

Ref: S2-FGJV-DPE-LET-0027

Date: 4 May 2023

Department of Planning, Industry and
Environment 4 Parramatta Square, 12 Darcy
Street PARRAMATTA, NSW 2150

Attention: Katrina O'Reilly
Team Leader Compliance

Project: Snowy 2.0 Main Works – CSSI 9687

Subject: R5 Over-disturbance Rehabilitation Update

Reference: [1] S2-FGJV-FRM-0024, dated 20 August 2021
[2] S2-FGJV-ENV-DPIE-LET-0011, dated 8 November 2021
[3] S2-FGJV-ENV-DPIE-LET-0012, dated 13 December 2021
[4] S2-FGJV-ENV-DPIE-LET-0020, dated 23 September 2022

Dear Katrina,

On 20 August 2021 disturbance outside the approved construction boundary was identified at R5 along Ravine Road. In the notification provided to the Department of Planning and Environment (DPE) on the 27 August 2021 [1], Future Generation Joint Venture (FGJV) stated that progress updates for the rehabilitation of this area would be provided. Updates were provided for September/October [2] and November/December [3] 2021 regarding the status of the revegetation of the area. In 2022 the Project Ecologists reviewed the over disturbed area at R5 and noted that the winter months detrimentally impacted juvenile plants. And that weed spraying and further planting were required.

In 2023 the Project Ecologists further reviewed the over disturbed area at R5 and noted:

- All monitoring plots show moderate native species richness with an average of 21 species being present.
- Habitat features were installed.

The over disturbed area was included in the weed spraying program in 2023 however, this reduced the planting window planting additional juvenile species prior to the winter. The Project ecologist has identified a list of trees, shrubs, forbs, grasses, and ferns needed for the four plots to meet the proposed outcome which have been ordered from a local supplier.

The plants that meet species requirements have been ordered, will be delivered to Lobs Hole the first week of September 2023, and will be planted within 2 days of delivery. The Ecologist will perform another annual review to assess regeneration.

Should the Department wish to discuss with FGJV in more detail, please do not hesitate to contact the Environmental Manager, Ellen Porter, on her mobile 0466 876 865 or e.porter@futuregenerationjv.com.au.

Yours sincerely,



Massimo Franceschi
Project Director & Contractor's Representative
Future Generation JV

Attachment 1 – Vegetation Monitoring Report – February 2023



Vegetation Monitoring Report

Snowy 2.0 Main Works – Ravine Road R5 Laydown

Report prepared by Narla Environmental

for Future Generations Joint Venture

March 2023



NARLA

environmental

Report:	Snowy 2.0 Main Works: Vegetation Monitoring Report – Ravine Road R5 Laydown
Prepared for:	Future Generation Joint Venture
Prepared by:	Narla Environmental Pty Ltd
Project no:	FGJV1
Date:	March 2023
Version:	Final v1.0

© Narla Environmental Pty Ltd

Disclaimer

The document may only be used for the purposes for which it was commissioned and in accordance with the Terms of the Engagement for the commission. This report and all information contained within is rendered void if any information herein is altered or reproduced without the permission of Narla Environmental. Unauthorised use of this document in any form whatsoever is prohibited. This report is invalid for submission to any third party or regulatory authorities while it is in draft stage. This document is and shall remain the property of Narla Environmental Pty Ltd. The sole purpose of this report and the associated services performed by Narla Environmental was to undertake yearly monitoring, with the scope of services set out in the contract between Narla Environmental and the client who commissioned this report. That scope of services, as described in this report, was developed with the client who commissioned this report. Any survey of flora and fauna will be unavoidably constrained in a number of respects. In an effort to mitigate those constraints, we applied the precautionary principle described in the methodology section of this report to develop our conclusions. Our conclusions are not therefore based solely upon conditions encountered at the site at the time of the survey. The passage of time, manifestation of latent conditions or impacts of future events may require further examination of the project and subsequent data analysis, and re-evaluation of the data, findings, observations and conclusions expressed in this report. Narla Environmental has prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures and practices at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law. This report should be read in full and no excerpts are to be taken as representative of the findings. No responsibility is accepted by Narla Environmental for use of any part of this report in any other context. The review of legislation undertaken by Narla Environmental for this project does not constitute an interpretation of the law or provision of legal advice. This report has not been developed by a legal professional and the relevant legislation should be consulted and/or legal advice sought, where appropriate, before applying the information in particular circumstances. This report has been prepared on behalf of, and for the exclusive use of, the client who commissioned this report, and is subject to and issued in accordance with the provisions of the contract between Narla Environmental and the client who commissioned this report. Narla Environmental accepts no liability or responsibility whatsoever for, or in respect of, any use of, or reliance upon, this report by any third party. Narla Environmental Pty Ltd has completed this assessment in accordance with the relevant federal, state and local government legislation as well as current industry best practices including guidelines. Narla Environmental Pty Ltd accepts no liability for any loss or damages sustained as a result of reliance placed upon this report and any of its content or for any purpose other than that for which this report was intended.

