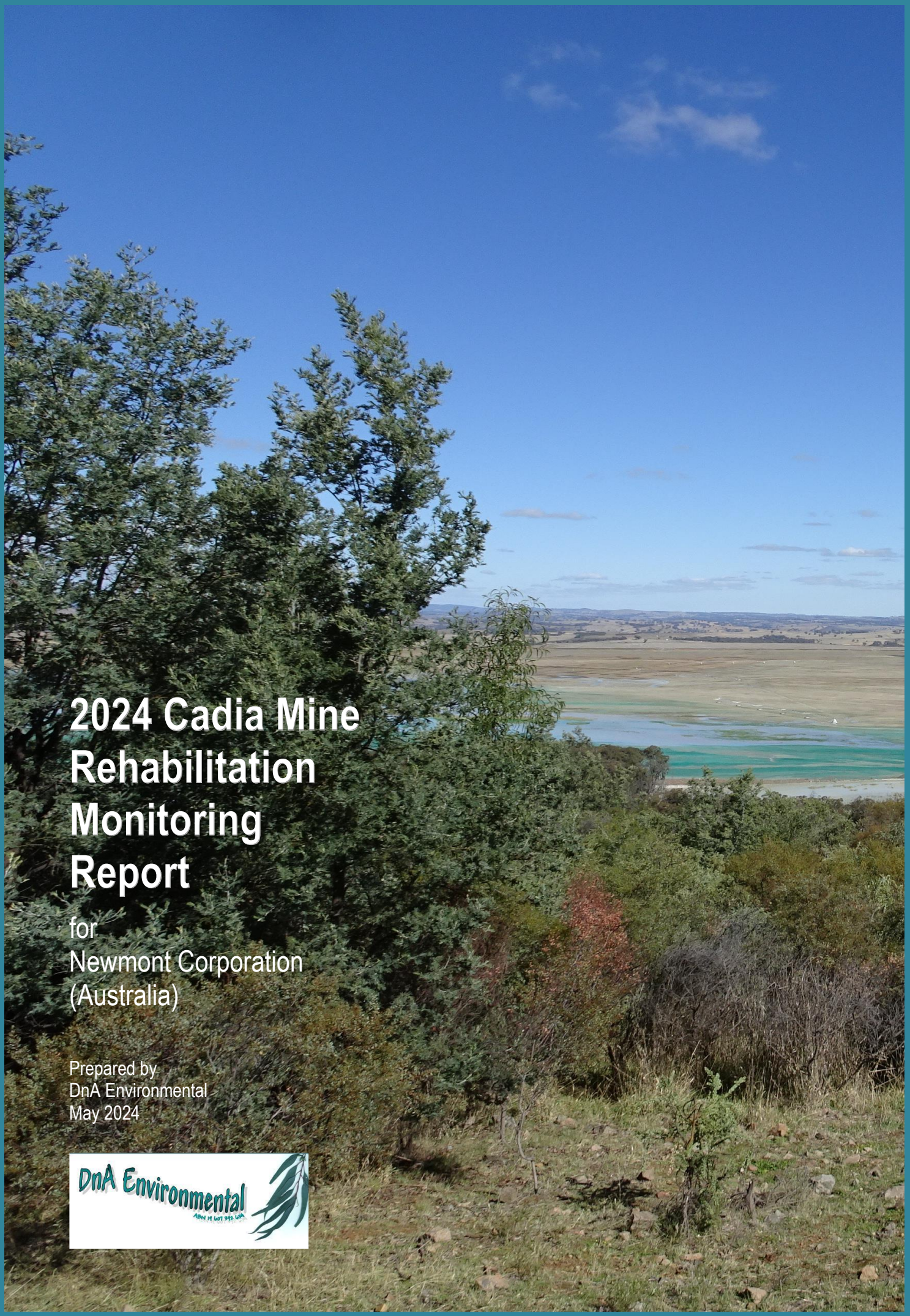

2024 Cadia Mine Rehabilitation Monitoring Report

for
Newmont Corporation
(Australia)

Prepared by
DnA Environmental
May 2024

Disclaimer

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Signed: 

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Executive summary

This 2024 rehabilitation monitoring report was undertaken by DnA Environmental and presents the results of Cadia Mine's annual rehabilitation monitoring program that first commenced in 2008. It aims to comply and be consistent with, conditions specified within a range of approval documents and associated Management Plans and align with the various regulatory guidelines and their revisions, whilst addressing the range of technical issues associated with mine rehabilitation.

Cadia Mine (Cadia) is located approximately 25 kilometres from the city of Orange in central west New South Wales (NSW). Final land use goals and rehabilitation activities at Cadia and surrounding lands are broadly based on pre-existing land uses including a combination of grazing land and endemic woodland on final mining disturbed landforms and to add value to the current vegetation corridor program of Cadia farmland. Therefore, three main vegetation communities form the basis of the rehabilitation objectives and these include woodland (open woodland with grassy understorey), riparian woodlands and perennial pastures (exotic grassland suitable for grazing).

Cadia's rehabilitation monitoring program assesses the progress of mine rehabilitation areas towards fulfilling long-term land use objectives by comparing a selection of ecological performance targets or completion criteria against remnant woodland and/or pastures not impacted by mining activities (reference sites). Reference sites are used as rehabilitation benchmarks for the final rehabilitated landscape and provide a time series record of ecosystem change and development.

Rehabilitation at Cadia has been progressive, with the number of rehabilitation monitoring sites adapted as required. Major rehabilitation was undertaken on the South Waste Rock Dump (SWRD) in 2008 and 2018, while in 2014/2015 rehabilitation of the North Waste Rock Dump (NWRD) was undertaken. Some older farmland and riparian woodland rehabilitation areas are monitored every 3 years, while no pasture rehabilitation has yet been undertaken. This year the monitoring program included monitoring of 3 woodland reference sites, 4 woodland rehabilitation sites on the South Dump and 3 woodland rehabilitation sites on the North Dump.

The monitoring methodology includes a combination of Landscape Function Analyses (LFA) and an adaptation of Biometric Assessment Method (BAM). Permanent transects and photo-points have been established to record changes in ecological attributes over time and soil analyses are regularly undertaken. Data obtained from reference sites are used to provide upper and lower ecological performance indicator ranges or "completion criteria targets", with these adapted annually to reflect climatic variations and local disturbance events.

Ecological monitoring has been undertaken in autumn in all monitoring years and this year occurred 9th – 11th April.

Rainfall

The long-term average annual rainfall recorded at Orange Airport is 892 mm however there have been extreme seasonal conditions and high rainfall variability since rehabilitation monitoring first commenced at Cadia. Annual rainfall 2008 – 2019 was typically low except in 2010 and 2016, with 3 years of drought experienced during 2017 to 2019. During 2020 - 2022, high rainfall activity caused widespread and unprecedented flooding across the state, with high rainfall activity extending into 2023. Dry conditions were again experienced during May to October 2023, followed by above average rainfall during November to April 2024, with the exception of March where only 18 mm of rain was recorded.

Progress of woodland rehabilitation sites

Ecological function (patch areas, stability, infiltration and nutrient recycling capacity) in rehabilitation areas has varied significantly, largely as a result of the way the landform was constructed (e.g. soil type, steepness), species that were sown, combined with the ongoing effects of climate and animal disturbance.

All rehabilitation sites on the SWRD and NWRD demonstrated a significant increase in functional patch area during the first few years after establishment. During 2017 – 2019, drought and increased grazing and disturbance by macropods resulted in a deterioration of functional patch area, minor increases in erosion and loss of ground covers in all rehabilitation sites, with this also being reflected in the range of reference sites.

While some sites have been relatively slow to develop, all sites on the SWRD have improved since 2021 due to above average rainfall resulting in increased growth, diversity and abundance of ground cover in most monitoring sites, although some sites may still be subjected to grazing and disturbances by native and pest animals. The NWRD continues to be heavily grazed by macropods, resulting in a high abundance of exotic annual plants and weeds. While monitoring sites were relatively stable, small bare patches persist, while North Dump 01 continues to have 2 rills. Despite most areas having relatively high stability, all sites had low infiltration and nutrient recycling capacity, compared to woodland reference sites.

Shrub densities and eucalypt regeneration was limited to absent in woodland reference sites, and as such, most woodland rehabilitation sites had a higher density and diversity of shrubs and juvenile trees. Seedling/sapling densities were highly variable across woodland rehabilitation sites and a declining trend continues to be recorded. Some individuals have grown and were now recorded as trees and mature shrubs (> 5 cm diameter at breast height (dbh)), however most individuals have died as a result of natural senescence and/or have been affected by drought. Overall, eucalypt densities were low or absent, except two sites on the South Dump (South Dump 07 and 08) and most were dominated by acacias and/or volunteer *Cassinia sifton* (Sifton Bush).

On the North Dump, thinning of acacia saplings via cut and paste methods and planting of eucalypt tubestock was undertaken in June 2023 as part of a trial program. While increased eucalypt densities are required, removal of acacias has resulted in a reduction in ecological function and loss of shrubby habitat.

There has been no consistent change in floristic diversity across the range of monitoring sites, however the level of diversity has tended to fluctuate with the seasonal conditions and degree of grazing intensity. In rehabilitation areas, floristic diversity is also implicated with rehabilitation methods. Since 2020, there has been an increase in plant diversity and this year, there was typically a higher diversity of species in rehabilitation sites than in woodland reference sites. All rehabilitation sites except South Dump 07, however had a higher diversity of exotic species.

All woodland rehabilitation sites met perennial ground cover targets and while most sites were dominated by exotic pasture species and weeds, they were in similar abundance to local woodlands. Exceptions included South Dump 10 and North Dump 01 which were weedier than desired, while in South Dump 07 and South Dump 08, native grasses had become dominant.

In total 6 Weeds Of National Significance (WONS) and priority weeds were recorded across the woodland monitoring sites, and these were scattered across a range of sites including woodland reference sites. It appears that there may be increasing occurrences of *Hypericum perforatum* (St. John's Wort) and *Nassella trichotoma* (Serrated Tussock). *Salix* species (Willows) were also observed to be increasing in abundance along the Creek Diversion Channel.

No threatened flora has been identified within the range of woodland monitoring sites and a range of wildlife have often been observed in or near rehabilitation areas. Rabbit burrows and scats continue to be common and feral pigs were observed on the South Dump and North Dump rehabilitation areas during the 2024 monitoring program.

Conclusion

Ecological performance is significantly different between rehabilitation sites largely due to difference in the way they were rehabilitate and when they were rehabilitated. All woodland monitoring sites had been affected by 3 consecutive years of drought during 2017 – 2019. Since then, most sites have improved levels of ground cover and have become ecologically stable, however infiltration and nutrient recycling capacities remain low compared to woodland reference sites.

In South Dump 07 and South Dump 08, there has been successful establishment of a high diversity and abundance eucalypts, acacias and other shrubs and native grasses have become dominant. Exotic pasture species and weeds were limited. Remaining rehabilitation areas had variable densities of shrubs, low densities of eucalypts and were dominated by exotic grasses and weeds and require additional rehabilitation intervention in order to meet tree density and diversity targets.

Due to close proximity to farmland and remnant bushland areas, current areas of rehabilitation are likely to be repeatedly overgrazed by macropods and other pest animals. Culling of macropods is likely to be unsustainable in the medium to long-term, subsequently, robust tree guards should be installed during in-fill planting programs and/or exclusion fences constructed until the vegetation is able to withstand impacts of grazing.

Weeds and feral and pest animals will require ongoing control through Cadia's weed and pest management programs.

Additional recommendations to improve rehabilitation outcomes on current and future rehabilitation areas have also been provided. Continued monitoring of rehabilitation sites will provide guidance on further management intervention, in order to trend towards and meet completion criteria targets.

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1 Introduction

1.1 Objectives

The primary objective of the Cadia rehabilitation monitoring program has been to compare the progress of rehabilitated landforms and revegetated conservation areas towards fulfilling long-term land use objectives by comparing a selection of ecological targets or completion criteria against unmined areas of remnant vegetation (reference sites) that are representative of the final land use and vegetation assemblage.

Established in 2008, the monitoring program involved developing a set of completion criteria consistent with various revisions of and those current at the time, CVOs Rehabilitation Strategy (CHPL 2020a), Land and Biodiversity Management Plan (BLMP; CHPL 2021), Mining Operations Plans (MOPs; CHPL 2020b), regulatory and best practice guidelines (NSW I&I 2010, NSW T&I 2013; NSW Department of Planning 2018, NSW Resources Regulator 2023) and current Rehabilitation Management Plan (CHPL 2024).

Primary objectives in establishing completion criteria are to establish clearly defined, repeatable and consistent methodologies for monitoring changes in various aspects of ecosystem stability, recovery and long-term sustainability. Part of this process includes:

- Establishing a range of relevant reference sites to compare and track the progress of rehabilitation areas and inherent ecosystem function;
- Selecting a range of suitable reference sites that reflect the desired final land use, biodiversity targets and local community expectations; and
- Undertaking monitoring programs that provide simple but informative and reliable information that indicates positive recovery trends or rapid detection of rehabilitation failure.

1.2 Background

Newmont Overseas Holdings Pty Corporation (Australia), a wholly owned indirect subsidiary of Newmont Corporation is the owner of Cadia Holdings Pty Limited (CHPL). CHPL is the owner and operator of Cadia Mine (Cadia), one of Australia's largest gold mining operations.

Commencing in 1998 and operating continuously since, Cadia is located approximately 25 km south of Orange in the Central Tablelands region of New South Wales (NSW). The mining operation occurs across 2 local government areas (LGAs) (Blayney Shire Council and Cabonne Council).

Cadia provides an important economic contribution to the region and NSW and is a major regional employer providing approximately 1,400 full time equivalent jobs. Confirmed mineable resources have been identified to extend operations well beyond the life of the current Project Approval (PA) 06_0295 which provides for mining until 30 June 2031. Cadia has commenced planning for the continuation of mining operations and is delivering this work through the Cadia Continued Operations Project (CCOP).

PA 06_295 issued to CHPL in January 2010 under the NSW Environmental Planning and Assessment Act 1979 (EP&A Act) provides for the following:

- Life of mine ore production (up to 30 June 2031) of approximately 525 million tonnes (Mt) of gold/copper ore from Cadia East and approximately 96 Mt of ore from Ridgeway underground mine.
- Processing of up to 35 Mt per annum (Mtpa) of gold/copper/molybdenum ore on site to produce gold doré from a gravity circuit, a gold-rich copper concentrate from a flotation circuit (which is piped to a

dewatering plant at nearby Blayney and then sent by rail to Port Kembla in NSW for export) as well as a molybdenum rich concentrate which is sent by truck to Port Kembla in NSW for export.
- Disposal of tailings through emplacement into one of 3 tailings storage facilities (TSFs) being the Northern TSF (NTSF), Southern TSF (STSF) and Pit TSF (PTSF).
- Significant surface infrastructure and ancillary activities to support the operation of the mine including ore processing, rock emplacements, water management, maintenance, store and staff facilities and land management practices.

PA 06_0295 has been modified 14 times since issue, with the most recent modification approved on 13 December 2021 to provide for the repair, upgrade, and reinstatement of tailings deposition to the NTSF and STSF and increase production from 32 to 35 Mtpa.

Cadia is currently progressing with a further modification to PA 06_0295 (Modification 15). This was lodged with the now NSW Department of Planning, Housing and Infrastructure (DPHI) in November 2023. Modification 15 seeks to change the existing NTSF and STSF embankment footprints, recommence mining in the Ridgeway underground mine, amongst other various minor changes or infrastructure additions to support ongoing mining activities. CHPL also hold other environmental licences and mining approvals and authorities related to Cadia.

1.3 History of mining operations

A detailed Rehabilitation Management Plan (RMP) has been developed for Cadia (CHPL 2024), however a summary of mining and progressive rehabilitation at Cadia is provided below.

1.3.1 Cadia Hill

Cadia Hill was the first development at Cadia. It was a large open cut mine approved in September 1996 and operated by CHPL. The mine commenced operations in 1998 and operated until June 2012 when the mine was placed into ‘care and maintenance. The Cadia Hill approval included construction of the:
- South Waste Rock Dump (SWRD);
- North Waste Rock Dump (NWRD);
- Northern Tailings Storage Facility (NTSF);
- Ore Processing Facility: and
- Ancillary infrastructure, including pumps, power lines, water infrastructure, roads, water storage dams (including Cadiangullong Dam).

The approval also included development and extraction of ore from a small secondary open-cut pit known as Cadia Extended (which has since been largely backfilled). In 2018, the Cadia Hill Pit was approved to be utilised for tailings deposition following a partial slump of the NTSF embankment. Cadia Hill Pit has since been known as the Pit Tailings Storage Facility (PTSF). In 2019, CHPL received approval to increase the final tailings deposition elevation to 713m Australian Height Datum (AHD) (pre-consolidation), with filling above 693m AHD subject to the fulfillment of conditions.

1.3.2 Ridgeway / Ridgeway Deeps Underground Mine

Ridgeway/Ridgeway Deeps (Ridgeway) is an underground sub-level and block caving mine with associated Subsidence Zone, located approximately 2.5 kilometres (km) north-west of Cadia Hill. Ridgeway was approved in October 2000 and commenced operations in 2002.The approval of Ridgeway also included the construction of

the STSF and Rodds Creek Dam. Ridgeway Deeps is an underground extension, approved in 2005. Ridgeway ceased active mining in September 2017 and is now in 'care and maintenance', although planning is ongoing with the potential to recommence mining.

