod - 6 (rabbit scats in plot)
GH4	Rabbit - 2	Rabbit – 1, Cow – 1, Macropod - 3	Cow – 2 Macropod – 5
GL1	0	Rabbit – 1, Cow – 4, Macropod - 6	Cow – 1 Macropod – 17 Rabbit - 20
GL2	0	Cow – 8, Macropod - 3	Cow – 3 Macropod - 33
GL3	0	Cow – 6, Macropod - 2	Cow – 4 Macropod - 13
GL4	0	Cow – 4, Macropod - 1	Cow – 4 Macropod - 4
NG1	0	Cow - 6	Macropod – 14 Wombat - 2
NG2	0	Cow – 2, Macropod - 1	Macropod - 3

4.6.2 Informal observations

Noxious weeds

St Johns Wort (**Hypericum perforatum*) was observed beside the highway, north of a small drainage line near the gate adjacent to site GL3.

During the 2014 and 2015 surveys, a large patch of Sweet Briar (*Rosa rubiginosa*) was observed on rocks in the Pigring Creek channel in the southern blocks offset site at 707787 5949117. The area was not revisited during the 2017 survey.

Pest animals

Pig diggings were observed in several locations at the offset sites, including at monitoring sites GH4, GL4 and NG1, just outside the orchid fence, near erosion monitoring site E1 in the Lake Wallace block and inside the riparian zone fence near site NG2 at the Southern Blocks site.

A wombat burrow was observed below a small farm dam in the Southern Blocks offset site at 707655 5949055; refer Figure 4-4. The burrow threatens the integrity of the dam wall and water quality in Pigring Creek.

Figure 4-3 Pig diggings in the Lake Wallace block beside the track near erosion site E1

Figure 4-4 Wombat burrow below a farm dam wall in the Southern Blocks site

4.7 SOIL EROSION

The locations of four gully heads recorded at the offset sites are shown on Figure 3-2 and Figure 3-3. Photographs of each site taken during the 2017 survey are provided below. Since the 2015 survey, erosion site E1 has been remediated, with the gully reshaped and fenced, coir logs placed to slow runoff and trap sediment and tree plantings undertaken around the former gully head (Figure 4-11 and Figure 4-12). The lower gully area appears stable and the planted Snow Gum seedlings have survived. However, the headcut area remains bare and unstable.

Site E4 has continued to slump at the head cut and has migrated under the riparian zone fenceline. Coir logs have been placed across the top of the gully head and within the channel below the cut. This area also remains unstable.

The less developed erosion at sites E2 and E3 are little changed but have not been treated.

Figure 4-5 Lake Wallace block erosion site E1 in 2015

Figure 4-6 Lake Wallace block erosion site E1 in 2017

Figure 4-7 Southern blocks erosion site E2 in 2015

Figure 4-8 Southern blocks erosion site E2 in 2017

Figure 4-9 Southern blocks erosion site E3 in 2015

Figure 4-10 Southern blocks erosion site E2 in 2017

Figure 4-11 Lake Wallace block erosion site E4 in 2015

Figure 4-12 Southern blocks erosion site E2 in 2017

4.8 PHOTOPOINTS

Photopoint photographs taken at each monitoring plot are provided in Appendix B.

4.9 SMALL SNAKE ORCHID MONITORING

4.9.1 Ecology, habitat and distribution

The Small Snake Orchid (*Diuris pedunculata* sens lat) is a tuberous geophyte inhabiting grassy slopes or flats, often on peaty soils in moist areas, on shale and fine granite, and among boulders. The life cycle typically involves the seasonal emergence of a leaf and flower stem, and the annual renewal of an underground tuber. Plants may enter dormancy for one or more years; multi-seasonal dormancy is undesirable because it has been shown to be positively correlated with mortality in some species (for example, Coates *et al.* 2006). Disturbance by burning has been documented as a trigger which promotes flowering and presumably interrupts dormancy (Collier and Garnett 2013, Jones *et al.* 1999).

The flowering period of the species is stated to be between August and October (Jones 1999, pers. comm in DSEWPAC 2012), although it has been recorded flowering in mid-November in the study area, and at Adaminaby in similar habitat at 1180m ASL (NGH Environmental 2003). Pollination is by sexual deception, with the Small Snake-orchid attracting mostly males of the insect *Halictus lanuginosus*, even though the plants produce nectar and emit a strong scent that usually attracts numerous pollinators (Jersáková et al. 2006 in DSEWPAC 2012). The flowers of some *Diuris* species are believed to mimic native pea flowers to attract pollinators (for example *D. maculata* and *D. aequalis*). Members of the Snake Orchid group most likely mimic yellow lilies such as *Hypoxis* species and *Bulbine* species (Bishop 2000).

The Small Snake Orchid *sens lat* is distributed on the NSW Northern and Southern Tablelands and north coast regions, Queensland, Victoria, South Australia and possibly Tasmania (DSEWPAC 2012). On the Southern Tablelands, it has been recorded at Bredbo, Adaminaby, Countegany and the ACT. There are no records in the OEH Atlas or Atlas of Living Australia online databases within 10 kilometres of the study area. The Lake Wallace colony appears to be the southernmost record in NSW.

4.9.2 Lake Wallace orchid colony

The Small Snake Orchid was recorded at the Lake Wallace site as a single colony comprising 15 flowering plants on 15-17 November 2010 (Eco Logical Australia 2011). The colony occurs on a gentle southwest-facing lower slope in woodland dominated by Black Sallee (*Eucalyptus stellulata*) with Snow Gum (*E. pauciflora*). The groundlayer is dominated by the grasses Weeping Grass (*Microlaena stipoides*), Snow Grass (*Poa sieberiana*) and the exotic Sweet Vernal Grass (**Anthoxanthum odoratum*). The groundlayer is relatively diverse, including *Ajuga australis, Asperula scoparia, Craspedia canens, Euchiton japonicus, Haloragis heterophylla, Hypericum gramineum, Leptorhynchos squamatus, Oreomyrrhis eriopoda, Plantago varia, Ranunculus lappaceus, Solenogyne gunnii* and *Viola betonicifolia,* with exotic forbs *Hypochaeris radicata* and *Trifolium* species. Scattered shrubs include *Leptospermum myrtifolia* and *Pimelea curviflora*. The composition and condition of vegetation adjacent to the orchid colony has been documented in the monitoring data collected for the monitoring site SW1.

The Lake Wallace dam project has potential to affect the colony indirectly by reducing grazing and grass biomass removal. In some cases, rare species have been observed to decline following the cessation of stock grazing (e.g. Scarlett and Parsons 1982 and 1990, Cropper 1993, Morgan 1995 in Lunt 2005), which has been attributed to competition from the dominant grasses. However, past research suggests that most geophytes, such as terrestrial orchids, decline when grazed and recover when fenced (Dorrough 2012).

Consistent with the project approval conditions, a fence around the orchid colony was constructed in late 2014, applying a 10 metre buffer around the colony visible in November 2014. A permanent fence with wire mesh, rather than a temporary fence, was constructed because of the threat posed by wild pigs, evidenced by diggings close to the orchid colony.

Figure 4-13 Small Snake Orchid at the offset site (2017)

Figure 4-14 Small Snake Orchid groundlayer comparison

Figure 4-15 Dense grassy groundlayer habitat inside the exclusion fence

Figure 4-16 Pig digging just outside orchid fence (2017)

4.9.3 Survey timing, effort and conditions

Survey timing, effort and conditions for the three monitoring years are summarised in Table 4-8 below. The increased effort in 2016 was due to the addition of the step point cover transect.

Table 4-8 Survey timing, effort and conditions in 2014, 2015 and 2016

	2014	2015	2016	2017
Date	18 November	17 November	9 November	14 November
Start time	8.30 am	9.30 am	1.00 pm	9.15 am
Weather	Warm, sunny, light winds	Warm, sunny, light winds	Mild, calm, partly cloudy	Mild, calm, partly cloudy
Effort	1 ecologist, 0.75 hrs	1 ecologist, 0.5 hrs	1 ecologist, 1 hr	1 ecologist, 1 hr

4.9.4 Population size and reproductive status

The population size and reproductive status of the colony recorded in the three survey years are summarised in Table 4-9. The total number of flowering or fruiting orchid plants recorded in the colony

was 9 in 2014, 17 in 2015, 26 in 2016 and 8 in 2017. Eco Logical Australia (2011) recorded 15 flowering plants at the site in 15-17 November 2010.