Narla Environmental Pty Ltd
www.narla.com.au

Report Certification

Works for this report were undertaken by:

Name	Company / Position
Chris Moore <i>BBioCon</i>	Narla Environmental – General Manager/ Senior Ecologist
Sjaak Verstappen <i>BSc</i>	Narla Environmental – Project Manager/ Ecologist
Brodie Miller <i>BA</i>	Narla Environmental – Ecologist
Louise Neville <i>MEnv</i>	Narla Environmental – Ecologist
Elly Baker <i>BEnv</i>	Narla Environmental – Ecologist

Document Control

Revision	Document Name	Issue Date	Document Review
Draft v1.0	Snowy 2.0 Main Works: Preliminary Monitoring Report – Ravine Road R5 Laydown	26/02/23	Chris Moore
Final v1.0	Snowy 2.0 Main Works: Preliminary Monitoring Report – Ravine Road R5 Laydown	7/03/23	Chris Moore

Contents

1. INTRODUCTION	7
1.1 Objectives and Key Performance Indicators	7
1.2 Scope of Works	7
1.3 Minimum Revegetation Outcomes.....	7
2. METHODOLOGY	9
2.1 Stratification of Project Site	9
2.2 Vegetation Monitoring	9
2.3 Fixed Monitoring Photo Points	9
2.4 Study Limitations	10
3. RESULTS	11
3.1 Revegetation Monitoring of Subject Site	11
3.1.1 Plot Species Richness.....	11
3.1.2 Plot Species Abundance	11
3.1.3 Vegetation Cover	11
3.1.1 Exotic Species.....	11
3.1.1 Health of Plantings	11
3.2 Threatened Fauna.....	12
3.3 Trial Plots and Minimum Vegetation Outcomes	12
4. ONGOING MANAGEMENT ACTIONS	16
4.1 Annual Spring Monitoring	20
4.1.1 Reference Sites	20
4.1.2 Annual Monitoring.....	20
5. ACCEPTANCE CRITERIA.....	21
6. RECOMMENDATIONS.....	22
6.1 Weed Control.....	22
6.2 Further Revegetation Works.....	22
6.3 Direct Seeding	22
7. CONCLUSION	23
8. REFERENCES.....	24
9. APPENDICES	25

Figures

Figure 1. Monitoring Plots and Photo Points within the Subject Site. 8

Tables

Table 1. GPS coordinates of fixed photo monitoring points..... 9

Table 2. Vegetation Cover in all Monitoring Plots..... 11

Table 3. Results for Monitoring Plot 1. 12

Table 4. Results for Monitoring Plot 2 13

Table 5. Results for Monitoring Plot 3. 14

Table 6. Results for Monitoring Plot 4. 15

Table 7. Key Performance Indicators 16

Glossary

Acronym/ Term	Definition
BAM	Biodiversity Assessment Method
BAR	Biodiversity Assessment Report
BC Act	<i>Biodiversity Conservation Act 2016</i>
DPE	Department of Planning and Environment (formerly DPIE)
DPIE	Department of Planning, Industry and Environment (now DPE)
ESCP	Erosion and Sediment Control Plan
EWRMP	Exploratory Works Rehabilitation Management Plan
FGJV	Future Generation Joint Venture
ha	Hectares
km	Kilometres
KNP	Kosciusko National Park
KPI	Key Performance Indicators
m	metres
mm	millimetres
NPWS	NSW National Parks and Wildlife Services
NSW	New South Wales
OEH	Office of Environment and Heritage (now DPE)
PCT	Plant Community Type
RP	Revegetation Plan (Narla 2021)

1. Introduction

Narla Environmental Pty Ltd (Narla) was engaged by Future Generation Joint Venture (FGJV) to undertake preliminary vegetation monitoring as part of the Revegetation Plan (RP; Narla 2021) for Ravine Road R5 Laydown within the Snowy 2.0 Project Area (**Figure 1**; hereafter the 'Subject Site').

1.1 Objectives and Key Performance Indicators

The objective of the RP (Narla 2021) was to ensure that the Subject Site is revegetated and rehabilitated in line with the 'Ecological Rehabilitation Objectives' detailed within Appendix C of the Exploratory Works Rehabilitation Management Plan [EWRMP] (FGJV 2020a).