1.3.3 Cadia East Underground Mine

The Cadia East Project was granted approval in 2010 (as Project Approval (PA) 06_0295), with there being 14 subsequent modifications (modification 15 submitted in November 2023). The approval permits the development of the Cadia East Mine, an underground panel cave mine with associated Subsidence Zone. It also includes the expansion of the Ore Processing Facility, expansion and height increase of the NTSF to 779m AHD and STSF to 702m AHD using the centreline or downstream lift construction methodology, and an increase to the height and storage volume of Rodds Creek Dam. PA 06_0295 permits the total extraction of 525 million tonnes (Mt) of ore (gold, copper, molybdenum and other trace metals), at a maximum rate of 35 million per annum1 (Mtpa).

1.4 Surrounding land uses

The dominant land use in the Cadia region is agriculture, principally grazing (sheep and cattle), cropping (winter forage crops), mining and orchards. Other primary production activities include honey production, viticulture and softwood plantations (predominantly Monterey Pine (*Pinus radiata*)). Historical mining has occurred in the vicinity of Cadia since the 1850s, with mining remnants common in the district. An increasing land use in the area is hobby farming/lifestyle blocks. The area is moderately populated with approximately 150-200 property owners identified as key stakeholders (CHPL 2023).

1.5 Rehabilitation strategy

The overall rehabilitation goal is to generate enduring land value, including both ecological value (e.g. biological diversity and other environmental values) and agricultural value (CHPL 2024). Rehabilitation activities at Cadia aim to generate safe and sustainable landforms at the mine site, CHPL-owned land and the region as a whole by rehabilitating mine disturbed lands to:

- add value to the current vegetation corridor programme (ecological value);
- allow for the future land use of grazing where appropriate and sustainable (agricultural value);
- retain areas that may be important for future industry and infrastructure needs; and
- provide safe and stable landforms and minimise any adverse potential impacts so that there is no future liability for CHPL or the community.

Cadia aim to provide a balanced rehabilitation outcome, recognising the alternative land uses that exist in the region and aiming to establish a combination of grazing land and indigenous woodland on final landforms. Rehabilitation programmes would be adjusted over the life of the mining operations as necessary, based on the outcomes of research trials, community and regulatory consultation, regional infrastructure requirements and industry knowledge. Progressive rehabilitation would be undertaken throughout the life of the mining operation, where practicable.

1.6 Cadia post-mining land use objectives

Specific post-mining land use goals include:

- High quality agriculture (grazing) areas were deemed to be sustainable and low risk of erosion, degradation, damage. Similar species composition and carrying capacity to surrounding areas.
- Woodland (conservation). Increasing the amount of conserved woodland in the district for future flora and fauna protection. Replacing / replicating Endangered Ecological Communities (EEC) where applicable. Similar vegetation types / composition to surrounding / local remnant vegetation.
- Allowing for future needs of the community through retaining key infrastructure where appropriate (pending future negotiations with regulatory bodies / community). Considerations may include regional water reticulation network, future industrial use of the site, landfill (within Cadia Hill Pit), roads, power assets etc.

1.7 Final land use and mining domains

Final land use goals are broadly based on the pre-existing land uses within the Cadiangullong Creek, with overall rehabilitation goals derived from the Cadia East Environmental Assessment (CHPL 2009), Cadia Rehabilitation Strategy (CHPL 2020) and the Cadia Land and Biodiversity Management Plan (CHPL 2021).

The dominant final land use will be native ecosystem (woodland and grassland) with smaller areas of agriculture (grazing), voids, water management areas, water storage and heritage. The final landform will generally be consistent with the surrounding topography, to the degree practical and approved. Specific future post-mining land uses include (CHPL 2024):

- Safe, stable, sustainable and productive landforms that blend in with the natural topography of the Cadiangullong Valley area.
- No future or residual ongoing liability from the mine site (e.g. from soil or water contamination) for CHPL, future landowners or the wider Cadia community.
- Agriculture (grazing). High quality agriculture (grazing) in areas deemed to be sustainable and low risk of erosion, degradation and damage. Similar species composition and carrying capacity to surrounding areas.
- Native Ecosystem. Woodland (conservation). Increasing the amount of conserved woodland in the district for future flora and fauna protection. Replacing/replicating Critically Endangered Ecological Communities where applicable, namely the *White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland*. Similar vegetation types/composition to surrounding/local remnant vegetation.
- Those that allow for the future needs of the community through retaining key infrastructure where appropriate (pending future negotiations with regulatory bodies / community). Considerations may include regional water reticulation network, future industrial use of the site, landfill (within voids), roads, power assets etc.
- Designated heritage areas to conserve regionally significant heritage buildings and relics.

1.8 Guiding principles

The following guiding principles will be implemented for the Mine Disturbed Landscape (CHPL 2024).

- Rehabilitation for the post-mining land use of woodland, forest or native communities to use:
    - A range of indigenous species (trees, shrubs, grasses, forbs, and aquatic species where applicable);

  - Seed that has been locally collected; and
  - A range of species to provide diversity (including structural diversity) consistent with the target vegetation association (based on soil type, aspect, slope and adjacent (or pre-existing) communities).
- Rehabilitation for the post-mining land use of agriculture / grazing to use:
  - Predominantly perennial species (supplemented with annual species as required such as legumes etc);
  - Ranges of native and / or introduced pasture species where suitable; and
  - Scattered paddock trees to match the surrounding agricultural landscape.
- Species will be selected based on the target vegetation community and derived from vegetation survey species lists from a similar community type or monitoring reference site. Where possible, attempt to re-create communities consistent with local EEC;
- The recovery and use of habitat and rehabilitation resources from remnant areas destined for clearance / subsidence should be maximised to enhance the success and colonisation of rehabilitated sites;
- Locally uncommon species from remnant areas or species that are difficult to propagate should be re-located / re-planted prior to approved clearing;
- Native seed to be collected from within 50km of mine lease boundary or within an acceptable distribution radius;
- Where possible immediately re-spread harvested topsoil to take advantage of seed banks and soil biota and to reduce damage to soil structure through rehandling;
- Utilise topsoil from areas with a similar post-mining land use to take advantage of available seed banks; and
- Undertake annual monitoring of rehabilitation sites and compare a range of parameters against selected reference sites.

1.9 Current rehabilitation areas

Primary domains relevant to this rehabilitation monitoring report are Native ecosystem: woodland community - conservation. Presently, 2 major rehabilitation areas include the NWRD and the SWRD. Primary rehabilitation over the NWRD was completed in 2014, while the SWRD has been progressively being rehabilitated since 2006. A map showing the conceptual final land use for these areas is provided in **Error! Reference source not found.**.

1.9.1 North Waste Rock Dump (NWRD)

The North Waste Rock Dump (NWRD) was designed to the following standard:

- The NWRD would have maximum batter slopes of 1:3, with 15 to 20 metre (m) wide, step-back, reverse graded berms and rock lined drains;
- Potentially acid forming (PAF) material contained in the dump would be encapsulated by covering with 0.5 m of compacted clay or a High-Density Polyethylene (HDPE) liner followed by 2 to 3 m of non-acid forming (NAF) material;
- This would be covered by 20 to 30 centimetres (cm) of topsoil. Where possible topsoil will be used that has been stripped from an area with a consistent final land use;
- Drainage control structures would be installed where necessary, utilising ‘chain of ponds’ concepts where appropriate; and
- The NWRD would be revegetated with indigenous bushland species with a final land use of conservation.

The final landform of the NWRD is approximately 66 ha in size and landform construction has been completed. As such any ongoing work associated with the NWRD landform relates to the inspection and repair of any areas of erosion (during the Landform Establishment Phase). As part of the assessment associated with section 240 notice NTCE0012411, further works are required to be undertaken on the NWRD landform (remedial work to surface water management structures and some erosion features) (CHPL 2024).

1.9.2 NWRD water management

Surface waters from the North Waste Rock Dump will flow to a constructed wetland located on the southern edge of the Cadia Extended void. Pending suitable water quality (to be assessed against water management plan. Guideline values and verified by a future research project), water will be discharged into Cadiangullong Creek (CHPL 2024).

1.9.3 South Waste Rock Dump (SWRD)

The SWRD has/will be constructed to the following standard:

- The revegetation objective for the SWRD is to provide woodland across the dump surface and batters with a final land use of woodland conservation;
- Selective encapsulation of PAF waste rock with a low permeability seal (compacted clay capping) followed by NAF material and topsoil;
- 20 to 30 cm of topsoil will be placed as the surface substrate. Where possible topsoil will be used that has been stripped from an area with a consistent final land use;
- Grading the final surface of the dump to blend in with the natural topography of the area, with an overall outer batter slope of 1:4 comprising 1:3 outer slopes and 15 to 20 m wide, step-back, reverse graded berms;
- Installation of rock lined drains and detention ponds to channel runoff safely to constructed outlet areas;
- Creation of additional habitat using trees cleared from disturbance areas supplemented with additional habitat structures targeting threatened and declining woodland species (e.g. nesting boxes, bat boxes, salvaged hollows etc);
- The woodland areas will be linked to other conservation areas in the Cadia Valley through the vegetation corridor programme;
- Rehabilitation trials would be conducted by CHPL to determine the best combination of techniques for the establishment of native woodland species (including soil treatments, seed mixes, sowing methods etc).

The SWRD was approved as part of the initial Cadia Hill approval in 1996 and was designed and constructed to be rehabilitated to the traditional ‘batter and berm’ design as described above . As part of the assessment associated with section 240 notice NTCE0012411, further works are required to be undertaken on the SWRD landform (remedial work to surface water management structures and some erosion features (Newmont 2024).

As of 30 June 2023, the SWRD was 449 ha and has been partially rehabilitated (183 ha including 120 ha of PAF and 63 ha of NAF). Unrehabilitated portions remain active for the placement of small amounts of waste rock / tramp material from Cadia East Mine, placement of waste material and for the reclamation of NAF material for

TSF construction. The SWRD also contains a portion of low-grade mineralised ore, that will likely be processed in the future. Approximately 100 ha remains available for active mining.

\Portions of the rehabilitated SWRD are now scheduled for re-excavation to salvage additional NAF waste rock for TSF embankment construction and buttressing. Of the 63 ha of rehabilitated NAF material, 6.1 ha will be re-excavated to 30 June 2024 (CHPL 2024).

1.9.4 SWRD water management

The SWRD water management structures were design with the following considerations:

- The top surface of the SWRD would be designed with a slight dish shape that would generally drain towards the north. Rock lined channels would be installed along the northern edge of the top surface to provide a stable means for surface water runoff to drain from the top of the SWRD;
- On the batters of the dump, surface water runoff would flow perpendicularly down the slope to the toe of each batter where it would be re-directed by the 15 to 20 m wide reverse graded berms. The water would gradually flow short distances along the berms to rock lined channels which would be constructed at regular intervals down the faces of the batters. These channels would enable water from one berm to be channelled in a controlled manner down the face of the batter to the next berm and ultimately to the base of the dump;
- Rock lined channels would be used at the base of the dump to direct runoff into natural creek lines, the surface of the NTSF, or the Rodds Creek Water Holding Dam;
- Drainage control structures would utilise ‘chain of ponds’ concepts where appropriate; and
- The existing sediment ponds and leachate collection ponds downstream of the dump would be retained until the revegetated surface of the dump is stable and the runoff water quality is acceptable.

Surface drainage from the SWRD reports to a number of different areas to avoid the accumulation of large volumes of water to a single control point. Discharge areas include:

- Rodds Creek Dam
- Northern Tailings Storage Facility
- Cadia East Subsidence Zone
- Northern Leachate Pond (NLP) (proposed Constructed Wetland)
- Southern Leachate Pond (SLP) (proposed Constructed Wetland)
- Process Water Pond / Site runoff pond (proposed Constructed Wetland).

It is proposed that three constructed wetlands will be built to the west of Site Runoff Pond, NLP and SLP prior to controlled discharge (pending water quality) to Cadiangullong Creek (CHPL 2024).

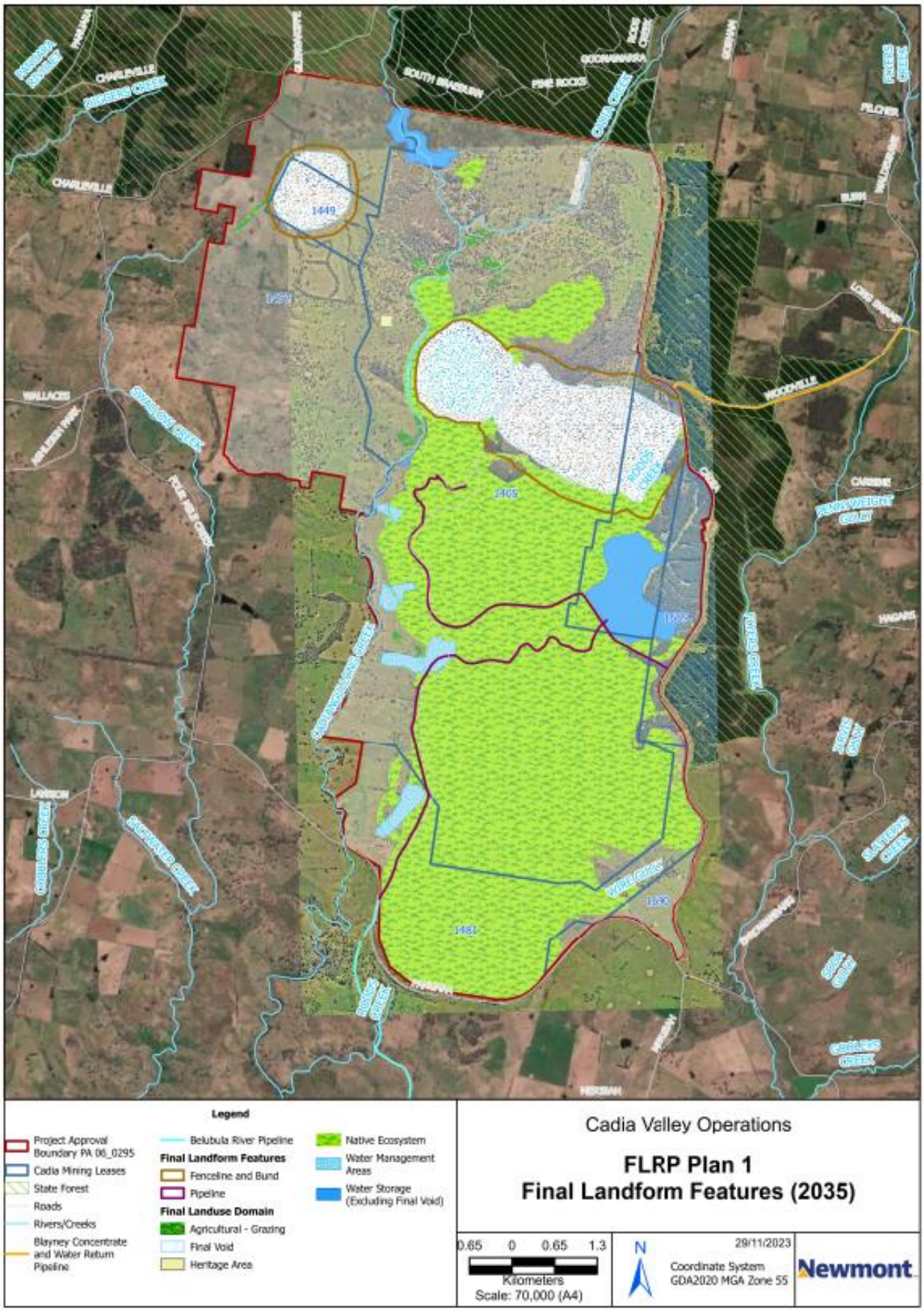


Figure 1-1. Conceptual final land use of mine disturbed areas (CHPL 2024).

1.10 Land and Biodiversity Management Plan

The Cadia Land and Biodiversity Management Plan provides an overview of the approach to land and biodiversity management at Cadia (CHPL 2021). The Plan has been developed to meet the broad rehabilitation, biodiversity and land management commitments made as part of the Cadia East Project Approval (PA 06_0295). The plan also aims to implement current best practice land and biodiversity management across CHPL owned land and where possible link to land management initiatives on a regional basis.

1.10.1 **Vegetation corridor program.**

The aim of the Cadia Vegetation Corridor Program is to generate enduring land value, including both ecological and agricultural value (CHPL 2021). This aim will be achieved through meeting the following objectives throughout the life of the plan including:

- Conserve and enhance areas of isolated remnant vegetation;
- Link significant areas of remnant vegetation;
- Provide habitat for native fauna;
- Allow the movement of genetic material between flora and fauna populations; and
- Increase the sustainability and biodiversity of Cadia farms and environs.

Figure 1-2 shows the status of the Vegetation Corridor Program (CHPL 2021). Figure 1-3 shows how the Vegetation Corridor Program aligns with the proposed mine site rehabilitation concepts to extend corridor linkages across CHPL owned land.