No plants were recorded outside the fence in 2015, 13 were recorded outside the fence in 2016 and only 1 was recorded outside the fence in 2017.

The flowering of terrestrial orchids can be spatially and temporally variable between years. Determining long term population trends will require monitoring over an extended period to account for varying seasonal conditions. Note that non-flowering plants present as leaves or tubers have not been included in the surveys.

Table 4-9 Population size and age structure of the Small Snake Orchid colony (2014 - 2017)

	Bud	Flowering	Spent flowers	Fruit	Split capsules	Total
2014						
No. plants	0	8	1	0	0	9
% visible colony	0	88.9	11.1	0	0	100
2015						
No. plants (all inside fence)	0	14	3	0	0	17
% visible colony	0	82.4	17.6	0	0	100
2016						
No. plants - inside fence	1	12	0	0	0	13
No. plants - outside fence	1	12	0	0	0	13
% visible colony	7.7	92.3	0	0	0	100
2017						
No. plants - inside fence	0	7	0	0	0	7
No. plants - outside fence	0	1	0	0	0	1
% visible colony	0	100	0	0	0	100

4.9.5 Area of occupancy

Eco Logical Australia (2011) recorded a similar area of occupancy of approximately 150 m^2. The visible colony in 2014 occupied a reduced area approximately 6 metres x 3 metres, centred on 706786 5951036.

This area was extended during the 2015 survey with the recording of additional plants in the north-west corner of the fenced area. No plants were recorded outside the fenced area in 2015.

In 2016, the area of occupancy of the colony was observed to cover the central, northern and western (lower) parts of the fenced area (13 plants). Additional plants (13) were recorded outside the fence, up to 6 metres from the north-west corner and western fenceline. A single plant was recorded 2 metres to the south of the fenced area. The visible area of occupancy for the orchid at the site in 2016 was approximately 160 m^2.

In 2017 the 7 records within the exclusion fence were confined to approximately 20 m^2 in the central west of the area, and a single plant was recorded outside the fence, 9 metres south of the SE corner.

4.9.6 Groundcover

During the 2015 survey, the favourable season had resulted in abundant flowering of the exotic perennial Sweet Vernal Grass (**Anthoxanthum odoratum*), estimated to be 15-20% foliage cover. Grass sward height within the orchid habitat was 10-12 cm, and live Sweet Vernal Grass inflorescences were 30-50cm high. Sweet Vernal Grass was abundant both inside and outside the then-new orchid fence, reflecting the favourable growing season.

In 2016, Sweet Vernal Grass inflorescences were not as prevalent. The fenced area had a high density of old inflorescence stems of the later-flowering native Weeping Grass in 2016, indicating a prolific 2015/2016 summer following construction of the fence (refer Figures 4-1 to 4-4). Native grasses (Weeping Grass - *Microlaena stipoides* and Snow Grass - *Poa sieberiana*) made up 63% of the cover. Exotic grasses represented 18.5% of the cover (predominantly Sweet Vernal Grass). Grass sward height within the fence was around 10 centimetres (excluding Sweet Vernal Grass inflorescence stems).

By 2017, both native grass and exotic grass cover had reduced, and litter cover had tripled. Grass cover was dominated by Snow Grass (31.5% of total cover). Sweet Vernal Grass made up 11.1% of total cover. The change was likely the result of the preceding dry period, and the tendency for the Snow Grass sward to thicken and exclude other plants (refer Figure 4-15).

The results of the 2016 and 2017 groundcover transect surveys are provided in Table 4-10.

Table 4-10 Groundcover transect survey results 2016 and 2017

Stratum	Percent cover	
	2016	2017
Native trees/shrubs (<1m)	0	1.8
Native grasses	63.0	44.4
Native herb (other)	7.4	12.9
Exotic grass	18.5	11.1
Exotic herb (other)	1.8	0
Litter	9.3	27.7
Rock (E- embedded, S – surface)	0	0
Bare ground	0	0
Total native (%)	**70.4**	**60.9**
Proportion of cover native (%)	**77.6**	**84.6**

4.9.7 Impacts and threats

The pig proof fence has largely removed a significant threat to the orchid colony. The presence of recent pig diggings close to the orchid fence (Figure 4-16) shows that this threat is still active at the location, and the exclusion fence is still required to protect the orchid colony.

The fence does however introduce a potential threat from increased competition from grasses caused by reduced herbivory. In 2017 this has been manifested by a thick mat of Snow Grass tussocks and litter in the groundlayer. Eucalypt seedlings are also being promoted by the exclusion of large herbivores.

Sweet Vernal Grass is likely to remain a recurring threat during wet years. It is fast-growing, shade-tolerant, copes well with nutrient-poor (especially low phosphorous) soils, produces allelopathic chemicals and large quantities of seed, and has a flowering period coinciding with the Small Snake Orchid.

Weeping Grass is also likely to proliferate during wetter years. It is a natural associate of the Small Snake Orchid at the site and is unlikely to compete with it directly during the orchid flowering period.

Snow Grass may need some form of biomass control outside the orchid flowering and seeding period. The similar early Snake Orchid (*Diuris chryseopsis*) has been observed to have a 6 week flowering period and a 6 week fruiting and seed release period on the Far South Coast (author pers obs). Applying a conservative 4 week pre-flowering period, the orchid fence could be opened for wild herbivore grazing from March till mid-September. However, this would only be possible once the pig threat had been removed (refer section 6).

If periodic native species grazing is not possible, careful spot-burning or slashing and removal of grass cuttings may be required during the above period of orchid dormancy. Eucalypt saplings within the fence may also need to be controlled using a highly targeted non-residual method (such as cut stump glyphosate application).

5 ASSESSMENT AGAINST CONDITION TARGETS

5.1 MONITORING SITES

The management guidelines in the Offset Management Plan are intended to produce continuing improvement in the condition of grassy groundcover at the offset sites. The condition targets set out in the plan and proposed achievement timeframes are summarised in section 2.4. The status of each monitoring site is summarised in the tables below.

The target for grazing-sensitive species is comparative between monitoring years, and has not been included in the 2014 table. Sward height is a specific condition indicator for Snow Gum – Candlebark Woodland secondary grassland.

Some condition parameters in grassy communities are heavily influenced by weather conditions, particularly rainfall. This will produce variation between monitoring years which is unrelated to background condition trends. Some caution should therefore be applied when interpreting monitoring results from a small number of repeat surveys.

Based on the 2017 monitoring results:

- native cover has declined since 2015, with most sites well below the 80% cover target
- Kangaroo Grass cover remains below target for all sites except one (GH2)
- all sites meet the ≤10% target for bare ground
- grass height is down on 2015 records for all sites, grazed and ungrazed. The stock-grazed GL sites and the ungrazed GH1 site were below target height.
- all sites continue to meet richness benchmarks, although richness scores are well down on 2015 for most sites
- Floristic Value Scores have also declined compared to 2015. Two ungrazed sites with low macropod scat counts maintained good FSV scores (SW1 and GH3)
- two plots indicated rabbit scats (GH3, GL1). Most sites showed a significant increase in macropod scats
- grazing sensitive species were depressed in 2017, in both grazed and ungrazed sites, and in sites with high and stable macropod scat counts.

- the Small Snake Orchid showed greatly reduced visible colony size and area of occupancy in 2017.