Revegetation works commenced in November 2021, with this report summarising the data collected in the field during the monitoring session in February 2023. This report focuses on the four (4) monitoring plots established in the RP (Narla 2021), with the intention of identifying existing or potential future management issues and to provide recommendations to meet the Rehabilitation Objectives of the EWRMP (FGJV 2020a).

Key Performance Indicators (KPI) have been used as a means to measure and ensure the desired objectives are being achieved for the RP. These are detailed in **Table 7**.

1.2 Scope of Works

The site assessment involved determining the overall condition of native vegetation, species richness and abundance, as well as recording weed species and coverage within the monitoring plot areas. This report details the following:

- Presentation of photographic evidence to illustrate progress of weed management and native regeneration;
- Any weed management issues/ recommendations required to meet performance targets;
- Update work specifications as required to meet targets; and
- Management/ maintenance requirements or recommendations to inform subsequent management of the site (to meet first-year maintenance period requirements and beyond).

1.3 Minimum Revegetation Outcomes

The following are the minimum revegetation outcomes established in the RP (Narla 2021):

- ≥ 4 tree species with 10 individuals of each species to be planted;
- ≥ 6 shrub species with 17 individuals of each species to be planted;
- ≥ 4 grass species with 250 individuals of each species to be planted;
- ≥ 24 forb species with 70 individuals of each species to be planted;
- ≥ 1 fern species with 2 individuals of each species to be planted; and
- ≥ 2 other species with 85 individuals of each species to be planted.

As the revegetation process has occurred in stages, the number of species and total individuals of each species to be planted has changed accordingly. Additionally, any native regeneration present within the Subject Site that has occurred since revegetation works has also been factored into the monitoring report.



Figure 1. Monitoring Plots and Photo Points within the Subject Site.

2. Methodology

2.1 Stratification of Project Site

The Subject Site has been delineated into four permanent monitoring (4) plots as detailed within the RP (Narla 2021; **Figure 1**). Historical vegetation mapping within the Subject Site that was presented in the Biodiversity Assessment Report- Snowy 2.0 Main Works ('the BAR', EMM Consulting 2019) indicated the presence of one (1) Plant Community Type (PCT):

- PCT 1196 – Snow Gum – Mountain Gum shrubby open forest of montane areas, South Eastern Highlands Bioregion and Australian Alps Bioregion.

2.2 Vegetation Monitoring

The field-based site assessment was conducted on the following dates by Narla Ecologists:

- Elly Baker, on the 12th of February 2023.

Monitoring was undertaken in each of the four (4) plots (approximately 125m² per plot) located within the Subject Site to determine species richness, abundance and percentage cover of vegetation across the Subject Site (**Figure 1**). A random quadrat sampling technique was utilised within each monitoring plot, with the methodology outlined as follows:

- Ten 1m² quadrats were randomly placed and growth form abundance was counted.
- Following this, the counts of each growth form were averaged across the 10 quadrats and then multiplied by 125 to represent the entire plot.
- Diversity was assessed through a detailed species list of each plot.

The field pro forma used for monitoring can be found in **Appendix D**.

The following was recorded within each monitoring plot:

- Native and exotic species, including species diversity and abundance;
- Photographic evidence of the regeneration occurring within the management plots;
- An assessment of the condition and survival rate of planted trees and shrubs; and
- The percentage of vegetative cover to assess its regeneration.

2.3 Fixed Monitoring Photo Points

Fixed photo points were utilised within each plot to support monitoring data and track the progress of revegetation works and natural regeneration within the plots across the lifetime of the RP (**Table 1**; **Figure 1**).

Table 1. GPS coordinates of fixed photo monitoring points.

Plot	Latitude	Longitude	Direction Facing
1	-35.847071	148.407607	SE
2	-35.847087	148.407905	SE
3	-35.84714	148.408188	SW
4	-35.847152	148.408171	SE

2.4 Study Limitations

Observations are limited to the date of the 12th of February 2023. Individuals may be missed by randomly spaced quadrats, resulting in under- or over-representative population estimates. As sampling events accumulate, these population estimates are expected to balance out.

3. Results

3.1 Revegetation Monitoring of Subject Site

A complete list of native and exotic flora species was recorded and can be found in **Appendix A** and **Appendix B**.

3.1.1 Plot Species Richness

All monitoring plots show moderate native species richness with an average of 21 species being present. Plot 4 had the highest species richness with 25 species present. In order to reach the required species benchmarks for each type of plant, further planting or direct seeding will need to occur. The current number of species for each growth form and their required benchmarks for the four monitoring plots are detailed in **Table 3**, **Table 4**, **Table 5**, and **Table 6**. As the northern boundary of the Subject Site is adjacent to an area consisting of mostly native vegetation, natural regeneration has contributed to the species richness of the Subject Site.