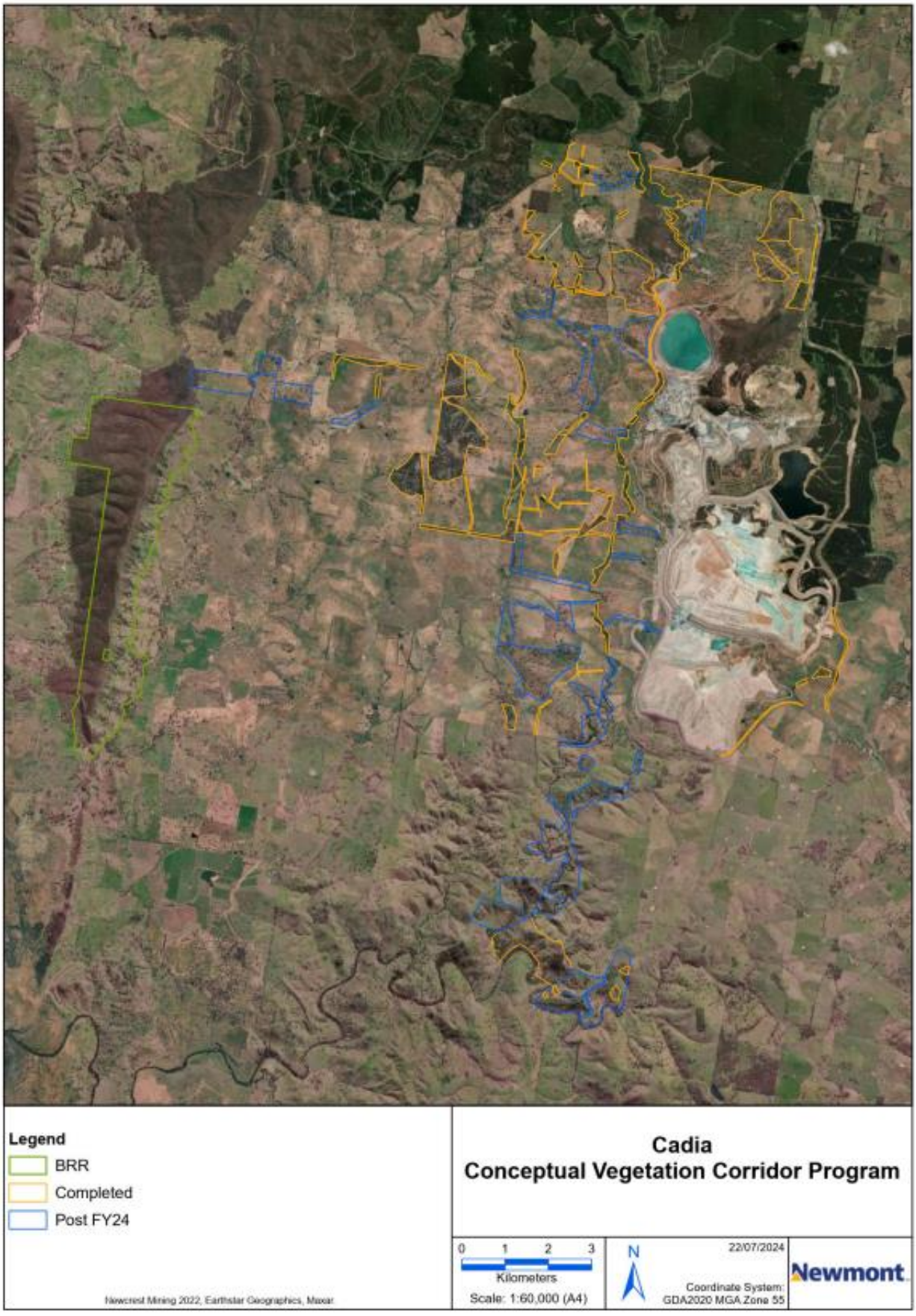


Figure 1-2. Vegetation Corridor Program (CHPL 2021).

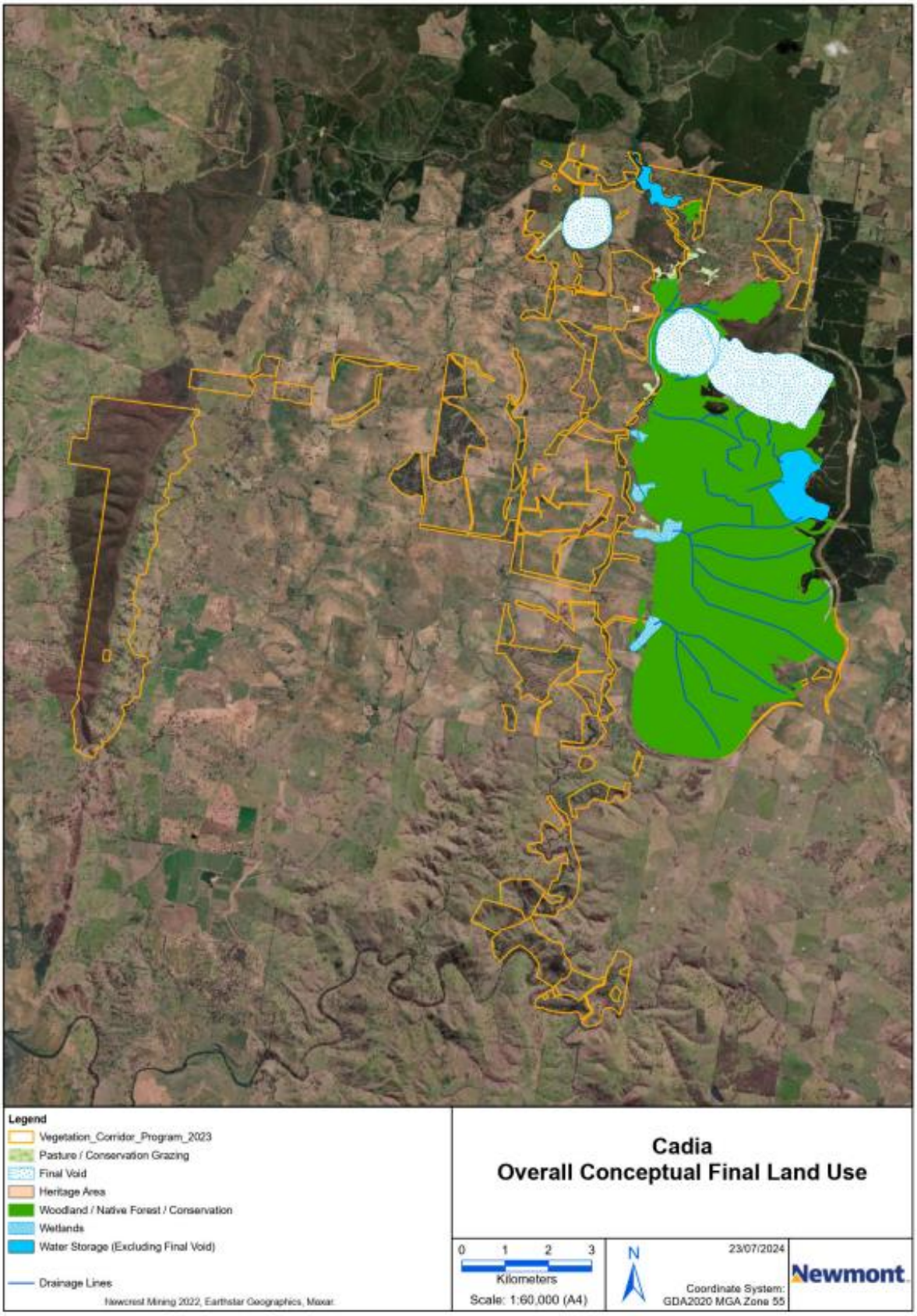


Figure 1-3. Vegetation Corridor Program and how it aligns with the mine site rehabilitations concepts (CHPL 2021).

1.11 Regulatory guidelines

In NSW, mining operations were previously carried out with an approved Mining Operations Plan (MOP) to assist the government regulators to monitor the progress of mining and rehabilitation activities across the life of a mine (NSW Department of Industry and Investment (I&I) 2010, NSW Department Trade and Investment (T&I) 2013, NSW Department of Planning 2018). The MOP was intended to fulfil the function of both a rehabilitation plan and a mine closure plan, with *ESG3: MOP Guidelines,* detailing the process for monitoring and managing progression towards successful rehabilitation outcomes. These guidelines required industry to identify and provide measurable data and demonstrate that proposed rehabilitation outcomes are achievable and realistic within a given timeframe.

The Mining Amendment (Standard Conditions of Mining Leases – Rehabilitation) Regulation 2021 (NSW) was enacted on 2 July 2021, formally amending the Mining Regulation 2016. The rehabilitation reforms comprise the following components.

- New standard Mining Lease Conditions introduced by the Rehabilitation Regulation.
- Form and Way documents setting out in detail the mandatory requirements relating to the format and content of various obligations under the new Mining Lease Conditions.
- A series of Guidelines intended to assist authority holders in fulfilling the obligations set out under the new Mining Lease Conditions in accordance with the Form and Way documents, without setting any additional mandatory requirements.

Subsequently, MOPs have been replaced by RMPs and Associated Annual Rehabilitation Report and Forward Program for large mines Code of Practice (NSW Resources Regulator (RR), 2023).

1.11.1 Rehabilitation phases

Many of the previous ESG3 guidelines are still however relevant to the current rehabilitation monitoring and reporting protocols. Successful rehabilitation of a mine site has been conceptually described in terms of logical steps or phases and are to be made applicable to each of the similar land management units or domains. It is recognised that most domains will require a different rehabilitation methodology to achieve the intended post-mining land use. Rehabilitation phases where the post-mining land use is a native plant ecosystem according to the previous guidelines and RMP 'Form and Way' documents include:

1. Active Mining;
2. Decommissioning;
3. Landform Establishment;
4. Growth Medium Development;
5. Ecosystem and Land Use Establishment;
6. Ecosystem and Land Use Development; and
7. Rehabilitation Completion (sign Off).

1.11.2 Performance Indicators

To satisfy regulatory conditions, performance measures, indicators and associated performance/completion criteria that are appropriate to the location and relevant to the stated rehabilitation goals and objectives must be presented for each land management unit or domain. The application of the ecological performance data during the Decommissioning phase (Phase 1) are not considered applicable within the presentation of the ecological data obtained within the Cadia rehabilitation monitoring program. Subsequently, the ecological performance

criteria which are consolidated into Key Performance Indicator (KPI) tables are only represented within Rehabilitation Phases 3 (Landform establishment) to Phase 6 (Ecosystem and land use development).

Data from reference sites provide suitable target values of key biophysical parameters, vegetation structures and diversity and habitat complexity. It provides the ability to monitor both success against true values of an existing ecosystem and the effects of climatic variations and disturbance events (such as fire, flooding, drought etc.). The reference site can be used as the target outcome of the final rehabilitated landscape and a time series record of ecosystem change or development can be obtained. By comparing data with reference sites, it is possible to see if the rehabilitation or disturbed site is developing adequately. All completion criteria at a given site should be within critical threshold values if ecosystem rehabilitation is to be judged successful.

1.12 Completion criteria and key performance indicators

At Cadia, a range of KPI's have been determined and are quantified by data obtained from replicated reference sites which are representative of the agreed final land use. All ecological performance indicators are quantified by range values measured annually (or 3-year monitoring cycle) from these reference sites which form *upper* and *lower* KPI targets. The same ecological performance indicators are measured in rehabilitation sites and these should equal or exceed these values or demonstrate an increasing trend.

These KPIs have been further separated into "*Primary performance indicators*" and "*Secondary performance indicators"*. Primary performance indicators are those chosen as completion criteria targets and have been identified as those that will satisfy various regulatory requirements as detailed in Cadia's RMP (CHPL 2024) and LBMP (CHPL 2021).

Secondary performance indicators are those that would be desirable to achieve but will not necessarily have an influence on relinquishment requirements. Therefore, please note that not all performance indicators are set as completion criteria targets.

2 Cadia rehabilitation monitoring program

2.1 Primary objectives

The primary objective of the Cadia rehabilitation monitoring program has been to compare the progress of rehabilitated landforms and revegetated conservation areas towards fulfilling long-term land use objectives by comparing a selection of ecological targets or completion criteria against unmined areas of remnant vegetation (reference sites) that are representative of the final land use and vegetation assemblage.

2.2 Reference sites

Three main vegetation community types have been identified as being rehabilitated onto mining disturbed areas or Cadia farmland areas and have included grassy woodlands, introduced/exotic pastures and riparian woodlands.

Subsequently, 2 to 4 reference sites of each vegetation community type were established to obtain baseline data and provide ongoing ecological data that quantify a range of key ecological performance indicators relating to the progress of rehabilitation of mine disturbed or farmland revegetation areas and resulting completion criteria as specified in the RMP and LBMP.

Due to the long agricultural and mining history of the local area, all reference sites have been subjected to some form of prior disturbance, in particular clearing for agriculture and livestock grazing and all woodland sites were regrowth woodland, with some invasion from introduced species. Introduced pastures are those cultivated and sown with exotic species suitable for agricultural production, primarily livestock grazing. These sites, despite their disturbance history were typical of the local area and set realistic rehabilitation targets and provide a benchmark for transitional processes that can be expected or that are presently occurring in the rehabilitation areas.

Reference sites were spread out where possible to maximise the spatial distribution and subsequent variations in community composition across the local landscape and all are now situated on Cadia owned land. Current reference sites include:

- Three grassy woodlands;
- Two riparian woodlands; and
- Two exotic pastures.

The location of the reference sites is provided in Figure 2-1.

2.3 General description of the reference sites

2.3.1 Grassy woodland reference sites

The grassy woodlands containing the reference sites RfWood01, RfWood02 and RWood05, were comprised of low various densities of *E. albens* (White Box) or *E. melliodora* trees but *E. blakelyi* (Blakely's Red Gum), *E. macrorhyncha* (Red Stringybark), *E. bridgesiana* (Apple Box) and/or *E. goniocalyx* (Bundy Box) may also have been present. Scattered old growth trees were present as well as younger regrowth and some relatively recent natural eucalypt recruitment was present in all sites. There was an absence of a shrub layer in 2 sites however in the other woodland site, there were some scattered *Acacia dealbata* (Silver Wattle) and *A. implexa* (Hickory) and scattered eucalypt regeneration was present. There may also have been occasional exotic shrubs in some

woodland areas *(i.e. Crataegus monogyna* (Hawthorn), *Ligustrum lucidum* (*Large-leaved Privet*), *Rubus fruticosus* (Blackberry) and *Rosa rubiginosa* (Sweet Briar). The understoreys were usually dominated by native perennial grasses and common native forbs and all sites contained a high cover of leaf litter. There were also scattered exotic annual grasses and pockets of exotic grasses or weeds, especially in old stockcamp areas.

2.3.2 Riparian woodland reference sites

The 2 riparian woodland sites were quite different to each other, but both were characteristically open grassy woodland.

One site (RrRip02) was comprised of scattered old growth trees of *E. camaldulensis* (River Red Gum)*, E. melliodora* and *E. bridgesiana* (Apple Box) and had an understorey dominated by *Phalaris aquatica* (*Phalaris*) and *Dactylis glomerata (Cocksfoot)* with patches of introduced annual grasses and native grass and herbs.

The second site (RrRip03) was also comprised of scattered old growth trees dominated by *E. viminalis* (Ribbon Gum)*, E. melliodora* and *E. bridgesiana* and a relatively intact and diverse native grassy understorey and contained some patches of shrubs including *Acacia melanoxylon* (Blackwood) and *A. dealbata*. Both sites however contained various priority and introduced weeds and periodic flooding continues to alter the stream morphology.

2.3.3 Introduced pasture reference sites

The 2 introduced pasture sites were dominated by *Phalaris aquatica* and contained various combinations of other pasture species such as *Dactylis glomerata* (Cocksfoot), *Lolium* sp. (Ryegrass) and *Trifolium* species (Clovers). At RfPast03, *Puccinellia stricta* (Australian Saltmarsh Grass) was also very abundant. These sites are intermittently grazed by sheep and cattle but both sites contained very high ground cover levels and had very few weeds.

2.4 Cadia rehabilitation monitoring sites

The monitoring program was first established in 2008 and rehabilitation has been progressive since the inception of the monitoring program, subsequently, the number of rehabilitation monitoring sites has also changed over the years. Major rehabilitation was undertaken on the main waste emplacements in 2008 (SWRD) and in 2014/2015 (NWRD and SWRD). An additional area of rehabilitation was undertaken on the southwest of SWRD in 2018 (South Dump 10). Rehabilitation monitoring sites were considered to be representative of the rehabilitation area as a whole or were similar to and representative of other areas of rehabilitation.

Sites South Dump 01,02, 03 are no longer assessed due to their association with the recovery of benign waste rock material used in mining development. Access to South Dump 05, 06 and 09 has been difficult and/or unsafe due to subsidence or nearby operational heavy machinery and were also not assessed due to safety risks.

Some of the older more stable farmland and riparian revegetation sites are monitored on a 3 year rotation, with these last being assessed in 2022 (due next in 2025). Due to the significant development of the woodland rehabilitation in most areas of the South Dump, some sites may also be placed on a 2 to 3 year rotation.

2.5 Summary of the monitoring program

In order to manage increasing quantities of data and omit sites no longer relevant, ecological data and trends since 2014 have been presented. Results from rehabilitation sites prior to 2014 can be reviewed in previous Cadia Annual Rehabilitation Monitoring Reports (DnA Environmental 2008b – 2013).

Table 2-1 shows a summary of the current monitoring sites (post 2014) assessed as part of the Cadia monitoring program, including the general locality, year of establishment, community type and frequency of monitoring. Figure 2-1 shows the location of the reference and rehabilitation monitoring sites. Global Positioning System (GPS) coordinates and other site-specific information is provided in Appendix 1.

Table 2-1. Summary of the monitoring program (post 2014).