Table 5-1 Assessment against offset site condition targets - 2014

	SW1	SW2	GH1	GH2	GH3	GH4	GL1	GL2	GL3	GL4	NG1	NG2
Management zone	**1**	**3**	**1**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**
Native groundcover	No	No	No	Yes	Yes	No	No	No	No	Yes	Yes	Yes
Kangaroo Grass	No	No	No	Yes	No	No	No	No	No	No	NA	NA
Bare ground	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sward height	NA	NA	No	Yes	No	No	No	No	Yes	Yes	NA	NA
Floristic richness	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Floristic Value Score	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	No
Pest animal scats	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Noxious weed count	No	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 5-2 Assessment against offset site condition targets - 2015

	SW1	SW2	GH1	GH2	GH3	GH4	GL1	GL2	GL3	GL4	NG1	NG2
Management zone	**1**	**3**	**1**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**
Native groundcover	No	No	Yes	No	No	Yes	No	No	No	No	Yes	Yes
Kangaroo Grass	No	No	No	No	No	No	No	No	No	No	NA	NA
Bare ground	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Sward height	NA	NA	Yes	Yes	Yes	No	No	No	No	No	NA	NA
Floristic richness	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Floristic Site Value	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes
Grazing sensitive species	Yes	Yes	NA	NA	No	Yes	NA	NA	No	Yes	NA	NA
Pest animal scats	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes
Noxious weed count	No	No	No	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes

Table 5-3 Assessment against offset site condition targets - 2017

	SW1	SW2	GH1	GH2	GH3	GH4	GL1	GL2	GL3	GL4	NG1	NG2
Management zone	**1**	**3**	**1**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**
Native groundcover	No	No	No	No	No	Yes	No	No	No	No	No	No
Kangaroo Grass	No	No	No	Yes	No	No	No	No	No	No	NA	NA
Bare ground	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sward height	NA	NA	Yes	Yes	Yes	No	No	No	No	No	NA	NA
Floristic richness	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Floristic Site Value	Yes	Yes	No	Yes	Yes	No	Yes	No	No	No	Yes	Yes
Grazing sensitive species	No	No	NA	NA	No	No	NA	NA	No	Yes	NA	NA
Pest animal scats	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
Noxious weed count	Yes	No	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes

5.2 VEGETATION UNITS

The current condition status of the EEC vegetation units at the offset sites, based on monitoring results, is summarised in Table 5-4 below.

Table 5-4 Summary condition status of vegetation units at the offset sites

Vegetation unit	Target status
Snow Gum – Candlebark Woodland structural woodland (SW)	Meets Biometric benchmarks except for dense overstorey cover and fauna habitat. Does not meet native cover or Kangaroo Grass cover targets. Meets bare ground target. Meets Floristic Site Value target.
Snow Gum – Candlebark Woodland secondary grassland high quality (GH)	Meets Biometric benchmarks, except for overstorey cover and fauna habitat. Generally does not meet native cover or Kangaroo Grass cover targets. Meets bare ground target. One grazed and one ungrazed site does not meet the Floristic Site Value target. One grazed site does not meet the sward height target.
Snow Gum – Candlebark Woodland secondary grassland low quality (GL)	Meets Biometric benchmarks, except for overstorey cover and fauna habitat. Does not meet native cover or Kangaroo Grass cover targets, or sward height targets. Meets bare ground target. Generally does not meet the Floristic Site Value target.
Natural Temperate Grassland (Wet Tussock Grassland) (NG)	Generally meets Biometric benchmarks except for high native non-grass cover scores. Does not meet native cover target. Meets bare ground target. Meets Floristic Value Score target.

6 CONCLUSIONS AND RECOMMENDATIONS

6.1 VEGETATION CONDITION

The monitoring results show a general decline in condition in relation to native vegetation cover, grass sward height, species richness, Floristic Site Value scores and abundance of grazing-sensitive species. Scat counts show an increase in macropod activity in both grazed and ungrazed plots.

The results for each of the condition attributes are correlated in Table 6-1 below. With the exception of GH4, all sites with a low sward height and all sites with significantly lowered FSV scores had either stock grazing and/or a high macropod scat count.

Grazing pressure appeared high, and grass sward height appeared low, in both grazed and ungrazed parts of the site (Figure 6-1), indicating factors additional to stock grazing.

Site GH3 with no grazing and relatively low macropod scat counts showed better condition with sward height within target range but still recorded reduced richness and lower abundance of some grazing sensitive indicator species (Figure 6-2). Conversely, the rare shrub *Discaria pubescens* and rare grass *Sorghum leiocladum* had proliferated in this plot. Rabbit scats were detected in GH3.

The results suggest that total grazing pressure in combination with weather and low plant growth rates have operated to reduce condition scores in the 2017 monitoring year.

Species detection rates and abundance estimates are likely to have been affected by an extended dry period which preceded the survey. The mean rainfall for Cooma between April and September is 200.7mm; in 2017 the recorded rainfall was 131.6mm (BOM 2017). The preceding summer was also dry, although March had above average rainfall. In contrast, the April-September period in 2015 recorded 297.9 mm of rainfall at Cooma. The poor flowering season in 2017 was also apparent at other sites on the Southern Tableleands (author pers obs).

Table 6-1 Correlation of condition attributes (shaded = low or declining)

Site	Stock grazing	Sward height	FSV	Scats (macropod)	Sensitive species
SW1	No	NA			
SW2	Yes	NA			
GH1	No				NA
GH2	Yes				NA
GH3	No			rabbits in plot	
GH4	No				
GL1	Yes			rabbits in plot	NA
GL2	Yes				NA
GL3	Yes				
GL4	Yes				
NG1	No	NA			NA
NG2	No	NA			NA

The vegetation at the sites is characteristic of land with a long history of continuous grazing using relatively low stocking rates in large paddocks. Some areas show heavy grazing impacts, while others have retained Kangaroo Grass dominance, scattered shrubs and high levels of groundlayer diversity (including grazing-sensitive species).

Total grazing pressure and prevailing weather conditions have resulted in grass sward heights in grazed parts of the sites which are too low to ensure adequate ecological function and biodiversity protection.

In view of the 2017 monitoring results, it is recommended that stock grazing be suspended for 2018 and not recommence until the average sward height at all sites is at least 10 centimetres.

Figure 6-1 Low sward heights either side of the riparian fenceline, ungrazed and grazed grassland

Figure 6-2 Better condition grassland at GH3 with no stock grazing and with a low macropod scat count

6.1.1 Progress toward condition targets

A summary of progress toward the condition targets in the Offset Management Plan (OMP) for the offset sites overall is provided in Table 6-2.

Table 6-2 Status of progress toward condition targets

Condition indicator	Condition target	Achievement target	Status
Native groundcover	≥80%	December 2017	Not achieved
Bare ground cover	≤10%	December 2017	Achieved
Average sward height	5-10 cm	December 2017	Not achieved
Kangaroo Grass cover	≥50%	December 2019	Not achieved
Floristic richness	SR637 – 20, SR610 - 16	December 2019	Achieved
Floristic Value Score	≥ high floristic value category	December 2019	Not achieved
Pest animal scat count	No occurrences	December 2017	Not achieved
Noxious weed count	No occurrences	December 2017	Not achieved
Grazing-sensitive flora	Abundance maintained or increased	Continuing	Not achieved
Small Snake Orchid	Abundance and area maintained or increased	Continuing	Not achieved

6.2 THREATENING PROCESSES

6.2.1 Pest plants and animals

Serious pest animal activity is occurring at the offset sites. Rabbits should be controlled and harbour destroyed using a low-impact method near sites GH3 and GL1.

Pigs remain a significant threat to biodiversity at the offet sites. Pigs threaten the survival of rare flora species by digging extensive areas for underground sedge, lily and orchid propagules. They threaten the integrity of grassland communities by damaging dominant grass cover and exposing soils to erosion and weed invasion. Pigs are also known to prey on native fauna, including invertebrates, reptiles, frogs and small mammals.

In August 2017 Council undertook a baiting program targeting feral pigs at the offset sites. Advice and participation was sought from the LLS Cooma for the feeding and baiting stages of the program. Initial feeding indications returned high potential kill rates but when baiting was undertaken, baited feed remained untouched. It was assumed that the mob of feral pigs had simply moved on as pig rip activity in the sites had also ceased.