3.1.2 Plot Species Abundance

Each monitoring plot shows a high level of species abundance; however, this is not distributed evenly across the growth forms. Grass-like and forb species generally dominate each plot whilst all plots contain insufficient shrub numbers, and Plot 1 lacks any tree species. All plots lack fern species and “other” growth forms (e.g., climbers). In order to reach species abundance requirements further planting or direct seeding will need to occur. The total count for each growth still required for each plot is detailed in **Table 3**, **Table 4**, **Table 5**, and **Table 6**. Natural regeneration along the northern boundary of the Subject Site has also contributed to the abundance of species within the plots.

3.1.3 Vegetation Cover

Vegetative cover across all strata (ground, mid-strata and canopy) was recorded within each monitoring plot (**Table 2**).

Table 2. Vegetation Cover in all Monitoring Plots

Monitoring Plot	Vegetative Cover (%)
1	25
2	20
3	35
4	40

3.1.1 Exotic Species

As of the 12th February 2023, exotic species were identified in each plot and their presence is considered to be low. There is considered a high risk of the priority weed *Hypericum perforatum* (St John’s Wort) infiltrating the Subject Site in the future due to infestations present in the areas adjacent to the plots. Environmental weeds *Rumex acetosella* (Red Sorrel) and *Holcus lanatus* (Yorkshire Fog) are also considered a high-risk exotic species given their abundance in nearby disturbed areas and prevalence within the Subject Site.

3.1.1 Health of Plantings

During the February 2023 survey, it was noted that the health of the plantings remains similar since the survey undertaken in September 2022 (Narla 2022). Photos taken in each plot show these similarities by comparing photos from the May 2022, July 2022, September 2022 and February 2023 surveys.

3.2 Threatened Fauna

During the February 2023 monitoring survey, no threatened fauna was observed.

3.3 Trial Plots and Minimum Vegetation Outcomes

The following tables detail the results of each monitoring plot and whether minimum revegetation outcomes have been met.

Table 3. Results for Monitoring Plot 1.

Monitoring Plot 1 (125m ²)							
Growth Form	Current Species Count	Sep 2022 Species Count	Number of species required (Narla 2021)	Current Total Abundance	Sep 2022 Total Abundance	Required Total Abundance of Growth Form (Narla 2021)	Requirements for Revegetation (Narla 2021)
Trees	0	0	4	0	0	10	Need 10 more plants, and 4 more species.
Shrubs	4	6	6	262.5	63	17	Need 2 more species.
Forbs	3	6	24	125	502	70	Need 21 more species.
Grasses	5	5	4	200	312	250	Need 50 more plants.
Fern	0	0	1	0	0	2	Need 2 more plants, and 1 more species.
Other	0	0	2	0	0	85	Need 85 more plants, and 2 more species.
Stakes and plant guards 1 guard per shrub or tree 3 stakes per guard					Yes, removed by Ecologist as no longer required.		
1g/m2 <i>Themeda triandra</i> grass seeds (planting in conjunction with tubestock)					No		

Table 4. Results for Monitoring Plot 2

Monitoring Plot 2 (125m ²)							
Growth Form	Current Species Count	Sep 2022 Species Count	Number of species required (Narla 2021)	Current Total Abundance	Sep 2022 Total Abundance	Required Total Count of Growth Form (Narla 2021)	Requirements for Revegetation (Narla 2021)
Trees	1	0	4	12.5	0	10	Need 3 more species.
Shrubs	4	5	6	212.5	150	17	Need 2 more species.
Forbs	3	10	24	75	373	70	Need 7 more species.
Grasses	3	7	4	187.5	140	250	Need 63 more plants, and 1 more species.
Fern	0	0	1	0	0	2	Need 2 more plants, and 1 more species.
Other	0	0	2	0	0	85	Need 85 more plants, and 2 more species.
Stakes and plant guards 1 guard per shrub or tree 3 stakes per guard					Yes, removed by Ecologist as no longer required.		
1g/m ² <i>Themeda triandra</i> grass seeds (planting in conjunction with tubestock)					No.		

Table 5. Results for Monitoring Plot 3.

Monitoring Plot 3 (125m ²)							
Growth Form	Current Species Count	Sep 2022 Species Count	Number of species required (Narla 2021)	Current Total Abundance	Sep 2022 Total Abundance	Required Total Count of Growth Form (Narla 2021)	Requirements for Revegetation (Narla 2021)
Trees	2	3	4	25	38	10	Need 2 more species.
Shrubs	2	3	6	87.5	25	17	Need 4 more species.
Forbs	6	3	24	62.5	213	70	Need 8 more plants, from 16 species.
Grasses	4	3	4	475	662	250	Requirements Met.
Fern	0	0	1	0	0	2	Need 2 plants, and 1 species.
Other	0	0	2	0	0	85	Need 85 plants, and 2 species.
Stakes and plant guards 1 guard per shrub or tree 3 stakes per guard					Yes, removed by Ecologist as no longer required.		
1g/m ² <i>Themeda triandra</i> grass seeds (planting in conjunction with tubestock)					No.		