Site type	Vegetation community	Site name	Rehabilitation method	Year est.	3-year monitoring rotation	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Reference sites	Woodland - Ashleigh Park	RfWood01	-	2008		1	1	1	1	1	1	1	1	1	1	1
	Woodland - Bundarra	RfWood02	-	2008		1	1	1	1	1	1	1	1	1	1	1
	Woodland - Cadiangullong Dam	RrWood03	-	2008		1	1									
	Woodland – Cadia Access Rd	RWood04	-	2017			1		1	1						
	Woodland - Cadiangullong Dam	RWood05	-	2016				1	1	1	1	1	1	1	1	1
	Pasture - Bundarra	RfPast01	-	2008	☑ 2019			1			1					
	Pasture - Willunga	RfPast03	-	2008	☑ 2019			1			1					
	Riparian - Bakers Shaft	RrRip02	-	2008	☑ 2022	1		1			1			1		
	Riparian - Cadiangullong Ck Cadia	RrRip03	-	2008	☑ 2022	1		1			1			1		
	Total reference sites					**5**	**4**	**7**	**4**	**4**	**7**	**3**	**3**	**5**	**3**	**3**
Rehabilitation sites	Woodland	Ashleigh Park	Direct seeded farmland	2008	☑ 2022			1			1			1		
	Woodland	WillungaDS01	Direct seeded farmland	2008	☑ 2022	1	1	1			1			1		
	Woodland	WillungaDS02	Direct seeded farmland	2008	☑ 2022	1	1	1			1			1		
	Riparian woodland	Cadiangullong Creek	Direct seeded farmland	2008	☑ 2022			1			1			1		
	Riparian woodland	Creek Diversion	Tubestock planting	2008	☑ 2022	1		1			1			1		
	Woodland	North Dump 01	Aerial seeding	2014		1	1	1	1	1	1	1	1	1	1	1
	Woodland	North Dump 02	Aerial seeding	2014		1	1	1	1	1	1	1	1	1	1	1
	Woodland	North Dump 03	Aerial seeding	2014		1	1	1	1	1	1	1	1	1	1	1
	Woodland	South Dump 01	Aerial seeding	2008		1	1	1	1	1						
	Woodland	South Dump 02	Aerial seeding	2008		1	1	1	1	1						
	Woodland	South Dump 03	Aerial seeding	2008		1	1	1	1	1						
	Woodland	South Dump 04	Aerial seeding	2014		1	1	1	1	1	1	1	1		1	1
	Woodland	South Dump 05	Aerial seeding	2014		1	1	1	1	1	1	1	1		1	
	Woodland	South Dump 06	Aerial seeding	2014		1	1	1	1	1						
	Woodland	South Dump 07	Aerial seeding	2016				1	1	1	1	1	1		1	1
	Woodland	South Dump 08	Aerial seeding	2016				1	1	1	1	1	1		1	1
	Woodland	South Dump 09	Aerial seeding	2016				1	1	1	1	1	1			
	Woodland	South Dump 10	Seeded	2018							1	1	1	1	1	1
	Total rehabilitation monitoring sites					**12**	**11**	**17**	**12**	**12**	**14**	**9**	**9**	**9**	**8**	**7**
	Total Monitoring Sites					**17**	**15**	**24**	**16**	**16**	**21**	**12**	**12**	**14**	**11**	**10**

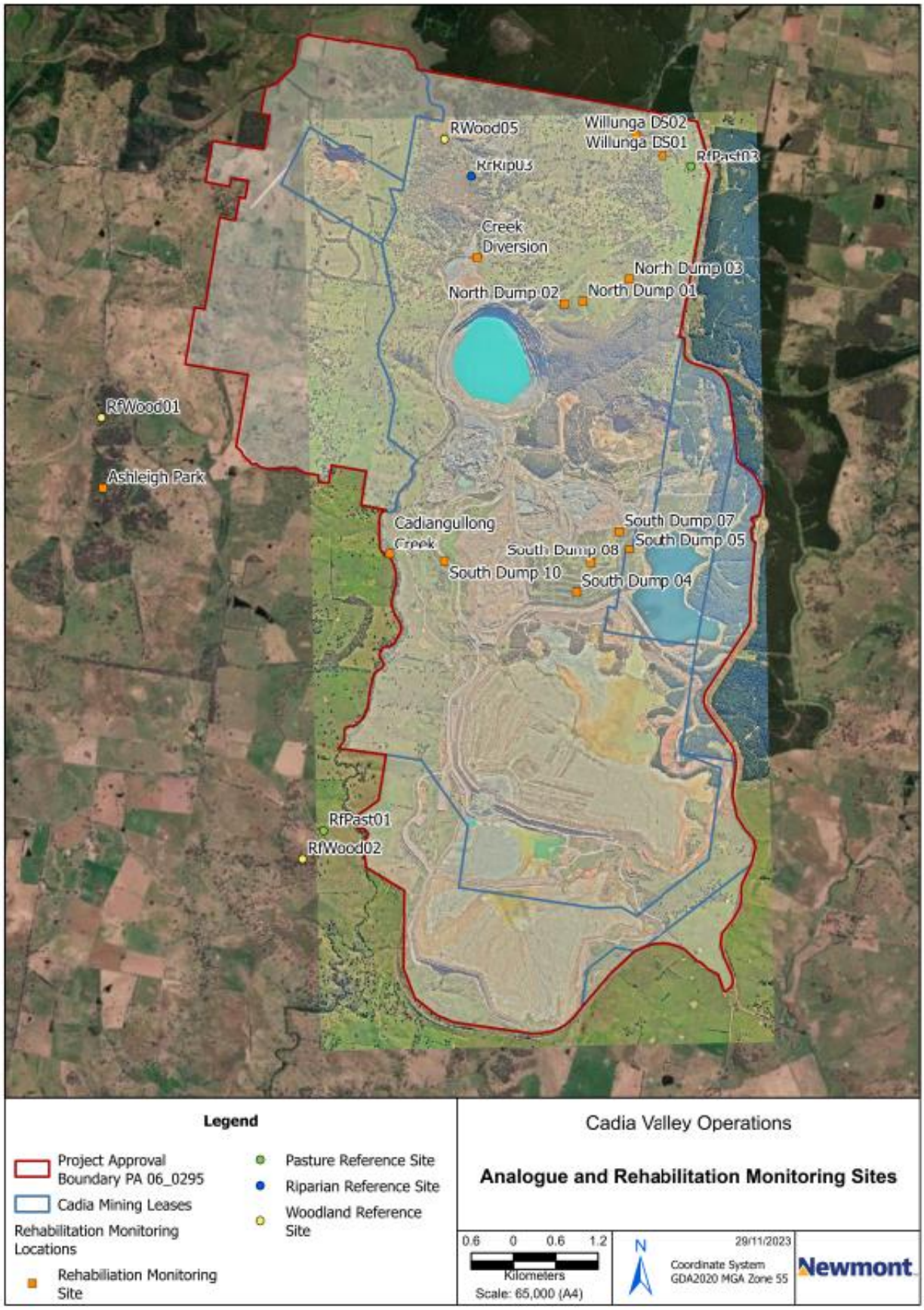


Figure 2-1. Map of the Cadia monitoring sites.

3 Rehabilitation monitoring methodology

Rehabilitation monitoring methodology and determination of completion criteria was first developed in 2008 and is documented in "Rehabilitation monitoring methodology and determination of completion criteria" (DnA Environmental 2008a) and have been detailed in previous monitoring reports (DnA Environmental 2008b - 2023).

Ecological monitoring has been undertaken in autumn in all monitoring years. Field work and associated reports 2008 – 2020 were undertaken by Dr Donna Johnston and Andrew Johnston from DnA Environmental. Since 2021, field surveys have been undertaken by Andrew Johnston (DnA Environmental) and Ray Mjadwesch (Mjadwesch Environmental Service Support) and this year were undertaken during 9 – 11th April 2024. Reports continue to be prepared by Dr Donna Johnston and Andrew Johnston.

3.1 Monitoring quadrats

The monitoring methodology adopted is a standard and simple procedure that can be easily replicated over any vegetation community or revegetation area. The 20 x 50 m plot is positioned such that the base line forms the basis for the LFA transect which must face down slope. The vegetation monitoring usually occurs along the 50m transect situated at the 10 m interval that runs perpendicular to the 20 m LFA transect, however in some situations the same transect may be used. Four marker pegs are used to establish a permanent transect position. GPS readings are taken to ensure quadrats can be relocated over time. Permanent photo-points are also established at various marker pegs of the quadrat to record changes in these attributes over time.

To obtain the range of ecological data which quantifies the completion criteria targets, the monitoring program incorporates a combination of LFA (Tongway and Hindley 1995, 1996, 2003, 2004), accredited soil analyses and various measurements of ecosystem diversity and habitat values based on and adapted from the BioBanking/Biometric methodologies (e.g. Gibbons 2002, Gibbons *et al* 2005, 2008) and Biometric Manual 3.1 (NSW Department of Environment, Climate Change and Water (DECCW 2011)).

Rehabilitation monitoring at Cadia has always followed early versions of the BioBanking/Biometric Assessment Methodologies (BAM) (DECCW 2011, Office of Environment and Heritage (OEH) 2012)) however BAM has undergone various changes over time. Subsequently, some changes of methodology have not always been adopted in order to ensure continuity of the monitoring data and relevance of the long-term monitoring efforts.

3.2 Amendments

In 2022, inclusions were made to the KPI tables regarding tree and mature shrub density (> 5 cm dbh), and shrub and juvenile tree density (< 5 cm dbh) targets. These included segregating the population(s) into:

- density of eucalypts;
- density of acacias;
- density of other endemic shrubs;
- density of weeds; and
- percentage of eucalypts.

3.3 Limitations

3.3.1 Species identification

In some cases, there may have been a lack of critical features and/or reproductive structures (due to heavy grazing or browsing, new germinants etc) that may be required for the positive identification of some plant genera, and therefore some species may have only been identified to the genera level.

Where species names have been changed and/or updated and/or plants may have been previously misidentified, corrections according to PlantNet have been applied where possible. In most cases these occurrences are unlikely to have an impact on meeting completion targets.

4 Rainfall

Rainfall measurements at Cadia are logged at two separate weather stations, which have been used to provide an average monthly rainfall across the mine site. Cadia's averaged on-site rainfall data have been compared to long-term average rainfall records (1996 – 2024) at Orange Airport, which is 892 mm (BoM 2024).

Since 2008 when rehabilitation monitoring at Cadia first commenced, there have been extreme seasonal conditions and high variability in annual rainfall. Annual rainfall has been well below average in years 2009 and 2013, while in 2010 and 2016, there was above average annual rainfall of 1153 mm and 927 mm respectively which caused widespread flooding across the state. This was followed by 3 consecutive years of extremely dry conditions during 2017 - 2019 (Figure 4-1), with these being the worst drought years on record.

Since 2020, improved rainfall conditions have occurred with several widespread and unprecedented flood events occurring across the state during 2020 – 2022. In 2023, dry conditions occurred during May to October 2023, while high rainfall activity was experienced during November to February and again in April 2024, however rainfall was well below average during March with only 18 mm. Rainfall relevant to the monitoring program and recorded to the end of April 2024 was therefore slightly above the expected average with 296 mm, compared to an expected average of 264 mm for the same yearly period (Figure 4-2).

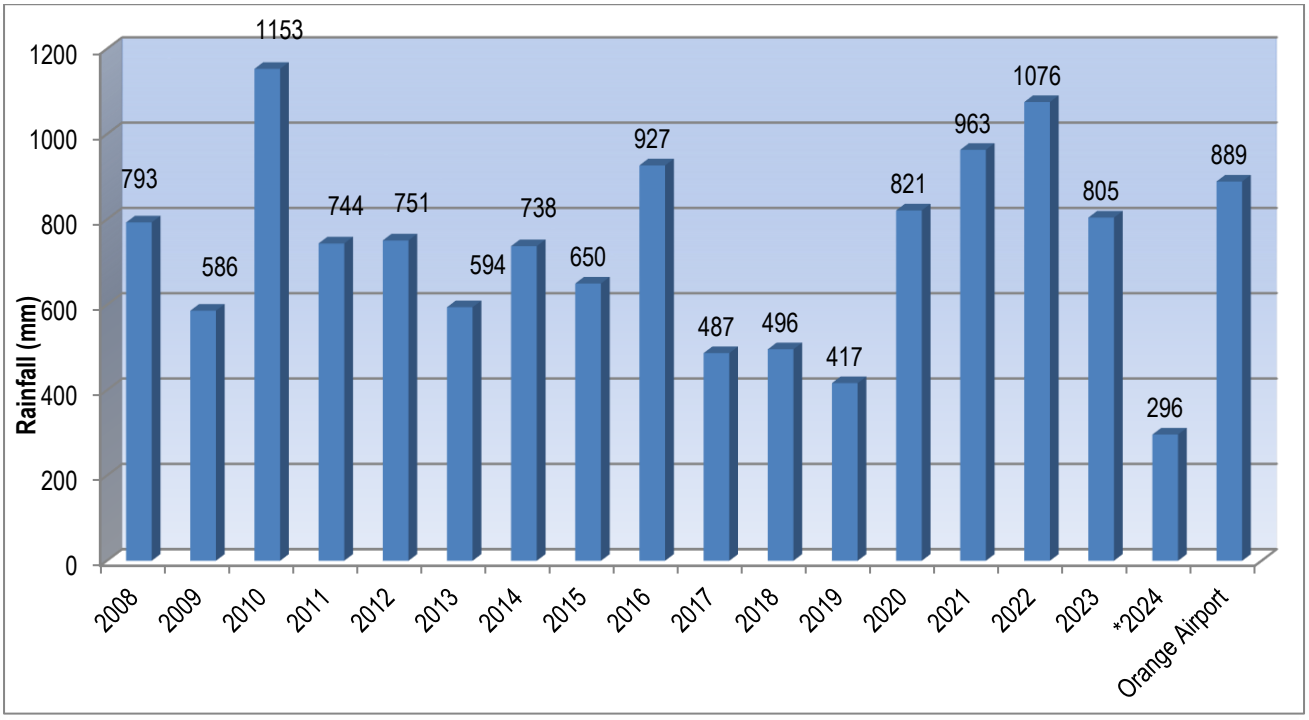


Figure 4-1. Annual average rainfall recorded at Cadia 2008 - April 2024 compared to 1996-2024 mean annual rainfall recorded at Orange Airport (*Jan – April 2024).

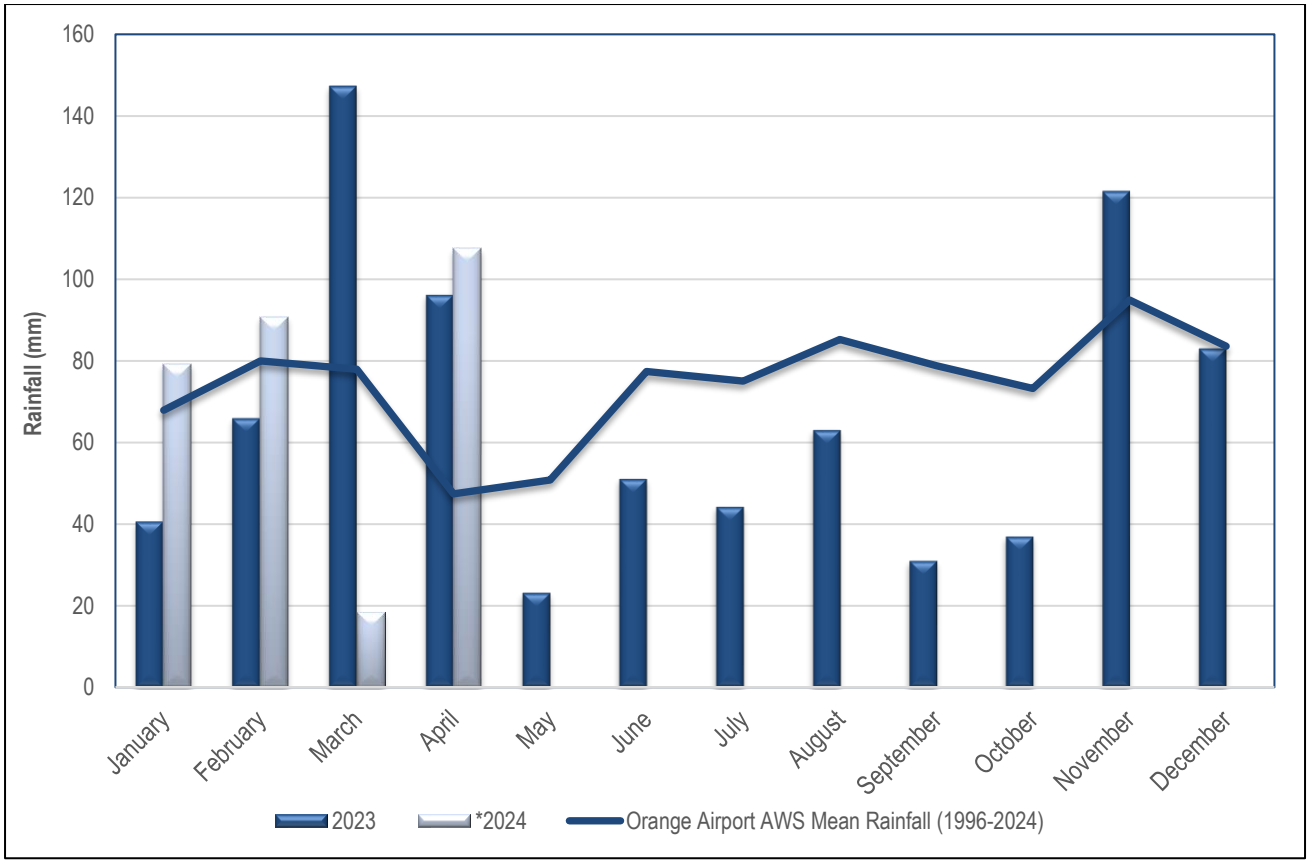


Figure 4-2. Average monthly rainfall recorded at Cadia January 2023 – April *2024 compared to long-term monthly mean rainfall recorded at Orange Airport.