The control of wild pigs at the offset sites should continue, subject to confirmation of fresh or recent digging activity. Pig trapping rather than baiting should be considered at the sites, in cooperation with the LLS and neighbours, until sign of pig presence is infrequent and uncommon. Portable pig traps are available from Bega LLS.

A wombat burrow is present below a small farm dam in the Southern Blocks offset site; refer section 4.6.

The wombat should be humanely trapped and relocated elsewhere in the offset site moved and the burrow remediated to protect the integrity of the dam wall.

Weeds are generally uncommon at the offset sites. Sweet Briar appears to be increasing and St Johns Wort infestations along the highway present a risk to the offset sites.

Sweet Briar should be controlled at the offset sites using a low impact technique, such as cut-stump glyphosate application. The St Johns Wort observed beside the highway, north of a small drainage line near the gate adjacent to site GL3, should be controlled before the plants flower and seed.

6.2.2 Erosion

Erosion is active at each of the monitored erosion sites. At erosion site E1, bare soil at the remediated headcut is vulnerable to further seepage and gullying. Site E4 continues to migrate upslope under the fenceline, threatening to allow cattle into the riparian zone.

The remediated head cut area at site E1 should be revegetated with grass cover. One option is to sow with a fast-growing sterile exotic cover crop together with perennial native grass seed (*Themeda triandra, Microlaena stipoides*, *Poa* spp, *Rytidosperma* spp), and a light hay mulch. Refer to Greening Australia (2003) and Greening Australia (undated). Overland flows should be diverted away from the gully catchment at least 5 metres above the gully head area, for example using staked coir logs.

At site E4, surface flows should also be diverted away from the gully catchment at least 5 metres upslope of the E1 site. The slumping headcut below the fence may require stabilisation and hardening with rock.

Flow diversion, low impact headcut reshaping and sowing of grass seed should also be used to stabilise sites E2 and E3.

6.3 SMALL SNAKE ORCHID

The recorded groundcover at the Small Snake Orchid site has changed from dense exotic Sweet Vernal Grass inflorescences over a low Microlaena-Snow-Grass sward after the construction of the fence and a wet growing season in 2015, prolific old Microlaena flowering stems and reduced Sweet Vernal Grass in 2016 and reduced overall grass cover and higher litter cover in a sward dominated by ageing Snow Grass tussocks in 2017. Between 2014 and 2017, the visible orchid population size each year was 9, 17, 26 and 8.

The changes in groundcover and orchid population reflect differences in rainfall between years, and the exclusion of grazing from the site. The threat from wild pigs is still apparent and the exclusion fence is still necessary to protect the orchid colony. The absence of grazing does however risk damage to the colony through excessive grass biomass.

The Small Snake Orchid population should be managed by:

- controlling the pig threat by trapping at the offset sites, and opening the orchid fence to wild herbivore grazing from March till mid-September, or
- careful spot-burning (protecting the mature trees and fence) or slashing and removing grass cuttings during the above orchid dormancy period, and
- removing eucalypt saplings within the fence using cut stump glyphosate application.

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APPENDIX A MONITORING DATA

Monitoring sites established in each EEC vegetation unit are represented by the following descriptors:

EEC vegetation unit	Monitoring sites
Snow Gum – Candlebark Woodland structural woodland	SW1, SW2 and SW3
Snow Gum – Candlebark Woodland secondary grassland high quality	GH1, GH2, GH3, GH4 and GH5
Snow Gum – Candlebark Woodland secondary grassland low quality	GL1, GL2, GL3 and GL4
Wet Tussock Grassland	NG1 and NG2

A.1 NATIVE PLANT RICHNESS – FLORISTIC QUADRAT SURVEY

Cover/abundance assessments are based on visual estimates of foliage cover (Carnahan 1997), scored using a modified Braun-Blanquet 7-point scale:

Braun-Blanquet cover-abundance scale	
r	Solitary (1-3 individuals), <5% cover
+	Few (4-15), <5% cover
1	Numerous/scattered, <5% cover
2	5 - 25% cover
3	26- 50% cover
4	51 - 75% cover
5	76 - 100% cover

Introduced species or non-local native species are denoted by an asterisk. Noxious weeds declared for the Cooma-Monaro control area under the *Noxious Weeds Act 1993* are indicated with a '†' symbol.

Where uncertainty exists due to the unavailability of reproductive material, the taxon is preceded by a question mark, or plants are identified to genus level only.

Botanical nomenclature follows Harden (1990-2002) and the Sydney Royal Botanic Gardens' PlantNet website. The family classification follows Angiosperm Phylogeny Group III (2009).

A.1.1 Snow Gum Woodland structural woodland

Total number of native species (2014 and 2015 totals in brackets):

SW1 - 44 (46, 62)
SW2 - 33 (31, 44)

Floristic value scores (2014 and 2015 scores in brackets):

SW1 - 53 (45, 62)
SW2 - 29 (23, 44)

Scientific name	Common name	Family	Cover/abundance	
			SW1	SW2
TREES				
Eucalyptus pauciflora	Snow Gum	Myrtaceae	2	3
Eucalyptus rubida	Candlebark	Myrtaceae		r
Eucalyptus stellulata	Black Sally	Myrtaceae	3	
SHRUBS, SUB-SHRUBS				
Acrotriche serrulata	Honeypots	Ericaceae	+	+
Bossiaea foliosa	Leafy Bossiaea	Fabaceae		+
Epacris gunnii	Coral Heath	Ericaceae	2	
Hovea heterophylla	Variable Hovea	Fabaceae	r	r
Leptospermum myrtifolium	Myrtle Tea-tree	Myrtaceae	2	
Leucopogon fraseri		Ericaceae	r	
Melicytus dentatus	Tree Violet	Violaceae		r
Pimelea linifolia ssp *caesia*	Slender Rice Flower	Thymelaeaceae		r
†**Rosa rubiginosa*	Sweet Briar	Rosaceae		+
VINES AND TWINERS				
Glycine clandestine	Twining Glycine	Fabaceae	+	r
FORBS				
Acaena sp		Rosaceae	1	1
**Acetosella vulgaris*	Sheep Sorrel	Polygonaceae		1
Arthropodium milleflorum	Vanilla Lily	Asparagaceae		r
Asperula conferta	Woodruff	Rubiaceae	1	+
Asperula scoparia	Prickly Woodruff	Rubiaceae	1	1
Brachyscome decipiens	Field Daisy	Asteraceae	1	
?Brachyscome scapigera	Tufted Daisy	Asteraceae	r	
Calotis scabiosifolia var *integrifolia*	Rough Burr-Daisy	Asteraceae	r	
Chrysocephalum semipapposum	Clustered Everlasting	Asteraceae	1	
**Cirsium vulgare*	Black Thistle	Asteraceae	r	+
Coronidium scorpioides	Button Everlasting	Asteraceae	1	1
Craspedia canens	Grey Billy Buttons	Asteraceae	1	
Cymbonotus preissianus	Austral Bear's Ear	Asteraceae	+	+
Dianella longifolia	Blue Flax Lily	Hemerocallidaceae		r
Dichondra repens	Kidney Weed	Convolvulaceae	1	
Euchiton japonicus	Creeping Cudweed	Asteraceae	1	
Galium liratum		Rubiaceae	+	1
**Gamochaeta calviceps*	Silky Cudweed	Asteraceae	1	
Geranium antrorsum	Rosetted Crane's-bill	Geraniaceae	1	
Geranium solanderi	Native Geranium	Geraniaceae		+
Gonocarpus tetragynus	Raspwort	Haloragaceae	1	+
Hydrocotyle laxiflora	Stinking Pennywort	Araliaceae	+	1