Table 6. Results for Monitoring Plot 4.

Monitoring Plot 4 (125m ²)							
Growth Form	Current Species Count	Sep 2022 Species Count	Number of species required (Narla 2021)	Current Total Abundance	Sep 2022 Total Abundance	Required Total Count of Growth Form (Narla 2021)	Requirements for Revegetation (Narla 2021)
Trees	1	3	4	37.5	25	10	Need 3 more species.
Shrubs	4	3	6	37.5	50	17	Need 2 more species.
Forbs	6	6	24	100	237	70	Need 16 more species.
Grasses	5	4	4	475	750	250	Requirements Met.
Fern	0	0	1	0	0	2	Need 2 plants, and 1 species.
Other	0	0	2	0	0	85	Need 85 plants, and 2 species.
Stakes and plant guards 1 guard per shrub or tree 3 stakes per guard					Yes, removed by Ecologist as no longer required.		
1g/m ² <i>Themeda triandra</i> grass seeds (planting in conjunction with tubestock)					No.		

4. Ongoing Management Actions

Table 7 outlines the management requirements and recommendations for each monitoring plot based on a performance review of each KPI. Subsequent reports will outline the progress of these requirements, and provide any recommendations in order to achieve them.

Table 7. Key Performance Indicators

Objective	Key Performance Indicator (KPI)	How this KPI will be assessed	Designated Time frame to meet KPI	Outcome met?	Recommendations	If KPI cannot be met by designated time
Control all priority weeds	The number and cover of weed species is comparable to, or less than, the interquartile range of local reference site values for PCT 1196.	Determined by the Project Ecologist through an annual site assessment in spring.	Yearly, in spring for the life of the RP.	No. Weed spraying was completed in January 2023. Weed Works will continue to occur each year in Spring.	Ongoing monitoring for weed infiltration and implement weed controls as necessary.	FGJV or the appointed subcontractor to perform corrective action, until KPI is met.
Control all environmental weeds	The number and cover of weed species is comparable to, or less than, the interquartile range of local reference site values for PCT 1196.	Determined by the Project Ecologist through an annual site assessment in spring.	Yearly, in spring for the life of the RP.	No. Weed spraying was completed in January 2023. Weed Works will continue to occur each year in Spring.	Ongoing monitoring for weed infiltration and implement weed controls as necessary.	FGJV or the appointed subcontractor to perform corrective action, until KPI is met.
Revegetation preparation	Any imported topsoil is tested by a NARA accredited testing laboratory for containments and any contaminants found must be removed prior to revegetation	Determined by FGJV or appointed subcontractor.	Prior to site revegetation.	Yes	N/A	FGJV or the appointed subcontractor to perform corrective

Objective	Key Performance Indicator (KPI)	How this KPI will be assessed	Designated Time frame to meet KPI	Outcome met?	Recommendations	If KPI cannot be met by designated time
	works. Any imported topsoil should come from a similar 'weed risk area'. The soil profile is restored to pre-construction conditions. All revegetation preparation is to be completed in line with the management requirements outlined within Section 3 of the RP (Narla 2021).					action, until KPI is met.
Revegetation	Revegetation is undertaken in accordance with the strategies outlined in Section 4.4 of the RP. Plantings must be representative of PCT 1196, a list of representative species of PCT 1196 is presented in Table 3 of the RP (Narla 2021). Initial plantings must conform to the Minimum Revegetation Outcomes outlined in Section 3.2.2.1 of the RP (Narla 2021).	Determined by the Project Ecologist through a site assessment after initial revegetation activities.	After initial revegetation activities.	No	In order to reach species abundance and richness requirements further planting or direct seeding will need to occur under the supervision of a Project Ecologist.	FGJV or the appointed subcontractor to perform corrective action, until KPI is met.
Watering Regime	All plantings must be watered sufficiently in line with the watering regime outlined in Section 4.2 of the RP (Narla 2021). Once plantings are established, they should be watered as required during summer months or during periods of drought throughout the year by the FGJV or the appointed subcontractor and staff and overseen by the Project Ecologist.	Determined by a FGJV or appointed subcontractor during environmental compliance checks.	N/A	Yes – plants were adequately watered over summer 22/23.	All new plantings must be watered sufficiently in line with the watering regime outlined in Section 4.2. of the RP. Once plantings are established, they should be watered as required during summer months or during periods of	FGJV or the appointed subcontractor to perform corrective action, until KPI is met.