5 Results: Woodland monitoring sites

5.1 Permanent photo-points: Woodland reference sites

Table 5-1 provides a series of photographs taken from permanent photo-points along vegetation transects 2014 – 2024. Photos from numerous years have been excluded for ease of presentation. GPS coordinates and other site-specific information for the reference sites are provided in Appendix 1.

Table 5-1. Permanent photo-points along vegetation transects in the woodland reference monitoring sites 2014 - 2024.

Site	2014	2020	2021	2023	2024
RfWood01: " Ashleigh Park"					
RfWood02: " Bundarra"					
RWood05: Cadiangullong Dam Est. 2016	**NA**				

5.2 Permanent photo-points: Woodland rehabilitation sites

Table 5-2 provides a photograph taken from the permanent monitoring point along the vegetation transect of rehabilitation sites established on the South and North Dumps from 2014 to 2024. North Dump 03 and South Dump 08 are relatively flat, while the remainder are on slopes. Sites South Dump 04 (and 05) and North Dump 01, 02 and 03 were aerial seeded during November 2013 with a blend of native trees and shrubs and exotic pasture species. Sites on the North Dump were over sown with Japanese Millet while sites on the South Dump were over sown with Cereal Rye, Couch, Cocksfoot, Phalaris, Subterranean Clover, Perennial Ryegrass and the native grass *Bothriochloa macra* (Redgrass). In October 2015, sites South Dump 04 (and 05) were cross ripped and re-seeded to reduce the compaction layer. South Dump 07 and 08 (and 09) were also aerial sown in February 2015 with a mix of endemic native, shrubs and ground cover species. South Dump 10 was sown in February 2018.

GPS coordinates and other site-specific information of the rehabilitation sites are provided in Appendix 1. Due to increasing quantities of photographs and monitoring data, some years have been omitted. Please refer to previous monitoring reports (DnA Environmental 2008 – 2015). In addition, note that sites South Dump 05, 06 and 09 are no longer assessed. In 2023 - 2024, additional revegetation activities on the North Dump included thinning of acacias and planting of eucalypts.

Farmland woodland revegetation sites are assessed on a 3-year rotation, next due in 2025. Please refer to 2022 Rehabilitation monitoring report for monitoring results (DnA Environmental 2022).

Table 5-2. Permanent photo-points of woodland rehabilitation monitoring sites on the south and north dumps 2014 - 2024.

Site	2014	2020	2021	2023	2024
South Dump 04					

Site	2014	2020	2021	2023	2024
South Dump 05					N/A
South Dump 07	N/A				
South Dump 08	N/A				
South Dump 10	N/A				

Site	2014	2020	2021	2023	2024
North Dump 01					
North Dump 02					
North Dump 03					

5.3 Ecological trends and performance against a selection of ecological performance indicators

The following section provides a summary of the ecological trends and performance of woodland rehabilitation sites against a selection of performance indicators obtained from the 3 woodland reference sites.

In terms of data analyses, the majority of young rehabilitation sites were established and first assessed in 2014. Data obtained prior to 2014 from the older sites has been omitted from the report for ease of presentation. For data obtained from these older rehabilitation sites please refer to 2009 – 2016 Cadia annual rehabilitation monitoring reports (DnA Environmental 2009 – 2014).

5.3.1 Landscape Function Analyses

5.3.1.1 Landscape Organisation Index

A patch is an area within an ecosystem where resources such as soil and litter tend to accumulate, while areas where resources are mobilised and transported away are referred to as interpatches. Landscape Organisation Indices (LOI) are calculated by the length of the patches divided by the length of the transect to provide an index or percent Landscape Organisation (LO) of the transect which is occupied by functional patch areas (Tongway and Hindley 2004).

Woodland reference sites were characterised by having a mature tree canopy and in 2 sites, there was a well-developed, decomposing leaf litter layer and a sparse cover of native perennial forbs and grasses. The remaining site tended to have much more dominant perennial grass cover. Drought conditions during 2017 - 2019 caused a reduction in perennial ground covers and increased disturbances by animals created minor bare interpatch areas in RfWood01 and RfWood02, thus lowering Landscape Organisation (LO) in these sites. Since 2020, improved seasonal conditions resulted in a significant increase in the diversity and abundance of ground cover. Despite the onset of drier conditions and recent grazing by livestock in 2 sites, 100% functional patch area continued to be recorded in all woodland reference sites (Figure 5-1).

All rehabilitation sites on the SWRD and NWRD demonstrated a significant increase in functional patch area during the first few years after establishment (Figure 5-1). In some cases however, a loss of many of the original troughs and banks occurred due to erosive processes, however these tended to be counteracted by a concurrent increase in plant and litter covers. During 2017 - 2019 prolonged dry conditions and increased grazing and disturbance by animals resulted in a deterioration of functional patch area, minor increases in erosion and loss of LO in all rehabilitation sites, with this also being reflected in the range of reference sites.

In early 2020, the ongoing effects of drought, heavy grazing and/or increased erosion continued to be recorded in South Dump 04 and 2 reference sites. In remaining sites however, increased patch area was recorded due to the relatively recent germination of annual plant covers. Since then, ongoing favourable seasonal conditions have continued to result in relatively high levels of ground cover and resultant LO. Two sites, South Dump 07 and North Dump 03, did not meet 100% LO targets this year, largely due to heavy grazing and disturbance by animals which have caused minor bare interpatch areas.

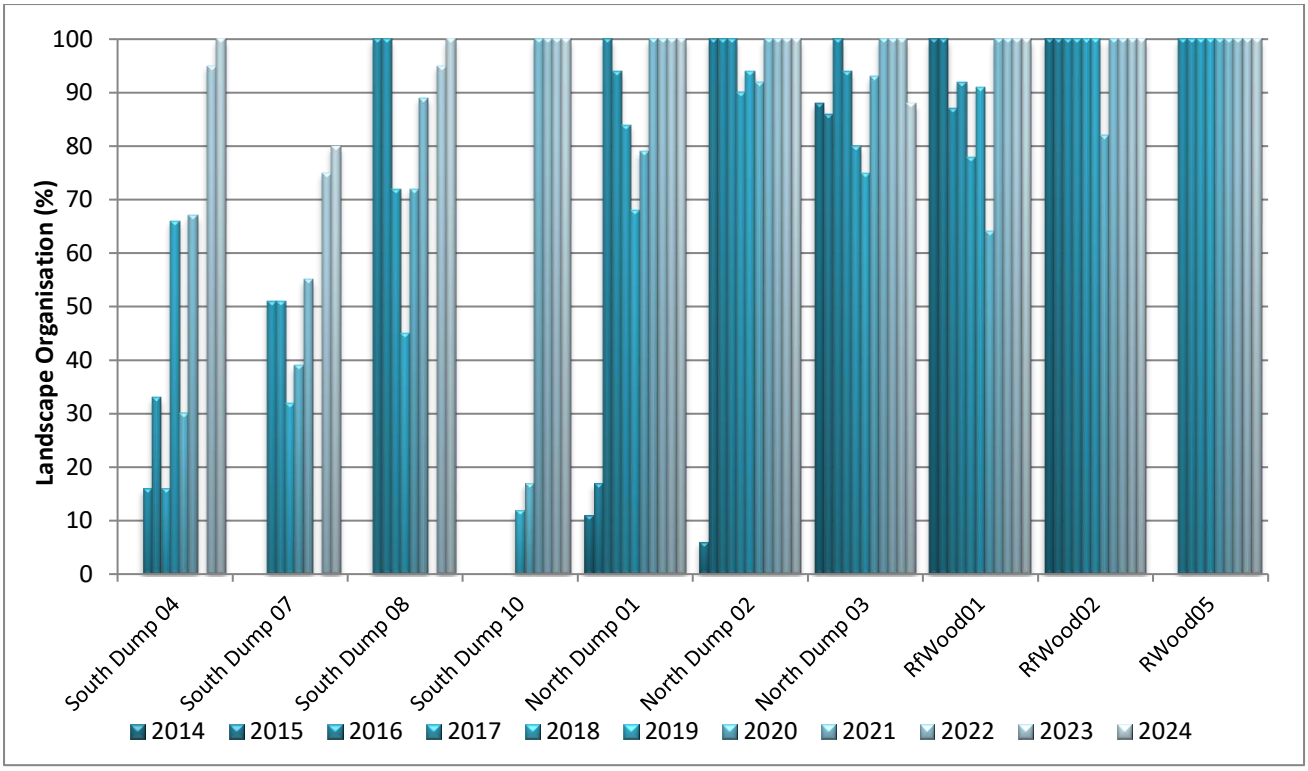


Figure 5-1. Landscape Organisation recorded in the woodland monitoring sites.

5.3.1.2 **Soil surface assessments**

5.3.1.2.1 Stability

Changes in stability in the various woodland reference sites have tended to fluctuate according to seasonal conditions and total grazing pressure with these being most affected during the end of the drought in 2020. While there was high variability between sites, stability has typically increased with improved seasonal conditions since then. However, last year stability in RWood02 declined due to a decline in active plant growth and increased cover of tall rank perennial grasses and litter, while increased stability was recorded in the remaining 2 sites. This year, RfWood01 had been subjected to heavy sheep grazing causing a decline in stability, while recent grazing in RfWood02 has reduced rank growth and improved the perennial grass growth, with a marginal increase in stability recorded in RfWood02 and RWood05 to provide a stability range of 68.5 – 76.3 this year (Figure 5-2).

Stability in the rehabilitation areas has varied significantly, largely as a result of the way the landform was constructed (e.g. soil type, steepness), species that were sown, combined with the ongoing effects of climate and animal disturbance. While some sites were relatively slow to develop, all sites on the SWRD have increased in stability since 2021, due to improved seasonal conditions and improved levels of ground cover, although some sites may still be subjected to grazing and disturbances by animals. This year stability across the 4 monitoring sites on the South Dump were quite similar to each other and ranged from 69.0 – 72.1.

On the NWRD rehabilitation area, there continues to be heavy grazing and the majority of the understorey has become dominated by a well-developed and mostly stable annual plant/litter layer especially in grassy clearings. There continued to be small bare patches which typically occurred on the top of old rip lines where some isolated erosion may have occurred, such as in North Dump 01 and 03. This year stability has declined in North Dump 01 and North Dump 02 with stability indices across the 3 sites ranging from 68.0 – 70.7. Compared to the reference sites, rehabilitation site North Dump 01 had a marginally low stability this year.

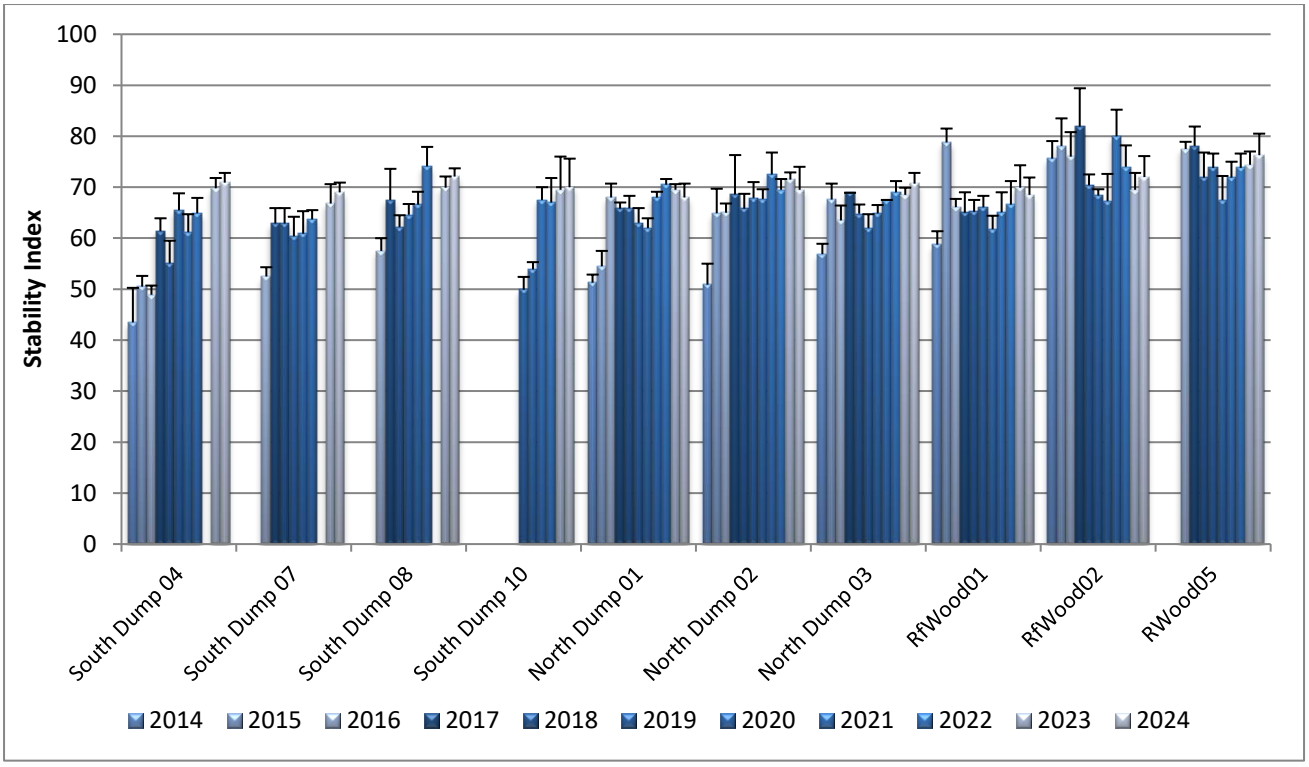


Figure 5-2 LFA stability indices recorded in woodland monitoring sites.

5.3.1.2.2 Infiltration

In the reference sites, there continued to be a well-developed and decomposing litter layer that had often formed a rich spongy humus layer, however during the drought 2017 - 2019, increased usage by wildlife increased soil surface crusting in some areas. There has been marginal change in infiltration with improved seasonal conditions since 2020, however a marginal decline continued to be recorded in RfWood01, due to additional effects of sheep grazing this year. While these changes were minor, reference sites provided an infiltration range of 56.7 – 65.6 (Figure 5-3).

Since the drought, all rehabilitation sites have also demonstrated improved infiltration capacity especially over the last few years of favourable seasonal conditions that has promoted good growth and development of the herbaceous and shrubby understorey in most areas and there has been an increased abundance of cryptogams. This year however, animal grazing and disturbance continues to be high and perennial ground cover was patchy and often low in most rehabilitation areas, with a decline in infiltration capacity being recorded in South Dump 07 and 2 sites on the NWRD. Compared to the reference sites, all rehabilitation sites continued to have a lower infiltration capacity and ranged from 34.0 (South Dump 07) to 51.2 (North Dump 02).

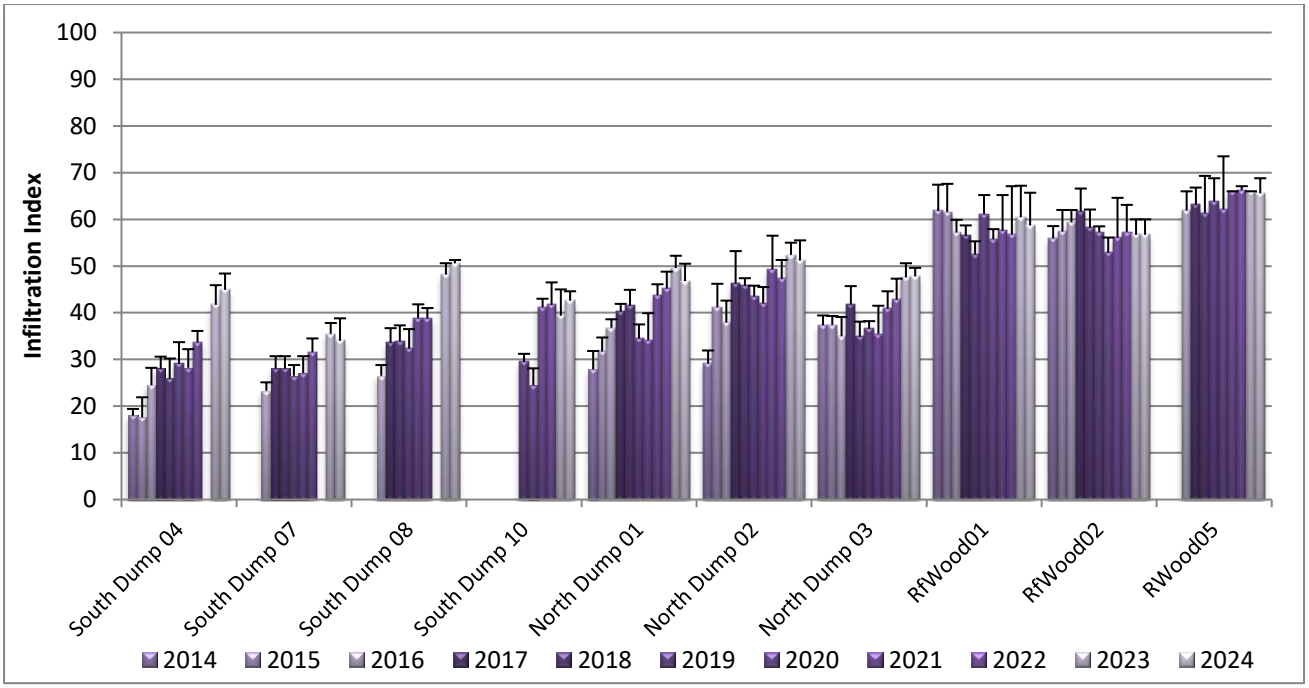


Figure 5-3. Infiltration indices recorded in the woodland monitoring sites.