Scientific name	Common name	Family	Cover/abundance	
			SW1	SW2
Hypericum gramineum	Grassy St John's Wort	Hypericaceae		r
**Hypochaeris radicata*	Catsear, Flatweed	Asteraceae	1	1
Leptorhynchos squamatus ssp squamatus	Scaly Buttons	Asteraceae	1	
Oreomyrrhis eriopoda	Native Carraway	Apiaceae	+	
Oxalis perennans	Wood Sorrel	Oxalidaceae		r
Plantago varia	Variable Plantain	Plantaginaceae	1	1
Poranthera microphylla	Small Poranthera	Euphorbiaceae	1	
Rumex brownii	Native Dock	Polygonaceae	r	
Scleranthus biflorus	Two-flowered Knawel	Caryophyllaceae		r
Scleranthus fasciculatus	Knawel	Caryophyllaceae		+
Senecio prenanthoides		Asteraceae	r	
Solenogyne gunnii	Hairy Solenogyne	Asteraceae	1	
Stylidium graminifolium	Trigger Plant	Stylidiaceae	1	
**Taraxacum officinale*	Dandelion	Asteraceae	r	+
**Trifolium repens*	White Clover	Fabaceae	+	1
Veronica calycina	Hairy Speedwell	Plantaginaceae	1	+
Veronica gracilis	Slender Speedwell	Plantaginaceae		r
Viola betonicifolia	Purple Violet	Violaceae	1	
GRASSES				
Anthosachne scabra	Wheat Grass	Poaceae	+	
**Anthoxanthum odoratum*	Sweet Vernal Grass	Poaceae	2	3
Austrostipa ?bigeniculata	Tall Speargrass	Poaceae	+	
**Bromus hordaceus*	Soft Brome	Poaceae		+
Microlaena stipoides	Weeping Grass	Poaceae	2	2
Poa labillardierei	Silver or River Tussock	Poaceae		+
Poa sieberiana	Snowgrass	Poaceae	4	2
Rytidosperma laeve	Smooth Wallaby Grass	Poaceae	2	
Rytidosperma sp	Wallaby Grass	Poaceae		1
Themeda triandra	Kangaroo Grass	Poaceae	1	1
SEDGES AND RUSHES				
Carex appressa	Tall Sedge	Cyperaceae	r	
Lomandra longifolia	Spiny-headed Mat-rush	Asparagaceae		+
Luzula densiflora	Woodrush	Juncaceae	+	
Schoenus apogon	Bog Sedge	Cyperaceae	+	

A.1.2 Snow Gum Woodland secondary grassland - high diversity

Total number of native species (2014 and 2015 totals in brackets):

GH1 - 22 (38, 46)
GH2 - 29 (23, 34)
GH3 - 39 (43, 48)
GH4 - 25 (43, 44)

Floristic value scores (2014 and 2015 scores in brackets):

GH1 - 16 (26, 30)
GH2 - 25 (24, 32)
GH3 - 53 (37, 52)
GH4 - 17 (29, 43)

Scientific name	Common name	Family	Cover/abundance			
			GH1	GH2	GH3	GH4
SHRUBS, SUB-SHRUBS						
Discaria pubescens	Australian Anchor Plant	Rhamnaceae			1	
Hovea heterophylla	Variable Hovea	Fabaceae			+	
Leptospermum myrtifolium	Myrtle Tea-tree	Myrtaceae	+			
Leucopogon fraseri	Beard-heath	Ericaceae	r	r	1	
Melicytus dentatus	Tree Violet	Violaceae			r	
Mirbelia oxylobioides	Mountain Mirbelia	Fabaceae		2		
Pimelea linifolia ssp *caesia*	Slender Rice Flower	Thymelaeaceae			1	
†**Rosa rubiginosa*	Sweet Briar	Rosaceae			+	
Rubus parvifolius	Native Raspberry	Rosaceae			+	
FORBS						
Acaena novae-zelandiae	Bidgee Widgee	Rosaceae			1	
Acaena sp		Rosaceae	1	+	1	+
**Acetosella vulgaris*	Sheep Sorrel	Polygonaceae	1	1	1	1
Ajuga australis	Austral Bugle	Lamiaceae			+	
Asperula conferta	Woodruff	Rubiaceae	1	1		1
Asperula scoparia	Prickly Woodruff	Rubiaceae			1	1
Bulbine sp	Bulbine Lily	Asphodelaceae		r		
Calotis scabiosifolia var *integrifolia*	Rough Burr-Daisy	Asteraceae			+	
Chrysocephalum apiculatum	Yellow Buttons	Asteraceae	1	1	1	1
Chrysocephalum semipapposum	Clustered Everlasting	Asteraceae	r	r		
**Cirsium vulgare*	Spear Thistle	Asteraceae	r			
Coronidium scorpioides	Button Everlasting	Asteraceae	1			
Cymbonotus sp	Bear's Ear	Asteraceae	1		r	
Dichondra repens	Kidney Weed	Convolvulaceae				1
Epilobium billardierianum ssp *cinereum*	Willow Herb	Onagraceae		r	r	
**Erodium cicutarium*	Common Stork's-bill	Geraniaceae	1			
Euchiton japonicus	Creeping Cudweed	Asteraceae		+		1
Galium liratum		Rubiaceae			1	
**Gamochaeta calviceps*	Silky Cudweed	Asteraceae	1			
Geranium antrorsum	Rosetted Crane's-bill	Geraniaceae	1	r	1	2
Geranium solanderi	Native Geranium	Geraniaceae	1	+	+	
Gonocarpus tetragynus	Raspwort	Haloragaceae		1	1	+
Hydrocotyle sibthorpioides	Shining Pennywort	Araliaceae				+
Hypericum gramineum	Native St John's Wort	Hypericaceae		r	+	
**Hypochaeris radicata*	Catsear, Flatweed	Asteraceae	1	1	1	2
Leptorhynchos squamatus ssp *squamatus*	Scaly Buttons	Asteraceae		2	1	
Oreomyrrhis eriopoda	Australian Carraway	Apiaceae			r	
Oxalis perennans	Wood Sorrel	Oxalidaceae	+	r		r
**Petrorhagia nanteuilii*	Proliferous Pink	Caryophyllaceae	r			
Plantago varia	Variable Plantain	Plantaginaceae	1	1	1	1

Scientific name	Common name	Family	Cover/abundance			
			GH1	GH2	GH3	GH4
Polygala japonica	Dwarf Milk-wort	Polygalaceae			r	
Pterostylis bicolor	Black-tip Greenhood	Orchidaceae		r		
Rumex brownii	Native Dock	Polygonaceae	r	r		r
Scleranthus biflorus	Two-flowered Knawel	Caryophyllaceae	1	r	r	1
Scleranthus fasciculatus	Knawel	Caryophyllaceae		r		r
Solenogyne gunnii	Hairy Solenogyne	Asteraceae	1	1	1	1
Stylidium graminifolium	Grass Trigger-plant	Stylidiaceae			1	
Swainsona monticola	Notched Swainson-pea	Fabaceae			r	
**Taraxacum officinale*	Dandelion	Asteraceae	+			
**Trifolium arvense*	Haresfoot Clover	Fabaceae	1		1	1
**Trifolium dubium*	Yellow Clover	Fabaceae	1	1	1	1
**Trifolium subterraneum*	Subterranean Clover	Fabaceae	1	+		
**Verbascum thapsus*	Great Mullein	Scrophulariaceae	r			
Veronica gracilis	Slender Speedwell	Plantaginaceae	1		+	
Viola betonicifolia	Purple Violet	Violaceae			+	
Vittadinia muelleri	New Holland Daisy	Asteraceae	1	r	1	+
Wahlenbergia planiflora	Flat Bluebell	Campanulaceae			+	
GRASSES						
**Aira caryophyllea*	Hair Grass	Poaceae	1	1	+	
**Anthoxanthum odoratum*	Sweet Vernal Grass	Poaceae	2	1	2	2
Austrostipa sp	Spear Grass	Poaceae			+	
**Holcus lanatus*	Yorkshire Fog	Poaceae				r
Microlaena stipoides	Weeping Grass	Poaceae	3	2	1	2
Poa labillardierei	Silver or River Tussock	Poaceae	2	r		2
Poa sieberiana	Snowgrass	Poaceae	2	2	3	2
Rytidosperma sp	Wallaby Grass	Poaceae	2	1	2	
Sorghum leiocladum	Wild Sorghum	Poaceae			1	
Themeda triandra	Kangaroo Grass	Poaceae	3	4	4	4
**Vulpia sp*		Poaceae		+		
SEDGES AND RUSHES						
Carex appressa	Tall Sedge	Cyperaceae				r
Carex breviculmis	Short-flowered Sedge	Cyperaceae	+			
Carex sp		Cyperaceae		+		r
Juncus filicaulis	Pinrush	Juncaceae				+
Juncus sp		Juncaceae				+
Luzula densiflora	Woodrush	Juncaceae		1	+	
Luzula sp	Woodrush	Juncaceae				+
Schoenus apogon	Bog Sedge	Cyperaceae			1	
FERNS AND FERN ALLIES						
Ophioglossum lusitanicum	Adder's Tongue	Ophioglossaceae		+		