Objective	Key Performance Indicator (KPI)	How this KPI will be assessed	Designated Time frame to meet KPI	Outcome met?	Recommendations	If KPI cannot be met by designated time
					drought throughout the year by FGJV or the appointed subcontractor.	
Planting Maintenance	All plantings are to be maintained at the Minimum Revegetation Outcomes outlined in Section 3.2.2.1 of the RP (Narla 2021). All plant mortalities must be replaced within the Subject Site where plantings stratum numbers fall below the Minimum Revegetation Outcomes.	Determined by the Project Ecologist and FGJV or appointed subcontractor	Annually for three (3) years in Spring.	No	In order to reach species abundance and richness requirements further planting or direct seeding will need to occur under the supervision of a Project Ecologist.	FGJV or the appointed subcontractor to perform corrective action, to meet KPI.
Fauna Habitat Restoration	Fauna habitat features and resources (food and shelter characteristics) within Subject Site are present and within or greater than the interquartile range of local reference site values for PCT 1196.	Determined by the Project Ecologist through a site assessment in spring.	Within 12 months of revegetation plan implementation	Yes. Habitat features (i.e., hollowed logs) have been installed.	Further planting or direct seeding to meet revegetation outcomes.	FGJV or the appointed subcontractor to perform corrective action, to meet KPI.
Sediment Control	Appropriate erosion and sediment controls must be installed and maintained until the Subject Site has been rehabilitated and suitably stabilised. Erosion and Sediment Control is carried out in accordance with the ESCP. All erosion and sediment controls must be installed prior to revegetation activities beginning.	Determined by FGJV or appointed subcontractor through a site assessment.	Prior to revegetation works and thereafter.	Yes.	Project Ecologist to continue monitoring and report any changes.	FGJV or the appointed subcontractor to perform corrective action, to meet KPI.

Objective	Key Performance Indicator (KPI)	How this KPI will be assessed	Designated Time frame to meet KPI	Outcome met?	Recommendations	If KPI cannot be met by designated time
Annual Monitoring	Annual monitoring in spring in accordance with Section (as per Section 4.5.4 of the RP, Narla 2021).	Determined by the Project Ecologist through a site assessment in spring.	Yearly, in spring for the life of the RP.	Yes.	N/A	FGJV or the appointed subcontractor to engage Project Ecologist to undertake spring annual monitoring.
Reporting	Monitoring report produced in accordance with Section 4.5.4 (Narla 2021).	Project Ecologist submitted Monitoring Report FGJV or appointed subcontractor.	Within an appropriate timeframe following monitoring events.	Yes.	N/A	Project Ecologist to undertake writing of Monitoring Report.

4.1 Annual Spring Monitoring

4.1.1 Reference Sites

In accordance with the Ecological Rehabilitation Objectives of Appendix C of the EWRMP (FGJV 2020), appropriate reference sites should be established outside of the disturbance area within similarly bushfire affected vegetation of the same PCT, as mapped in the Biodiversity Assessment Report (EMM Consulting 2019). Reference sites will be monitored in line with the monitoring methodology of the fixed vegetation monitoring plots in order for the floristic and compositional data to be comparable, as detailed below.

4.1.2 Annual Monitoring

Annual monitoring in spring should be undertaken for all revegetation sites, in line with the EWRMP (FGJV 2020). Revegetation monitoring should be undertaken by the Project Ecologist who will:

- Assess the progress of any weed control works through an annual site visit;
- Establish a 5x5m BAM plot within the reference monitoring plot;
- Establish a 5x5m BAM plot within a fixed monitoring plot within the Subject Site;
- Assess the stability of the Subject Site, including topsoil retention;
- Establish the presence/absence of fauna habitat features (e.g., flowering plants, decorticating bark, stags with hollows and/or nest boxes); and
- Establish photo points to highlight weed and native vegetation cover within fixed vegetation plot, included in annual monitoring reports.

5. Acceptance Criteria

The criteria as outlined below will determine the success of the revegetation program, as determined by annual spring monitoring (**Section 4.1.2**):

- The number and cover of weed species is comparable to, or less than, the interquartile range of local reference site values for PCT 1196;
- Plantings must be representative of PCT 1196 (Appendix B of the RP, Narla 2021);
- Plantings must conform to the Minimum Revegetation Outcomes outlined in **Section 1.3**; and
- Fauna habitat features and resources (food and shelter characteristics) within Subject Site are present and within or greater than the interquartile range of local reference site values for PCT 1196.