5.3.1.2.3 Nutrient recycling

Nutrient recycling indices followed similar trends as infiltration capacity of the sites. They also tended to be influenced by the increased levels of perennial canopy and ground cover, litter cover and decomposition as well as cover provided by cryptogams. This year there was a marginal decline in nutrient recycling indices in the woodland reference sites and these ranged from 54.3 – 63.6 (Figure 5-4).

There has been quite a significant increase in nutrient recycling capacity in most rehabilitation sites due to the improved cover of shrubs, with some also having increased levels of ground cover and cryptogams were often abundant, although these were patchy. All rehabilitation sites continue to have a lower nutrient recycling capacity compared to the woodland reference sites and ranged from 35.5 (South Dump 07) to a high of 52.4 (North Dump 02).

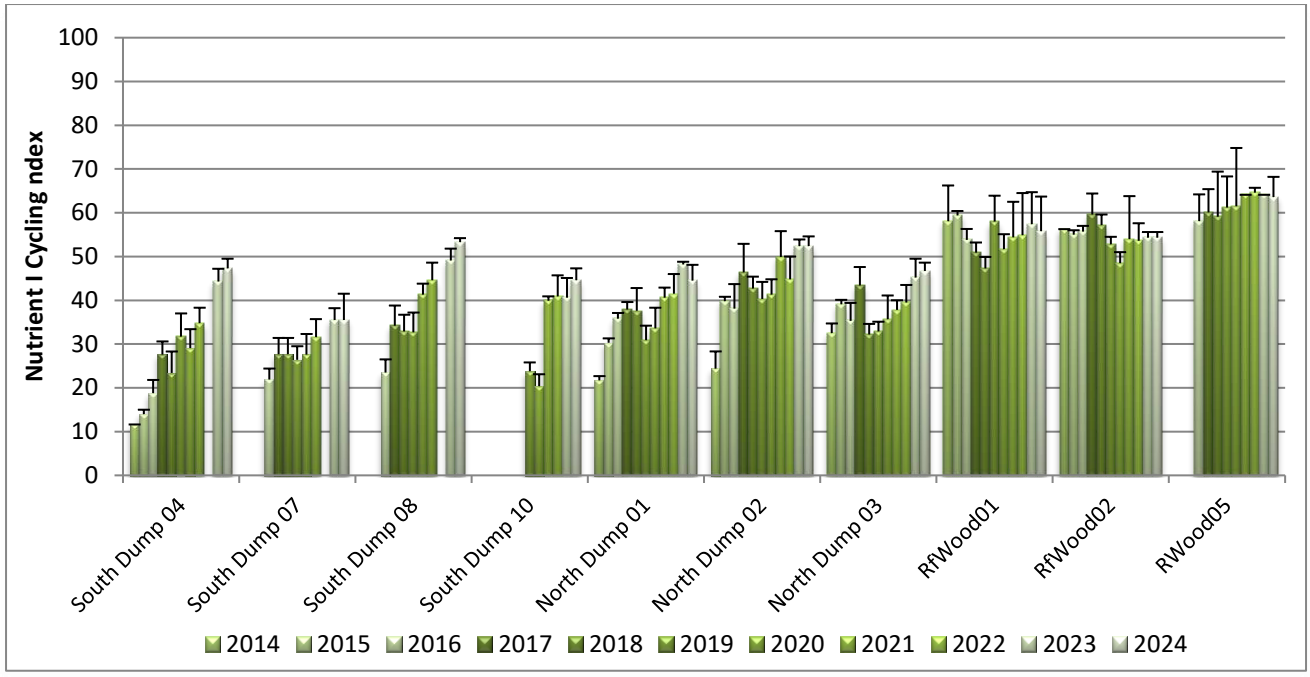
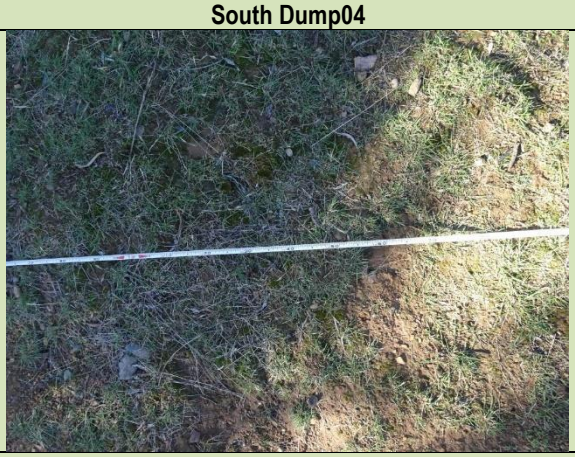


Figure 5-4 LFA nutrient recycling indices recorded in the woodland monitoring sites.

5.3.1.3 **Examples of ground covers**

Examples of ground covers in the various woodland monitoring sites in 2024 is provided in Table 5-3.

Table 5-3. Examples of the ground cover in the woodland monitoring sites in 2024.

South Dump04	South Dump07
	
South Dump08	**South Dump10**
	

North Dump 01	North Dump 02
	
North Dump 03	**RfWood01**
	
RfWood02	**RWood05**
	

5.3.2 Tree and mature shrub populations

5.3.2.1 Density

The total density of live trees and mature shrubs (>5 cm dbh) recorded in the woodland reference sites was variable between sites. There has been a further increase in density recorded in RWood05 this year, as several saplings had grown. The resultant tree densities were 8 – 40 trees per 50 x 20 m (0.1 ha) plot, equating to stem densities of 80 – 400 trees per hectare (Figure 5-5).

Tree and mature shrub densities have been previously increasing in several sites on the SWRD as rehabilitation sites develop and this year there continued to be increased numbers in South Dump 08. In addition, one individual

was recorded for the first time in South Dump 10. No change in trees and mature shrubs was recorded in South Dump 04, however a reduction in numbers were recorded in South Dump 07 due to 8 mortalities.

In sites North Dump 01 and North Dump 03 tree densities remained low, while increased densities were recorded in North Dump 02 as many acacia saplings continue to grow. This year, tree and shrub densities remained low in rehabilitation sites South Dump 04 and 10 and North Dump 01 and 03, compared to the woodland reference sites.

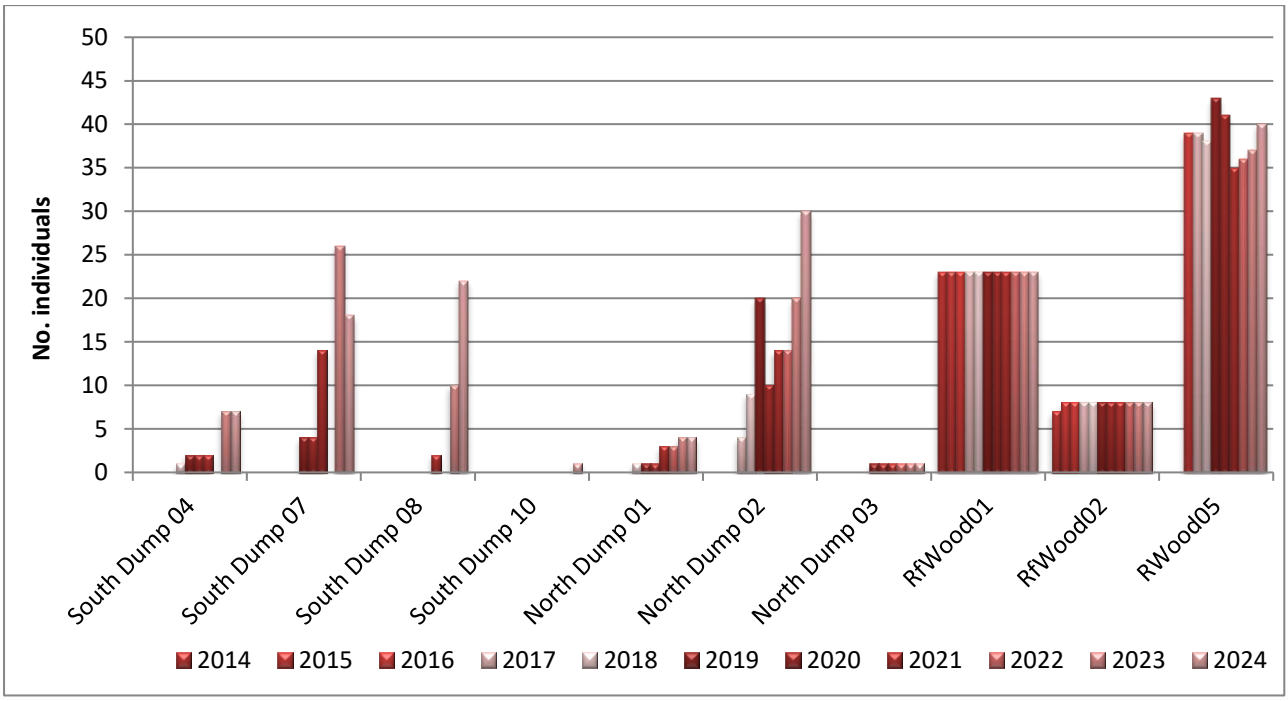


Figure 5-5. Tree and mature shrub densities (>5 cm dbh) in the woodland monitoring sites.

5.3.2.2 **Composition**

The composition of the tree and mature shrub populations is highly variable across the range of sites, with eucalypts being the dominant species in the woodland reference sites. In the SWRD rehabilitation areas where tree and mature shrubs densities were highest (sites 07 and 08), 55 – 78% of the tree and mature shrub populations were eucalypts, with the remainder being acacia species. In South Dump 04, all tree and mature shrubs were acacias, while in South Dump 10, there was only one eucalypt (>5 cm dbh).

In sites on the WRD, tree and mature shrub densities were highly variable, however no monitoring site had eucalypts > 5 cm dbh and all individuals were acacias (Figure 5-6).

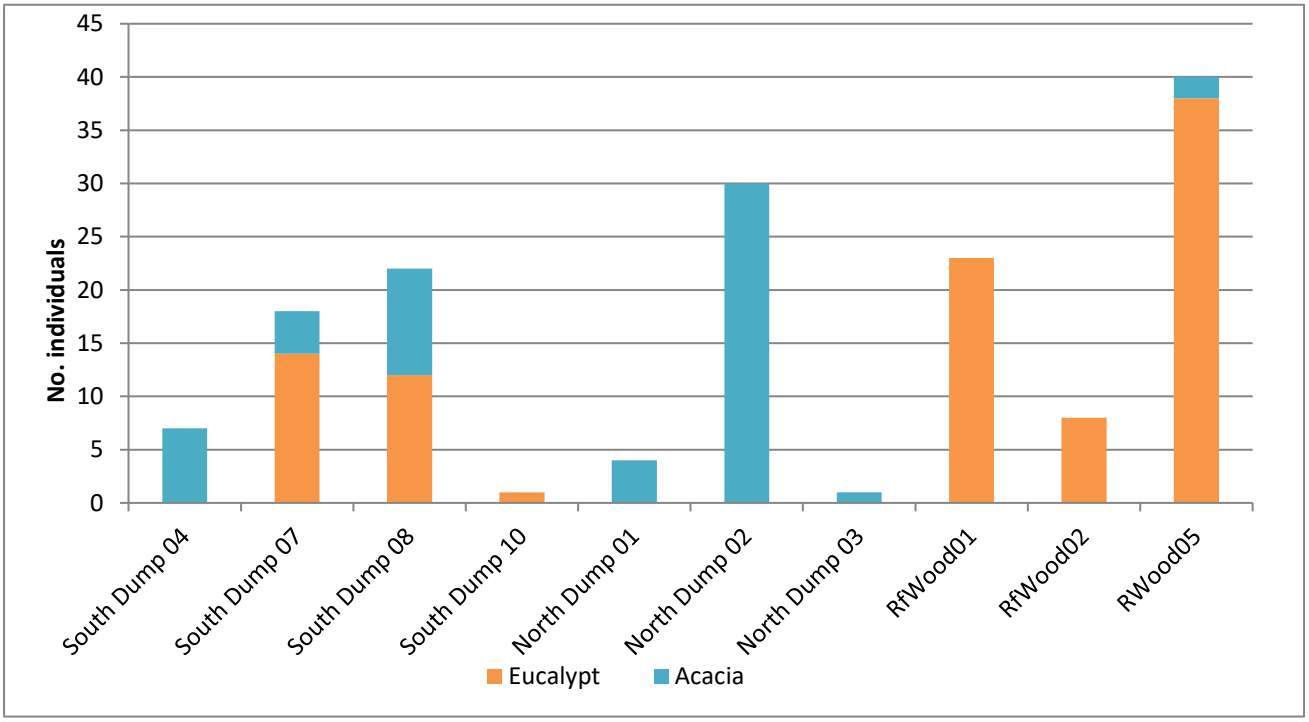


Figure 5-6. Composition of the tree and mature shrub populations in 2024.

5.3.2.3 **Condition**

The average dbh recorded in the reference sites ranged from 26 – 69 cm with the smallest being 6 cm and the largest 95 cm. On the SWRD, tree and mature shrub diameters were 7 – 14 cm on average with some being up to 21 cm at South Dump 04. Trunk diameters in rehabilitation sites on the NWRD ranged from 5 – 16 cm, with the average being 8 - 12 cm (Table 5-4).

Trees and mature shrubs in the woodland reference sites were predominantly in good to moderate health this year however, a small number continue to be stressed in RWood01 and RWood05 and 8 – 13% were stags [dead]. In the reference sites, 50 – 89% of the tree population contained reproductive structures such as buds, flowers or fruits (Table 5-4). RWood02 contained tree hollows (>5 cm) with 44% of the tree population bearing suitable habitat hollows, while fewer were recorded in the remaining 2 sites. Mistletoe was not recorded in any site.

In sites on the SWRD, all individuals were in good to moderate health, however, there has been an increasing number that have died in South Dump 07, including some eucalypts, with 25% of the total stems being dead. Many acacias had reproductive structures and a few eucalypts were in bud. In sites on the NWRD, most individuals were also in good to moderate health, however 25% were in a state of advanced dieback in North Dump 01. Rehabilitation sites were too young to contain tree hollows or mistletoe, however reproductive structures (buds) were recorded in acacias on the NWRD.

5.3.2.4 **Species**

In the reference sites, the tree populations were comprised of 1 – 4 species of tree and mature shrubs (Table 5-4). The most dominant species were *Eucalyptus melliodora* (Yellow Box), *E. albens* (White Box) and *E.*

goniocalyx (Bundy Box), with *E. macrorhyncha* (Red Stringybark), *E. bridgesiana* (Apple Box), *Acacia dealbata* (Silver Wattle) and *A. implexa* (Hickory) typically occurring in fewer numbers.

Rehabilitation sites on the SWRD and NWRD typically had tree populations comprised only of mature *A. dealbata.* Additional species recorded may have included *Acacia implexa* (Hickory), *A. filicifolia* (Fern-leaved Wattle), *A. penninervis* (Mountain Hickory), *Eucalyptus goniocalyx* (Bundy Box), *E. albens* (White Box) and/or *E. bridgesiana* Apple Box).

Table 5-4. Trunk diameters and condition of trees and mature shrubs in woodland monitoring sites in 2024.

Site Name	No species	Average dbh (Cm)	Max dbh (cm)	Min dbh (cm)	Total trees	No. with multiple limbs	% Live trees	% Healthy	% Medium Health	% Advanced Dieback	% Dead	% Mistletoe	% Flowers / fruit	%. Trees with hollows
South Dump 04	1	14	21	8	7	4	100	71	29	0	0	0	86	0
South Dump 07	4	10	15	5	24	4	75	33	42	0	25	0	8	0
South Dump 08	5	8	13	6	22	4	100	100	0	0	0	0	27	0
South Dump 10	1	7	7	7	1	1	100	100	0	0	0	0	0	0
North Dump 01	1	12	16	9	4	3	100	25	50	25	0	0	50	0
North Dump 02	1	8	14	5	38	12	79	53	26	0	0	0	53	0
North Dump 03	1	10	10	10	1	0	100	0	100	0	0	0	100	0
RfWood01	**2**	**33**	**89**	**8**	**25**	**9**	**92**	**68**	**20**	**4**	**8**	**0**	**80**	**4**
RfWood02	**1**	**69**	**95**	**32**	**9**	**1**	**89**	**89**	**0**	**0**	**11**	**0**	**89**	**44**
RWood05	**5**	**26**	**75**	**6**	**46**	**14**	**87**	**26**	**41**	**20**	**13**	**0**	**50**	**13**

5.3.3 Shrubs and juvenile trees

5.3.3.1 Density

The density of shrubs and/or juvenile trees (<5 cm dbh) recorded in woodland reference sites was highly variable with only 2 – 3 individuals recorded in RfWood01 and RfWood02, while 116 seedlings were recorded in RWood05, with these having declined over the past year. Seedling densities were also highly variable in woodland rehabilitation sites and in all monitoring sites a declining trend has occurred.