A.1.3 Snow Gum Woodland secondary grassland - low diversity

Total number of native species (2014 and 2015 totals in brackets):

GL1 - 24 (30, 41)
GL2 - 25 (26, 34)
GL3 - 20 (19, 33)
GL4 - 26 (27, 31)

Floristic value scores (2014 and 2015 scores in brackets):

GL1 - 20 (12, 21)
GL2 - 11 (17, 15)
GL3 - 12 (6, 15)
GL4 - 17 (10, 21)

Scientific name	Common name	Family	Cover/abundance			
			GL1	GL2	GL3	GL4
SHRUBS, SUBSHRUBS						
Leucopogon fraseri	Beard-heath	Ericaceae	1			
Mirbelia oxylobioides	Mountain Mirbelia	Fabaceae	1			
†**Rosa rubiginosa*	Sweet Briar	Rosaceae			+	
FORBS						
Acaena sp		Rosaceae	1	1	1	1
**Acetosella vulgaris*	Sheep Sorrel	Polygonaceae	1	1	1	1
Asperula conferta	Woodruff	Rubiaceae		1	+	1
Brachyscome scapigera	Tufted Daisy	Asteraceae				r
Bulbine sp	Bulbine Lily	Asphodelaceae				r
**Centaurium erythraea*	Centaury	Gentianaceae			r	
Chrysocephalum apiculatum	Yellow Buttons	Asteraceae				1
Chrysocephalum semipapposum	Clustered Everlasting	Asteraceae	+			
Cymbonotus preissianus	Austral Bear's Ear	Asteraceae		1	1	
Cymbonotus sp	Bear's Ear	Asteraceae				r
Diuris monticola	Mountain Golden Moths	Orchidaceae				r
Epilobium billardierianum ssp *cinereum*	Willow Herb	Onagraceae	r			r
**Erodium cicutarium*	Common Stork's-bill	Geraniaceae	+			
Euchiton japonicus	Creeping Cudweed	Asteraceae	1	1	1	1
Galium sp		Rubiaceae		1	+	
**Gamochaeta* sp	Cudweed	Asteraceae		r		
Geranium antrorsum	Rosetted Crane's-bill	Geraniaceae		1	+	1
Geranium solanderi	Native Geranium	Geraniaceae	r		+	
Gonocarpus tetragynus	Raspwort	Haloragaceae	r			
Haloragis heterophylla	Rough Raspwort	Haloragaceae		+		
Hydrocotyle laxiflora	Stinking Pennywort	Araliaceae	+			1
Hydrocotyle sibthorpioides	Shining Pennywort	Araliaceae		+		
Hypericum gramineum	Grassy St John's Wort	Hypericaceae	r			
**Hypochaeris radicata*	Catsear, Flatweed	Asteraceae	1	1	1	1
Oxalis perennans	Wood Sorrel	Oxalidaceae	+			
**Petrorhagia nanteuilii*	Proliferous Pink	Caryophyllaceae	r			
Plantago varia	Variable Plantain	Plantaginaceae	1	1	1	+
Rumex brownii	Native Dock	Polygonaceae		+	r	
**Salvia verbenaca*	Wild Sage	Lamiaceae			1	
Scleranthus biflorus	Two-flowered Knawel	Caryophyllaceae	1	1	1	+
Scleranthus fasciculatus	Knawel	Caryophyllaceae	1		+	+
Solenogyne gunnii	Hairy Solenogyne	Asteraceae		1	1	+
**Taraxacum officinale*	Dandelion	Asteraceae		+	1	r
**Trifolium arvense*	Haresfoot Clover	Fabaceae	1	1	1	1
**Trifolium dubium*	Yellow Clover	Fabaceae	1	1	1	1
**Trifolium repens*	White Clover	Fabaceae				1
**Trifolium subterraneum*	Subterranean Clover	Fabaceae				1
Veronica gracilis	Slender Speedwell	Plantaginaceae				r

Scientific name	Common name	Family	Cover/abundance			
			GL1	GL2	GL3	GL4
Vittadinia muelleri	Fuzzweed	Asteraceae	1	r	r	
Wahlenbergia gracilis	Sprawling Bluebell	Campanulaceae	r			
GRASSES						
**Aira caryophyllea*	Hair Grass	Poaceae	1	+	+	+
Anthosachne scabra	Wheat Grass	Poaceae	r			r
**Anthoxanthum odoratum*	Sweet Vernal Grass	Poaceae	1	2	1	2
Austrostipa sp	Spear Grass	Poaceae	+	+		
Microlaena stipoides	Weeping Grass	Poaceae	3	3	4	4
Poa labillardierei	Silver or River Tussock	Poaceae		3	3	2
Poa sieberiana	Snowgrass	Poaceae	2	2	1	2
Rytidosperma sp	Wallaby Grass	Poaceae	1	1		1
Sorghum leiocladum	Native Sorghum	Poaceae	+			
Themeda triandra	Kangaroo Grass	Poaceae	3	2	1	3
**Vulpia* sp		Poaceae	1			
SEDGES AND RUSHES						
Carex appressa	Tall Sedge	Cyperaceae		r	1	+
Carex breviculmis	Short-flowered Sedge	Cyperaceae	2			
Carex sp		Cyperaceae			r	r
Juncus filicaulis	Pinrush	Juncaceae		r		r
Juncus sp	Rush	Juncaceae		r		r
Luzula sp	Woodrush	Juncaceae		+	+	
Schoenus apogon	Bog Sedge	Cyperaceae		+		
FERNS AND FERN ALLIES						
Ophioglossum lusitanicum	Adder's Tongue	Ophioglossaceae		r		

A.1.4 Natural Temperate Grassland (Wet Tussock association) - NG

Total number of native species (2014 and 2015 totals in brackets):

NG1 - 22 (21, 28)

NG2 - 18 (22, 24)

Floristic value scores (2014 and 2015 scores in brackets):

NG1 - 20 (21, 31)

NG2 - 22 (17, 26)

Scientific name	Common name	Family	Cover/abundance	
			NG1	NG2
FORBS				
Acaena novae-zelandiae	Bidgee Widgee	Rosaceae		+
Acaena sp		Rosaceae	r	
**Acetosella vulgaris*	Sheep Sorrel	Polygonaceae		+
Asperula conferta	Woodruff	Rubiaceae	1	+
?Brachyscome scapigera	Tufted Daisy	Asteraceae		+
Cardamine paucijuga	Annual Bitter-cress	Brassicaceae		1
**Cerastium vulgare*	Mouse-ear Chickweed	Caryophyllaceae		r
**Cirsium vulgare*	Black Thistle	Asteraceae	r	+
Dichondra repens	Kidney Weed	Convolvulaceae	1	
Euchiton japonicus	Creeping Cudweed	Asteraceae	1	1
Geranium antrorsum	Rosetted Crane's-bill	Geraniaceae	+	+