6. Recommendations

6.1 Weed Control

The Subject Site is located adjacent to disturbed areas where both native and exotic vegetation is present. Weed growth was observed particularly along the northern boundary which had begun encroaching into the site. As the site still has low levels of vegetation coverage, it is important weeds in adjoining areas and those beginning to encroach inwards are controlled. The removal of the annual priority weed, *Hypericum perforatum* (St. John's-wort), and other environmental weeds from within the Subject Site and nearby areas is recommended to prevent the establishment of exotic weeds in the future. Weed control within the Subject Site should focus around plantings and naturally regenerating natives so exotics do not smother these species. Although weed control was completed in January 2023, ongoing weed management works should continue to take place in Spring each year to control weed levels within the Subject Site.

6.2 Further Revegetation Works

While the Subject Site has improved in overall condition since the initial disturbance, the minimum revegetation outcomes are still yet to be met. Revegetation must also occur in the appropriate planting and seeding period to give them the best chance at survival. The current health of plantings within the Subject Site has been impacted by harsh winter conditions and so it is important future revegetation works are timed so plantings are well established before winter.

6.3 Direct Seeding

The plot design of the RP specifically included the laying of *Themeda triandra* seed (Kangaroo Grass), in order to trial germination success and growth for future revegetation projects. This has yet to be implemented. Soil in areas to be seeded must be well prepared and weed free. Seed should be well integrated into the soil so that it is not carried away by water, wind or fauna.

7. Conclusion

Overall, the vegetation within the Subject Site has improved since the original clearing event with good rates of survival despite difficult winter conditions. However, further orders of tubestock and/or seed for planting still need to occur in order for minimum revegetation outcomes to be met and to replace those plantings which have not survived.

As summer continues it will be important for a weed control program to be implemented to keep environmental and priority weeds to a minimum to give the plantings and any natural regeneration the best possible chance of survival. The design of the Subject Site in terms of the establishment of four (4) distinct monitoring plots, the laying down of specific straw and mulch layers, the installation of habitat features and the fencing of the Subject Site have all been completed as per the plot design (Narla 2021).

8. References

- Costermans, L. (2017). Native trees and shrubs of south-eastern Australia. Sydney: Reed New Holland.
- Department of Primary Industries [DPI] (2022) NSW WeedWise Profiles
- Department of Planning and Environment [DPE] (2022) BioNet Vegetation Classification.
- Future Generation Joint Venture [FGJV] (2020a) Snowy 2.0 Exploratory Works Rehabilitation Management Plan
- Future Generation Joint Venture [FGJV] (2020) Snowy 2.0 Main Works Biodiversity Management Plan.
- Narla Environmental (2021) Revegetation Plan – Ravine Road R5 Laydown.
- Narla Environmental (2022) Snowy 2.0 Main Works: Preliminary Monitoring Report – Ravine Road R5 Laydown
- Office of Environment and Heritage [OEH] (2017) Scarlet Robin – Profile
<https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=20133>
- PlantNET (2022) The NSW Plant Information Network System, Royal Botanic Gardens and Domain Trust, Sydney.
<http://plantnet.rbgsyd.nsw.gov.au>
- Ralph, M. (1997). Growing Australian native plants from seed: for revegetation, tree planting and direct seeding. Fitzroy Vic.: Murray Ralph/Bushland Horticulture.
- Robinson, L. (2003) 'Field Guide to the Native Plants of Sydney', Third Edition, Kangaroo Press.

9. Appendices

Appendix A. Native Flora Inventory.

Appendix B. Exotic Flora Inventory.

Appendix C. Monitoring plot photos taken from fixed points.

Appendix D. Monitoring Pro Forma.

Appendix A. Native Flora Inventory.

Species	Tree	Shrub	Forb	Grass	Fern	Other
<i>Acacia dealbata</i>		x				
<i>Acacia melanoxylon</i>		x				
<i>Acaena novae-zelandiae</i>			x			
<i>Agrostis sp.</i>				x		
<i>Asperula conferta</i>			x			
<i>Bossiaea buxifolia</i>		x				
<i>Carex sp.</i>				x		
<i>Cassinia longifolia</i>		x				
<i>Cassinia uncata</i>		x				
<i>Chloris truncata</i>				x		
<i>Chrysocephalum apiculatum</i>			x			
<i>Cymbonotus lawsonianus</i>			x			
<i>Daviesia latifolia</i>		x				
<i>Derwentia perfoliata</i>			x			
<i>Dianella tasmanica</i>				x		
<i>Eucalyptus dalrympleana</i>	x					
<i>Eucalyptus pauciflora</i>	x					
<i>Eucalyptus robertsonii</i>	x					
<i>Geranium solanderi</i>			x			
<i>Lobelia pedunculata</i>			x			
<i>Lomandra longifolia</i>				x		
<i>Luzula flaccida</i>			x			
<i>Microlaena stipoides</i>				x		
<i>Poa sieberiana</i> var. <i>sieberiana</i>				x		
<i>Ranunculus sp.</i>			x			
<i>Rytidosperma sp.</i>				x		
<i>Senecio linearifolius</i>			x			
<i>Stellaria pungens</i>			x			
<i>Stylidium graminifolium</i>			x			
<i>Themeda triandra</i>				x		
<i>Wahlenbergia stricta</i>			x			

Appendix B. Exotic Flora Inventory.