There has also been a declining trend in shrub densities over the last few years in the rehabilitation sites and while some individuals may have grown and were now recorded as mature trees in some cases, the majority have been drought mortalities and/or had reached the end of their life span (natural senescence). This decline continued to be observed and in South Dump 07, semi-mature eucalypts and additional young acacias had recently died.

In North Dump 01 however, thinning of acacia saplings has occurred as part of a rehabilitation trial. Despite these losses, seedling/sapling densities remained high in all sites except in South Dump 10 where only 9 seedlings were recorded this year (Figure 5-7).

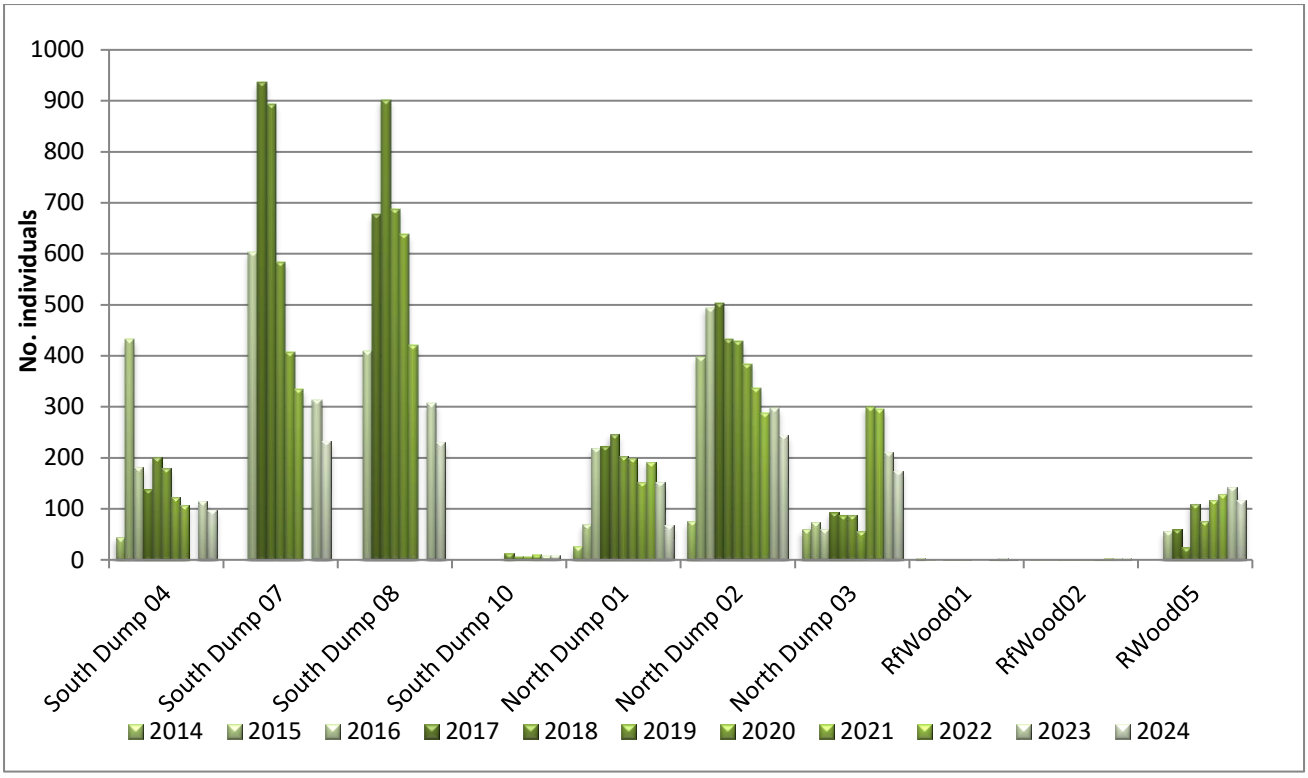


Figure 5-7. Densities of shrubs and juvenile trees in woodland monitoring sites.

5.3.3.2 **Composition**

The composition of the shrub and juvenile tree populations is highly variable across the range of sites, with limited eucalypt seedlings in reference sites this year. In rehabilitation sites, the vast majority of individuals were acacias, however some sites also had volunteer *Cassinia Sifton* (Sifton Bush), with high densities recorded in South Dump 08, North Dump 03. Site South Dump 10 also had exotic *Rubus fruticosus* (Blackberry) and so did RfWood01. A variety of other exotic shrubs seedlings also continue to be recorded in RWood05 (Figure 5-8).

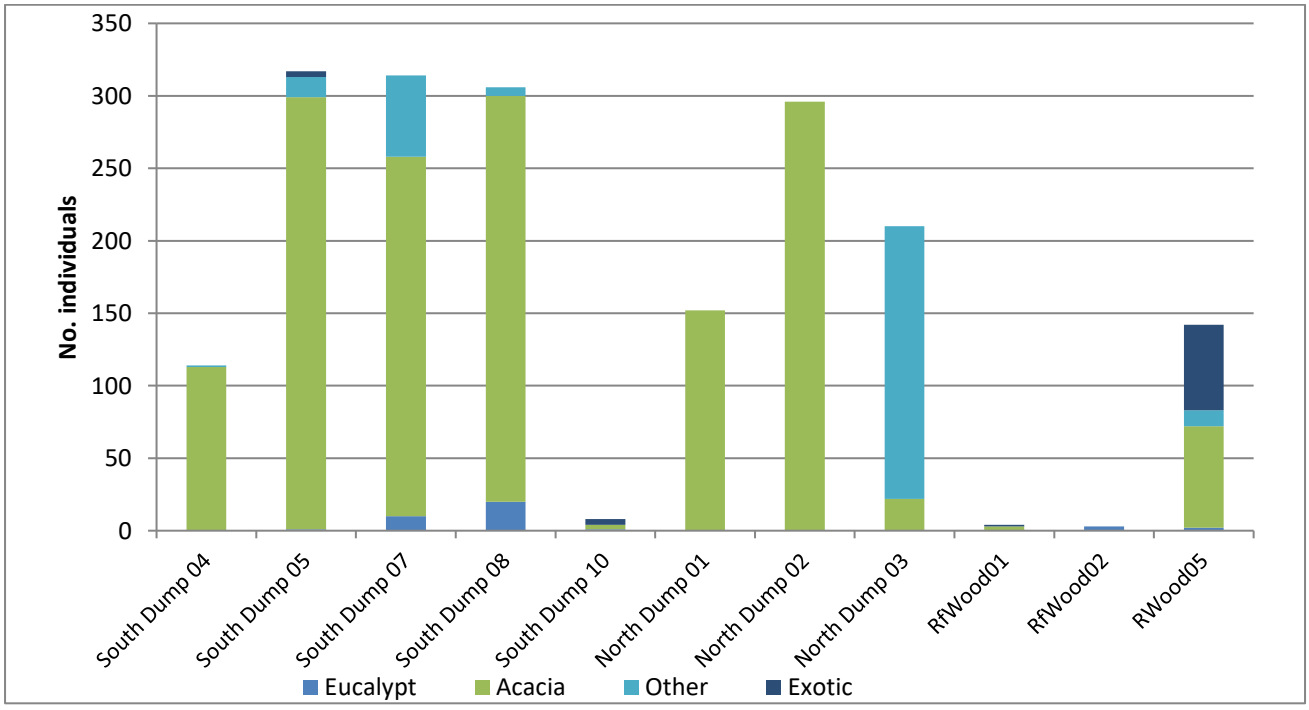


Figure 5-8. Composition of shrub and juvenile tree populations in 2024.

5.3.3.3 **Diversity**

In woodland reference sites there were 1 – 9 different species, including species such as *A. dealbata, A. decora, Cassinia sifton, A. implexa* and *Brachychiton populneus* (Kurrajong) and/or juvenile *E. albens, E. macrorhyncha and/or E. goniocalyx.* There were also numerous exotic shrubs in RWood05 including *Crataegus monogyna* (Hawthorn), *Ligustrum lucidum* (Privet), *Rubus fruticosus* (Blackberry) and *Rosa rubiginosa* (Sweet Briar) which collectively comprised 28% of the shrub population.

Most rehabilitation sites on the SWRD had a relatively high diversity of shrubs and juvenile trees with 5 - 15 different species in South Dump 04, 07 and 08, while on the NWRD, there were 3 – 6 species. In South Dump 10 however, seedling establishment was limited to 2 *A. decora* and 7 *Rubus fruticosus*.

On the NWRD and SWRD, *A. buxifolia* tended to be the most abundant species followed by *A. dealbata* and *A. vestita*. Other occasional species may have included *A. spectabilis* (Mudgee Wattle)*, A. genistifolia* (Early Wattle)*, A. verniciflua* (Varnish Wattle)*, A. penninervis* (Mountain Hickory)*, A. decora* (Western Golden Wattle)*, A. filicifolia* (Fern leaved Wattle), *A. melanoxylon* (Blackwood), *A. paradoxa* (Kangaroo Thorn) and volunteers of Cassinia *sifton. O*ther occasional species may have included *Daviesia leptophylla, Leptospermum continentale, Hakea decurrens, Pultenaea spinosa, P. procumbens* and the native vine *Hardenbergia violacea* (Happy Wanderer).

Eucalypts were recorded more frequently in South Dump 07 and 08, with common species being juvenile *Eucalyptus albens, E. goniocalyx, E. bridgesiana, E. melliodora* and *E. polyanthemos* (Red Box). *Eucalyptus viminalis* (Ribbon Gum)*, E. dives* (Broad-leaved Peppermint) and *E. macrorhyncha* have also been previously recorded in sites on the South Dump that are no longer assessed. This year, one *Eucalyptus viminalis* and 2 *E. goniocalyx* had been planted in North Dump 03. While eucalypt densities were somewhat limited in rehabilitation areas, sites that did not presently contain any eucalypts included South Dump 04 and North Dump 01 and 02.

5.3.3.4 **Height class**

Most seedlings tended to be less than 0.5m in height in the reference sites, while RWood05 also had individuals in all height categories with some >2.0 m tall this year. In rehabilitation areas, all height classes were represented however most individuals tended to be taller than 2.0 m, indicating good growth and development (Table 5-5, Figure 5-9).

Table 5-5. Shrubs and juvenile trees recorded in each height class in woodland monitoring sites in 2024.

Site Name	0-0.5m	0.5-1.0m	1.0-1.5m	1.5-2.0m	>2.0m	Total	No. species	% endemic
South Dump 04	1	11	10	21	54	97	5	100
South Dump 07	8	10	28	66	120	232	11	100
South Dump 08	32	46	52	60	40	230	15	100
South Dump 10	5	4	0	0	0	9	2	22
North Dump 01	30	12	4	13	8	67	3	100
North Dump 02	6	0	22	60	156	244	4	100
North Dump 03	17	68	77	10	2	174	6	100
RfWood01	**2**	**0**	**0**	**0**	**0**	**2**	**2**	**50**
RfWood02	**1**	**0**	**1**	**0**	**1**	**3**	**1**	**100**
RWood05	**62**	**23**	**23**	**6**	**2**	**116**	**9**	**72**

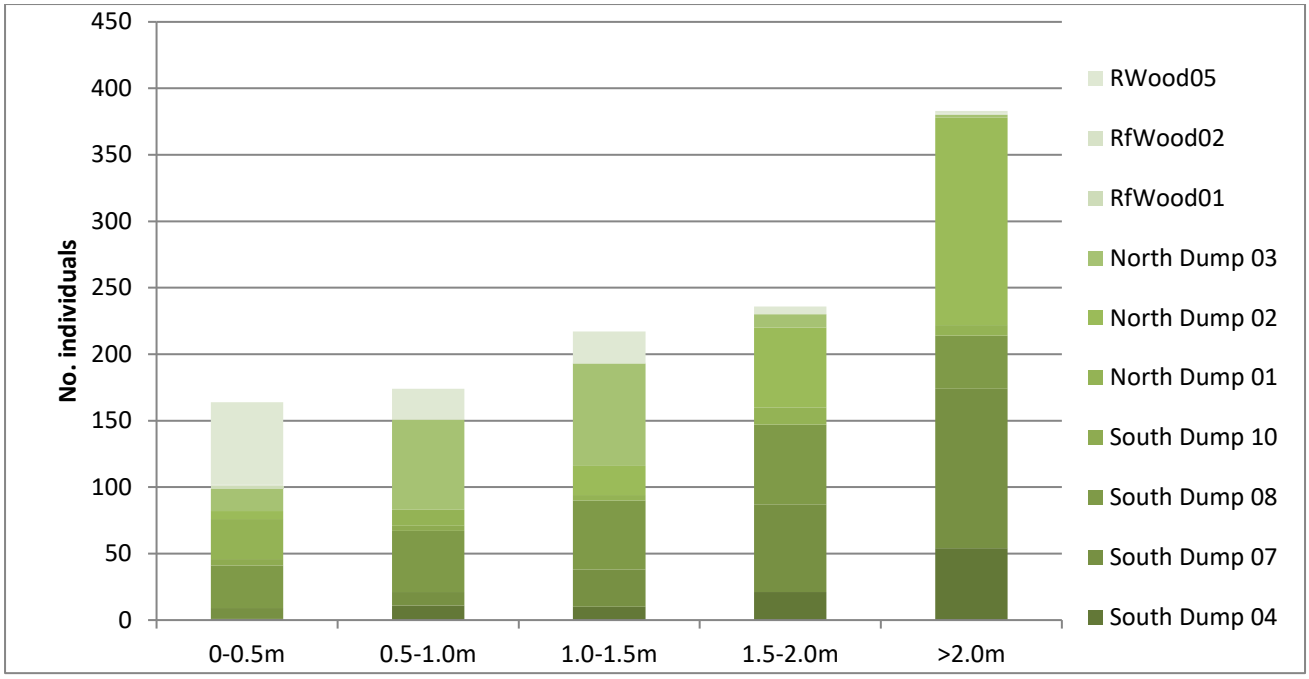


Figure 5-9. Number of individuals across the 5 height classes.

5.3.4 Total ground cover

Total ground cover is a combination of leaf litter, annual plants, cryptogams, rocks, logs and live perennial plants (<0.5 m in height). There was limited overall change in total ground cover across the range of monitoring sites with 96 – 100% cover recorded in the reference sites. There was 84 – 96% cover in sites on the SWRD, while there was 95 – 100% cover on the NWRD. Small bare patches from macropod disturbance and/or camps may have reduced ground cover in some sites (Figure 5-10).

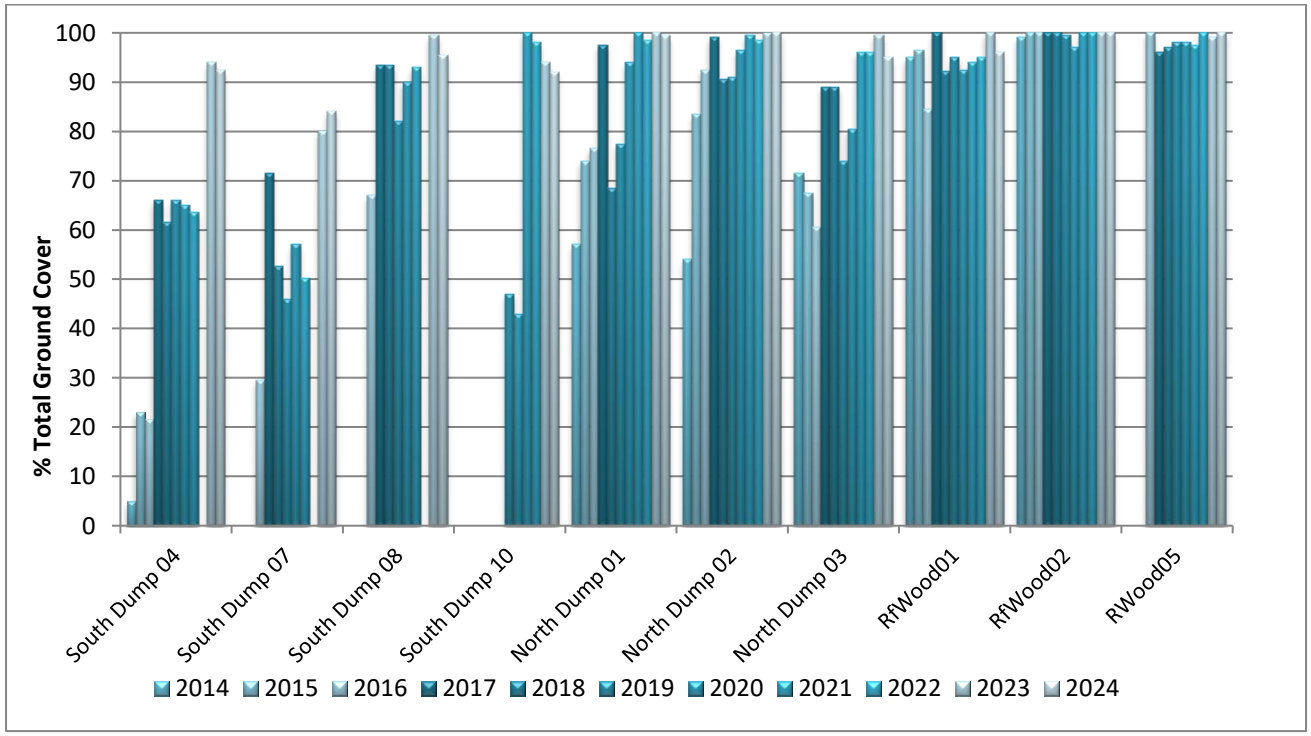


Figure 5-10. Total ground cover recorded in woodland monitoring sites.