Scientific name	Common name	Family	Cover/abundance	
			NG1	NG2
Geranium solanderi	Native Geranium	Geraniaceae	r	
Haloragis heterophylla	Rough Raspwort	Haloragaceae	+	
Hydrocotyle sibthorpioides	Shining Pennywort	Araliaceae	2	2
Hypericum japonicum	Small St John's Wort	Hypericaceae	1	2
**Hypochaeris radicata*	Catsear, Flatweed	Asteraceae	1	1
Hypoxis hygrometrica	Weathergrass, Golden Star	Hypoxidaceae		+
Neopaxia australasica	White Purslane	Portulacaceae	1	+
**Prunella vulgaris*	Selfheal	Lamiaceae		1
Ranunculus pimpinellifolius	Bog Buttercup	Ranunculaceae	1	+
Rumex brownii	Native Dock	Polygonaceae	r	
**Taraxacum officinale*	Dandelion	Asteraceae	+	+
**Trifolium dubium*	Yellow Clover	Fabaceae	+	
**Trifolium repens*	White Clover	Fabaceae	1	1
**Trifolium* sp	Clover	Fabaceae		1
Viola betonicifolia	Purple Violet	Violaceae	+	
GRASSES				
**Aira caryophyllea*	Hair Grass	Poaceae	1	
**Anthoxanthum odoratum*	Sweet Vernal Grass	Poaceae	2	2
**Holcus lanatus*	Yorkshire Fog	Poaceae	1	2
Microlaena stipoides	Weeping Grass	Poaceae	2	2
**Paspalum dilatatum*	Paspalum	Poaceae	+	1
Poa labillardierei	Silver or River Tussock	Poaceae	3	2
Poa sieberiana	Snowgrass	Poaceae	1	+
Themeda triandra	Kangaroo Grass	Poaceae	1	1
SEDGES AND RUSHES				
Carex appressa	Tall Sedge	Cyperaceae		r
Carex chlorantha	Green-top Sedge	Cyperaceae	2	1
Carex gaudichaudiana	Fen Sedge	Cyperaceae		1
Juncus falcatus	Sickle-leaf Rush	Juncaceae	+	
Juncus filicaulis	Pin Rush	Juncaceae	r	
Juncus ?usitatus	Common Rush	Juncaceae		3
Juncus sp		Juncaceae	2	
Schoenus apogon	Bog Sedge	Cyperaceae	1	

A.2 COVER RESULTS

A.2.1 Snow Gum Woodland structural woodland – SW1

Ground cover and understorey

Stratum	Percent cover	
	2015	2017
Native groundcover (grasses)	42	36
Native groundcover (other)	10	8
Native shrubs (<1m)	2	2
Exotic species (groundcover)	30	10
Exotic species (mid/overstorey)	0	0
Litter	16	44
Rock (E- embedded, S – surface)	0	
Bare ground	0	0
River Tussock cover (%)	0	0
Kangaroo Grass cover (%)	2	2
Total native groundcover (%)	52	46
Proportion native groundcover (%)	63	82

Midstorey and overstorey cover

Stratum	Percent foliage cover (average)	
	2015	2017
Midstorey	0	0
Overstorey	39	35.5

A.2.2 Snow Gum Woodland structural woodland – SW2

Ground cover and understorey

Stratum	Percent cover	
	2015	2017
Native groundcover (grasses)	34	12
Native groundcover (other)	12	2
Native shrubs (<1m)	0	4
Exotic species (groundcover)	26	10
Exotic species (mid/overstorey)	0	0
Litter	20	64
Rock (E- embedded, S – surface)	6 (E)	8 (E)
Bare ground	0	0
River Tussock cover (%)	6	0
Kangaroo Grass cover (%)	2	2
Total native groundcover (%)	46	18
Proportion native groundcover (%)	64	64.3

Midstorey and overstorey cover

Stratum	Percent foliage cover (average)	
	2015	2017
Midstorey	0	0
Overstorey	39.5	40

A.2.3 Snow Gum Woodland secondary grassland high diversity - GH1

Ground cover and understorey

Stratum	Percent cover	
	2015	2017
Native groundcover (grasses)	60	68
Native groundcover (other)	14	4
Native shrubs (<1m)	0	0
Exotic species (groundcover)	24	10
Exotic species (mid/overstorey)	0	0
Litter	2	18
Rock (E- embedded, S – surface)	0	0
Bare ground	0	0
River Tussock cover (%)	26	10
Kangaroo Grass cover (%)	16	6
Total native groundcover (%)	74	72
Proportion native groundcover (%)	76	87.8

Midstorey and overstorey cover

Stratum	Percent foliage cover (average)	
	2015	2017
Midstorey	0	0
Overstorey	0	0

Groundcover sward height (cm)

Maximum (cm)		Minimum (cm)		Ave. sward height (cm)	
2015	2017	2015	2017	2015	2017
13	6	4	4.5	7.9	5.45

A.2.4 Snow Gum Woodland secondary grassland high diversity – GH2

Ground cover and understorey

Stratum	Percent cover	
	2015	2017
Native groundcover (grasses)	58	68
Native groundcover (other)	8	8
Native shrubs (<1m)	10	2
Exotic species (groundcover)	22	10
Exotic species (mid/overstorey)	0	0

Litter	2	12
Rock (E- embedded, S – surface)	0	0
Bare ground	0	0
River Tussock cover (%)	2	0
Kangaroo Grass cover (%)	44	56
Total native groundcover (%)	66	78
Proportion native groundcover (%)	75	88.6

Midstorey and overstorey cover

Stratum	Percent foliage cover (average)	
	2015	2017
Midstorey	0	0
Overstorey	0	0

Groundcover sward height (cm)

Maximum (cm)		Minimum (cm)		Ave. sward height (cm)	
2015	2017	2015	2017	2015	2017
10	7	4	4	6.4	5.4

A.2.5 Snow Gum Woodland secondary grassland high diversity – GH3

Ground cover and understorey

Stratum	Percent cover	
	2015	2017
Native groundcover (grasses)	70	62
Native groundcover (other)	14	12
Native shrubs (<1m)	0	0
Exotic species (groundcover)	8	10
Exotic species (mid/overstorey)	0	0
Litter	2	8
Rock (E- embedded, S – surface)	8 (E)	8 (E), 2 (S)
Bare ground	0	0
River Tussock cover (%)	2	2
Kangaroo Grass cover (%)	36	20
Total native groundcover (%)	84	74
Proportion native groundcover (%)	91	88.1

Midstorey and overstorey cover

Stratum	Percent foliage cover (average)	
	2015	2017
Midstorey	0	0
Overstorey	0	0

Groundcover sward height (cm)

Maximum (cm)		Minimum (cm)		Ave. sward height (cm)	
2015	2017	2015	2017	2015	2017
12	7	0	2.5	5.5	5.4

A.2.6 Snow Gum Woodland secondary grassland high diversity – GH4

Ground cover and understorey

Stratum	Percent cover	
	2015	2017
Native groundcover (grasses)	76	76
Native groundcover (other)	12	6
Native shrubs (<1m)	0	0
Exotic species (groundcover)	6	6
Exotic species (mid/overstorey)	0	0
Litter	4	12
Rock (E- embedded, S – surface)	0	0
Bare ground	2	0
River Tussock cover (%)	4	4
Kangaroo Grass cover (%)	48	48
Total native groundcover (%)	88	82
Proportion native groundcover (%)	94	93.2

Midstorey and overstorey cover

Stratum	Percent foliage cover (average)	
	2015	2017
Midstorey	0	0
Overstorey	0	0

Groundcover sward height (cm)

Maximum (cm)		Minimum (cm)		Ave. sward height (cm)	
2015	2017	2015	2017	2015	2017
7	5	1	3.5	4.3	3.9

A.2.7 Snow Gum Woodland secondary grassland low diversity - GL1

Ground cover and understorey

Stratum	Percent cover	
	2015	2017
Native groundcover (grasses)	40	48
Native groundcover (other)	28	8
Native shrubs (<1m)	2	0
Exotic species (groundcover)	18	6
Exotic species (mid/overstorey)	0	0
Litter	8	34
Rock (E- embedded, S – surface)	0	0
Bare ground	4	4
River Tussock cover (%)	0	0
Kangaroo Grass cover (%)	16	14
Total native groundcover (%)	68	56
Proportion native groundcover (%)	79	90.3