Species	Common Name
<i>Cardamine hirsuta</i>	Hairy Bittercress
<i>Centaureum erythraea</i>	European Centaury
<i>Holcus lanatus</i>	Yorkshire Fog
<i>Hypericum perforatum</i>	St John's Wort
<i>Oxalis sp.</i>	Wood Sorrel
<i>Plantago lanceolata</i>	Ribwort Plantain
<i>Rumex acetosella</i>	Red Sorrel
<i>Sonchus sp.</i>	Sow Thistle
<i>Taraxacum officinale</i>	Common dandelion
<i>Trifolium arvense</i>	Hare-Foot Clover
<i>Verbascum virgatum</i>	Twiggy Mullein

Appendix C. Monitoring plot photos taken from fixed points.

Monitoring Plot 1 – 23/5/2022



Monitoring Plot 1 – 21/7/2022



Monitoring Plot 1 – 12/02/2023



Monitoring Plot 2 – 23/5/2022



Monitoring Plot 2 – 21/7/2022



Monitoring Plot 2 – 12/02/2023



Monitoring Plot 3 – 23/5/2022



Monitoring Plot 3 – 21/7/2022



Monitoring Plot 3 – 12/02/2023



Monitoring Plot 4 – 23/5/2022



Monitoring Plot 4 – 21/7/2022



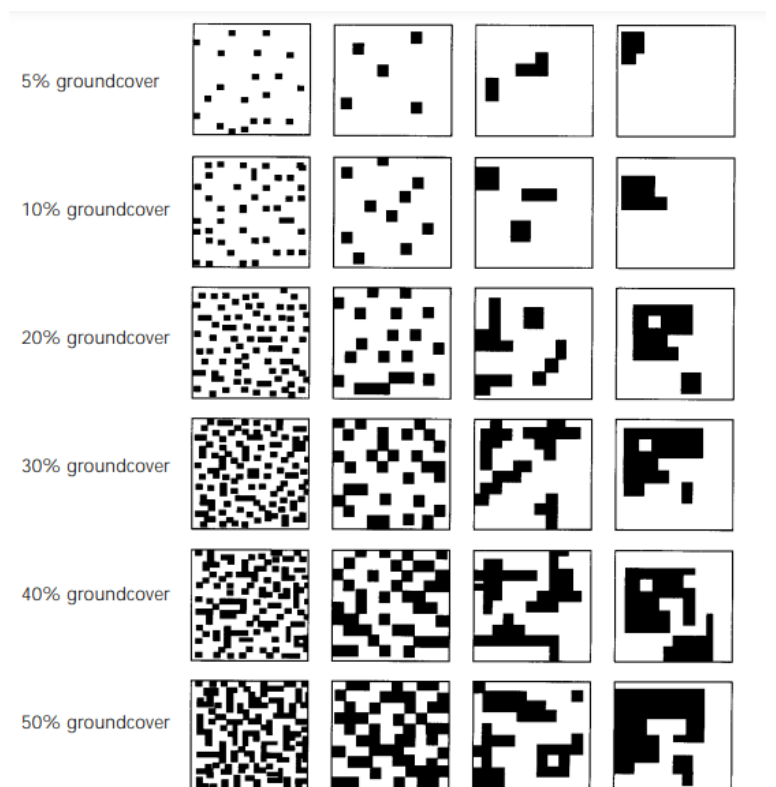
Monitoring Plot 4 – 12/02/2023



Appendix D. Monitoring Pro Forma.

Quadrat #	Number of OTHER (climbers etc)	Number of FERNS	Number of TREES	Number of SHRUBS	Number of FORBS	Number of GRASSES
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

Growth Form	Percentage of cover
Forbs	
Grasses	
Shrubs	
Trees	
Other	
Fern	



T = Tree, S = Shrub, G= Grasses, F = Forbs, Fe = Fern, O = Other

[illegible]



NARLA

environmental

Eastern Sydney Office
Unit 2.01, 4-10 Bridge Street
Pymble
NSW 2073

Western Sydney Office
7 Twenty-Fifth Avenue
West Hoxton
NSW 2171

Hunter Valley Office
10/103 Glenwood Drive
Thornton
NSW 2322

Ph: 02 9986 1295
www.narla.com.au