Midstorey and overstorey cover

Stratum	Percent foliage cover (average)	
	2015	2017
Midstorey	0	0
Overstorey	0	0

Groundcover sward height (cm)

Maximum (cm)		Minimum (cm)		Ave. sward height (cm)	
2015	2017	2015	2017	2015	2017
8	4	3	2	4.3	2.85

A.2.8 Snow Gum Woodland secondary grassland low diversity – GL2

Ground cover and understorey

Stratum	Percent cover	
	2015	2017
Native groundcover (grasses)	54	42
Native groundcover (other)	10	4
Native shrubs (<1m)	0	0
Exotic species (groundcover)	26	22
Exotic species (mid/overstorey)	0	0
Litter	0	16
Rock (E- embedded, S – surface)	10	10
Bare ground	0	6
River Tussock cover (%)	14	10
Kangaroo Grass cover (%)	10	10
Total native groundcover (%)	64	46
Proportion native groundcover (%)	71	67.6

Midstorey and overstorey cover

Stratum	Percent foliage cover (average)	
	2015	2017
Midstorey	0	0
Overstorey	0	0

Groundcover sward height (cm)

Maximum (cm)		Minimum (cm)		Ave. sward height (cm)	
2015	2017	2015	2017	2015	2017
12	5	1	1	4.7	2.25

A.2.9 Snow Gum Woodland secondary grassland low diversity – GL3

Ground cover and understorey

Stratum	Percent cover	
	2015	2017
Native groundcover (grasses)	48	50
Native groundcover (other)	10	10
Native shrubs (<1m)	0	0
Exotic species (groundcover)	36	16
Exotic species (mid/overstorey)	0	0
Litter	4	22
Rock (E- embedded, S – surface)	0	0
Bare ground	0	2
River Tussock cover (%)	12	8
Kangaroo Grass cover (%)	4	8
Total native groundcover (%)	68	60
Proportion native groundcover (%)	52	78.9

Midstorey and overstorey cover

Stratum	Percent foliage cover (average)	
	2015	2017
Midstorey	0	0
Overstorey	0	0

Groundcover sward height (cm)

Maximum (cm)		Minimum (cm)		Ave. sward height (cm)	
2015	2017	2015	2017	2015	2017
5	5	1.5	1.5	2.95	2.85

A.2.10 Snow Gum Woodland secondary grassland low diversity – GL4

Ground cover and understorey

Stratum	Percent cover	
	2015	2017
Native groundcover (grasses)	52	58
Native groundcover (other)	24	8
Native shrubs (<1m)	0	0
Exotic species (groundcover)	10	24
Exotic species (mid/overstorey)	0	0
Litter	2	6
Rock (E- embedded, S – surface)	0	0
Bare ground	12	2
River Tussock cover (%)	6	4
Kangaroo Grass cover (%)	12	16
Total native groundcover (%)	76	66
Proportion native groundcover (%)	88	73.3

Midstorey and overstorey cover

Stratum	Percent foliage cover (average)	
	2015	2017
Midstorey	0	0
Overstorey	0	0

Groundcover sward height (cm)

Maximum (cm)		Minimum (cm)		Ave. sward height (cm)	
2015	2017	2015	2017	2015	2017
5	5	3	3.5	3.8	3.65

A.2.11 Wet Tussock Grassland - NG1

Ground cover and understorey

Stratum	Percent cover	
	2015	2017
Native groundcover (grasses)	44	26
Native groundcover (other)	44	28
Native shrubs (<1m)	0	0
Exotic species (groundcover)	10	30
Exotic species (mid/overstorey)	0	0
Litter	0	8
Rock (E- embedded, S – surface)	0	0
Bare ground	2	8
River Tussock cover (%)	32	10
Kangaroo Grass cover (%)	0	0
Total native groundcover (%)	88	54
Proportion native groundcover (%)	90	64.3

Midstorey and overstorey cover

Stratum	Percent foliage cover (average)	
	2015	2017
Midstorey	0	0
Overstorey	0	0

A.2.12 Wet Tussock Grassland - NG2

Ground cover and understorey

Stratum	Percent cover	
	2015	2017
Native groundcover (grasses)	28	20
Native groundcover (other)	58	44
Native shrubs (<1m)	0	0
Exotic species (groundcover)	8	32
Exotic species (mid/overstorey)	0	0

Litter	0	2
Rock (E- embedded, S – surface)	0	0
Bare ground	6	0
River Tussock cover (%)	20	12
Kangaroo Grass cover (%)	0	0
Total native groundcover (%)	86	64
Proportion native groundcover (%)	91	66.7

Midstorey and overstorey cover

Stratum	Percent foliage cover (average)	
	2015	2017
Midstorey	0	0
Overstorey	0	0

A.3 FAUNA HABITATS (2014)

Monitoring site	Length of fallen logs in plot (m)	No. hollow-bearing trees in plot (m)
SW1	23.5	1?
SW2	78.5	1
GH1	0	0
GH2	0	0
GH3	0	0
GH4	0	0
GL1	0	0
GL2	0	0
GL3	0	0
GL4	0	0
NG1	0	0
NG2	17	0

A.4 PEST PLANT AND ANIMAL SCAT TRANSECTS

M- macropod
C – cow
S - sheep
R – rabbit
W - wombat

Monitoring site	Noxious weeds		Scat count	
	2015	2017	2015	2017
SW1	0	0	2C	4M, W1
SW2	0	0	3M, 4C	10M, 2C
GH1	0	0	M2	15M
GH2	0	0	M1, C2	10M,3C
GH3	0	0	M2, C2	6M
GH4	0	0	M3, C1, R1	5M, 2C
GL1	0	0	6M, 4C, R1	17M, 1C, 20R
GL2	0	0	3M, C8	33M, 3C
GL3	0	0	6C, M2	13M, 4C
GL4	0	0	1M, 4C	4M, 4C
NG1	0	0	6C	14M, 2W
NG2	0	0	1M, 2C	3M

A.5 OVERSTOREY REGENERATION (WHOLE VEGETATION UNITS)

- 2014 data

Vegetation unit	Overstorey regeneration	Species
SW	3/3	*Eucalyptus pauciflora, E. stellulata, E. rubida*
GH	Not applicable	
GL	Not applicable	
NG	Not applicable	

APPENDIX B PHOTOPOINT PHOTOGRAPHS

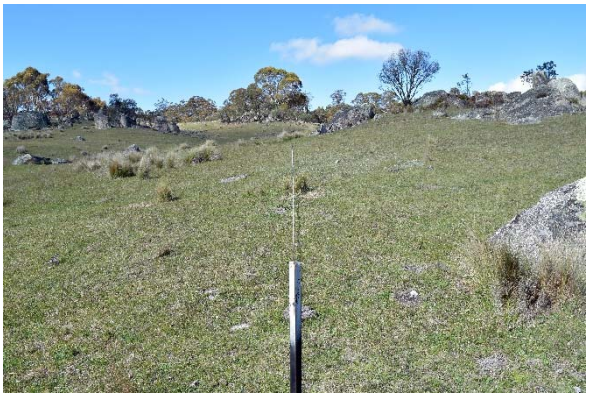
SW1

SW2

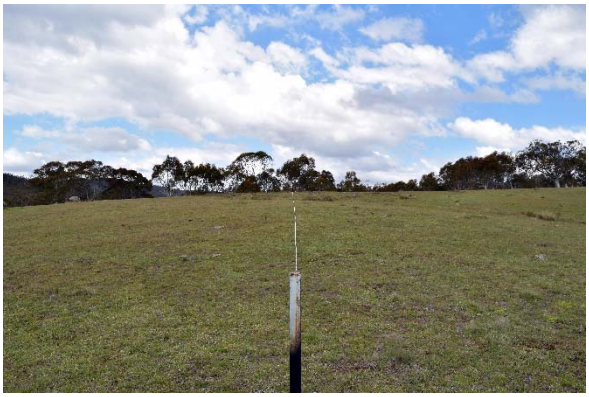
GH1

GH2

GH3



GH4



GL1

GL2

GL3

GL4

NG1

NG2