5.3.5 Structural composition

This year, ground cover in the reference sites continued to be similar to each other and all had increased levels of dead leaf litter which provided 69 - 82% cover. There has been a reduction on annual plant covers however all sites contained a sparse scattering of annual (1 – 2%) and perennial (5 - 23%) ground covers. In all 3 sites there was a small amount of cover from fallen branches and in RfWood02 there continued to be a rocky outcrop. Cryptogam cover continued to be absent due to the high levels of plant and litter covers (Figure 5-11).

In rehabilitation sites on the SWRD, dead litter provided 46 – 71% ground cover, while perennial ground covers or low hanging shrubs (<0.5 m) provided 10 – 25% cover. Annual plant cover was highly variable and ranged from 4 – 24%, while 2 sites had scattered rocks and cryptogams were low in abundance in all sites except South Dump 10. On the NWRD, there was on average 28 – 75% litter, 10 – 24% perennial ground cover and 4 – 40% annual plant cover. Scattered rocks provided minor cover in all sites and in North Dump 03, cryptogams were also in low abundance. No logs were recorded in any rehabilitation site.

Woodland reference sites had a mature canopy cover (>6.0 m) that provided 27 – 40% projected foliage cover, but typically there was limited foliage cover in the lower height classes, a characteristic feature of open grassy woodland communities. On the SWRD, establishing tree and shrub seedlings/saplings provided relatively high densities of foliage cover 0.5 – 4.0 m in height in all sites except South Dump 10, with some cover up to 6.0 m tall in 2 sites this year.

On the NWRD, highest canopy cover was recorded in North Dump 02 with relatively dense cover of foliage cover up 4.0 m tall, while there was also some limited cover up to 4.0 m in North Dump 03. In North Dump 01, cover was limited and almost all was less than 0.5 m tall. Community structure of individual rehabilitation monitoring sites in 2024 is provided in Appendix 3.

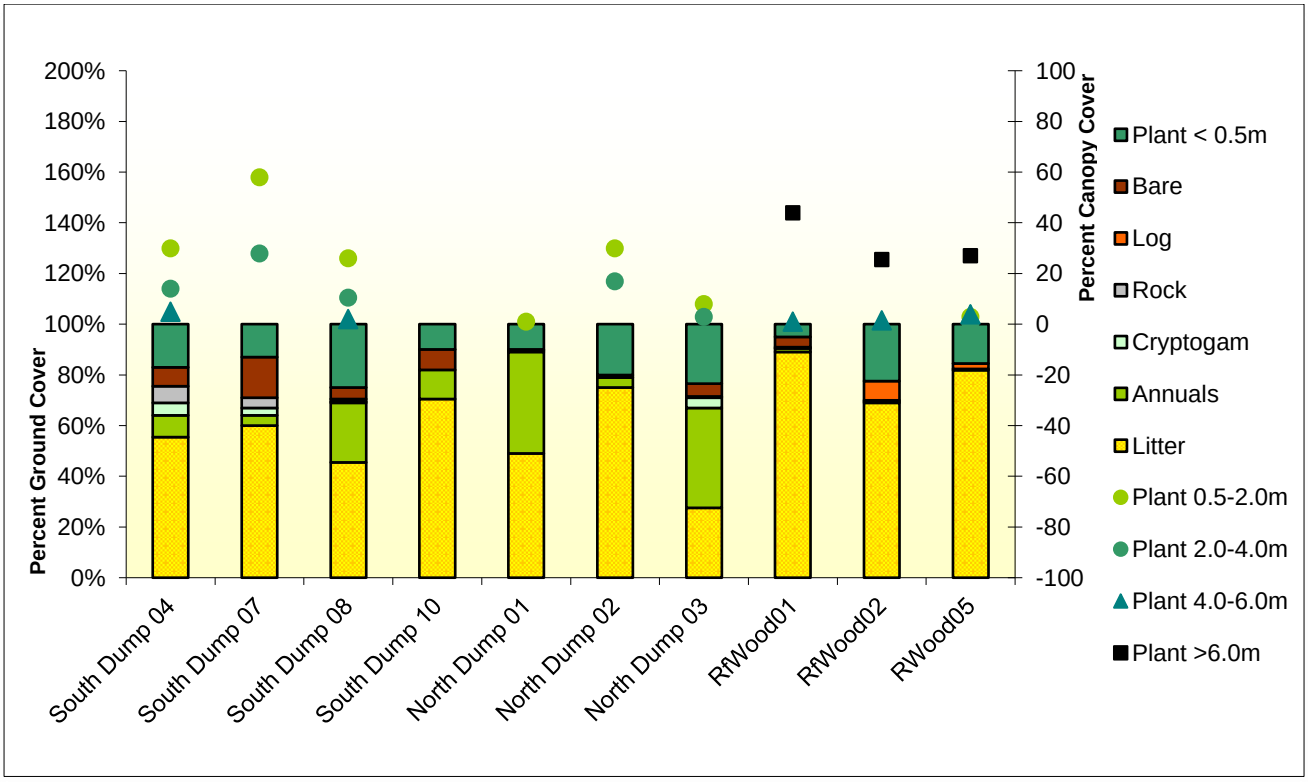


Figure 5-11. Average percent ground cover and projected foliage cover recorded in the woodland monitoring sites in 2024.

5.3.6 Floristic Diversity

There has been no consistent change in total species diversity across the range of monitoring sites, however the level of diversity has tended to fluctuate with the seasonal conditions and degree of grazing intensity. In rehabilitation areas, floristic diversity is also implicated with rehabilitation construction methods, origin of topsoil, species selection, sowing rates, success of establishment as well as stage of successional development and/or management intervention/s of the areas.

In all monitoring sites, species diversity was lowest during 3 years of drought, with the lowest diversity in the reference sites being recorded in 2018. Since improved seasonal conditions in 2020 there has been an increase in diversity across most sites. In the reference sites, there were 23 – 61 species recorded this year, with a reduction being recorded in RfWood01 as a result of livestock grazing. Most rehabilitation sites had a minor increase in floristic diversity, where there were 30 – 61 species on the South Dump and 37 – 48 on the North Dump (Figure 5-12).

Exotic species comprised 41 – 65% of species in the reference sites this year, where there were 15 – 25 exotic species (Figure 5-13). In rehabilitation sites, exotic species made up 28 – 83% of diversity in sites on the South Dump with 10 – 25 exotic species. On the North Dump, exotic species were quite dominant and made up 67 – 73% of diversity, with 26 - 32 exotic species. All rehabilitation sites except South Dump 07 had a higher diversity of exotic species than the reference sites this year (Figure 5-14). A comprehensive list of flora species recorded in the monitoring sites is provided in Appendix 2.

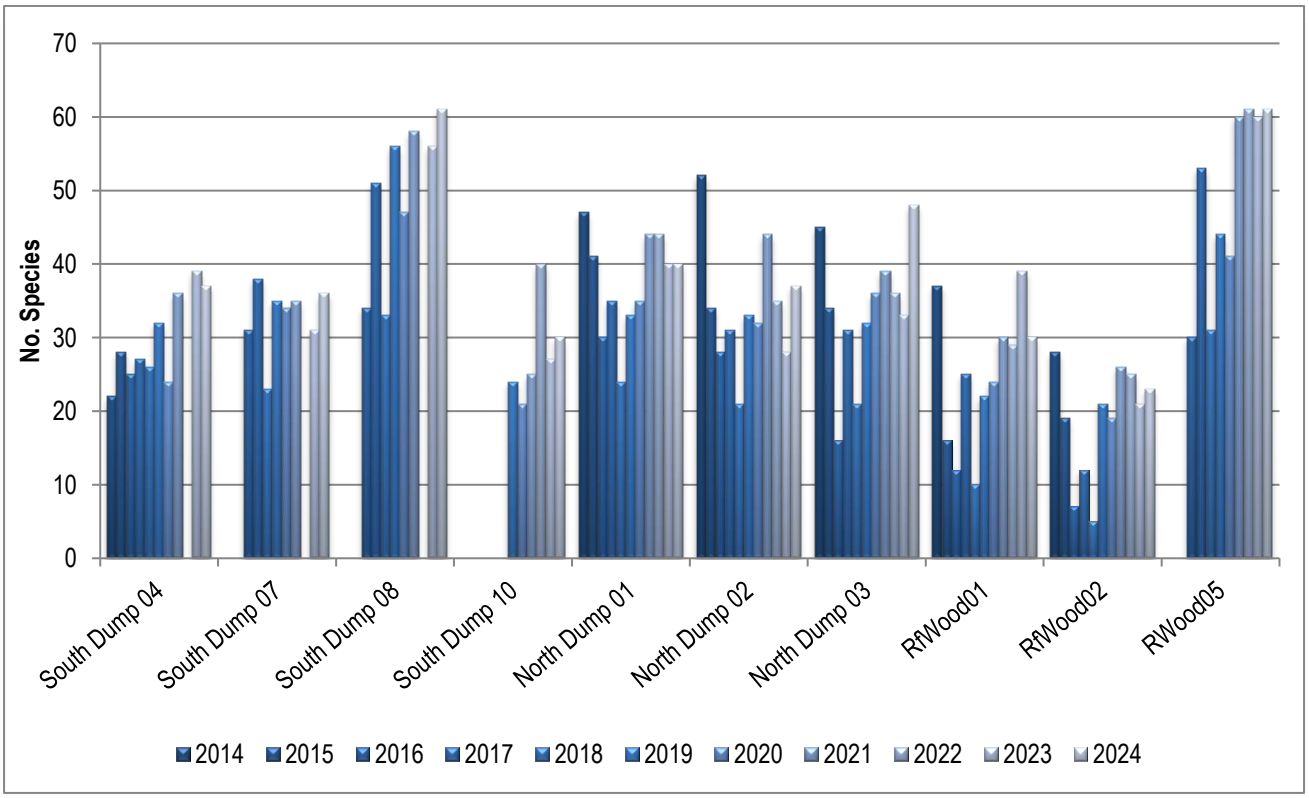


Figure 5-12. Total species diversity recorded in the woodland sites.

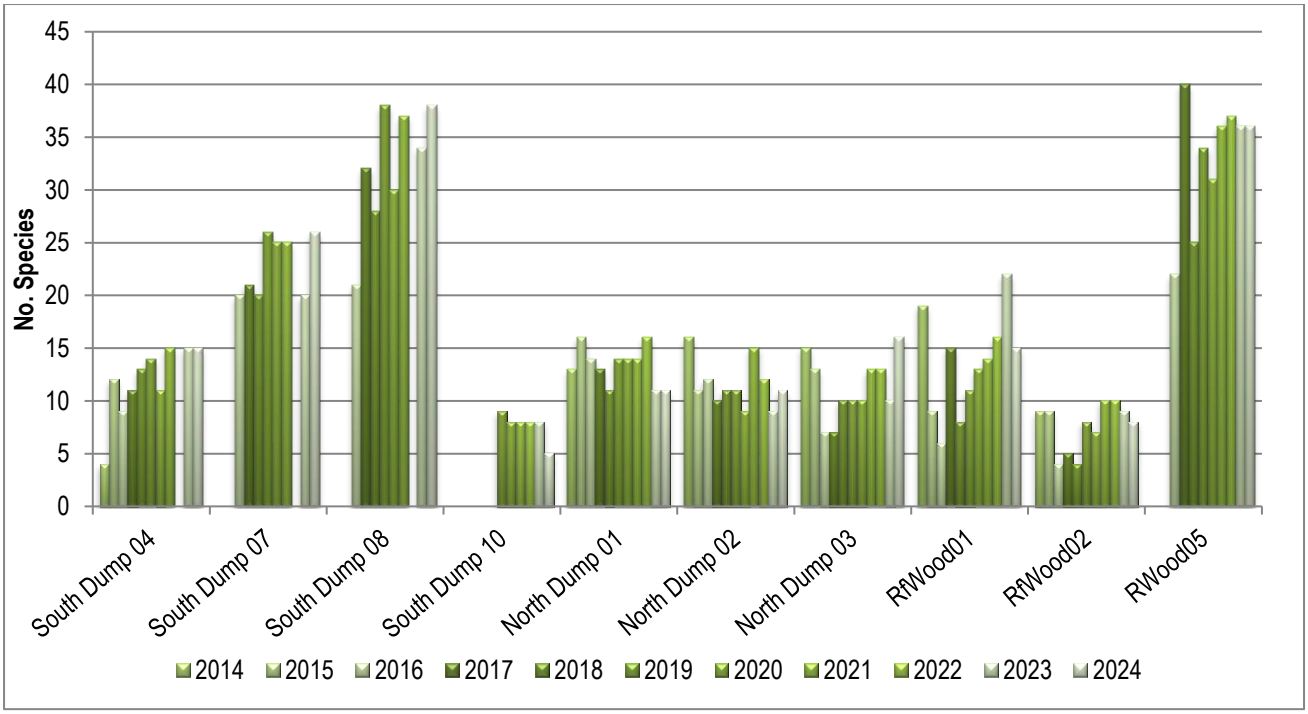


Figure 5-13. Native species diversity recorded in woodland monitoring sites.

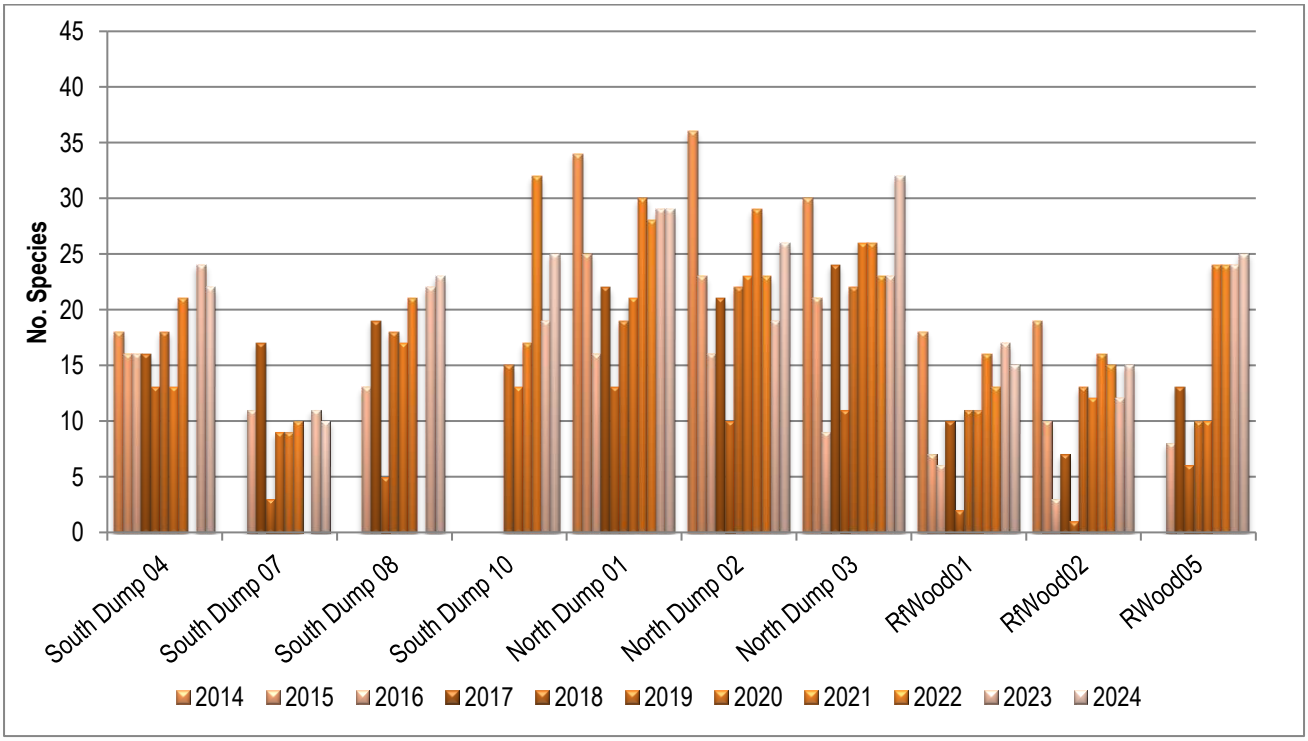


Figure 5-14. Exotic species diversity recorded in woodland monitoring sites.

5.3.7 Native ground cover abundance

Native ground cover abundance is an additional ecological indicator which provides a measure of the cover abundance of the native vegetation and an indication of the overall weediness of the sites (Figure 5-15). Similarly, to the floristic diversity data, the proportionate ground cover provided by native plants has also been strongly influenced by the seasonal conditions and degree of grazing pressure. Dry conditions usually result in the lower abundance of exotic annual plants thus tending to increase the cover provided by live native perennial species.

This year, drier conditions has tended in an increase in the proportion of native plant cover, with native plants providing 26 - 79% of the live plant cover in the reference sites.

In rehabilitation sites on the SWRD, there was also an increase in native plant cover in all sites except South Dump 10 where no native ground cover was recorded at all. Native ground covers had become dominant in South Dump 04 and 07 with 60% and 80% native plant cover, while 40% native plant cover was recorded in South Dump 08 this year.

On the NWRD cover provided by native plants has declined in 2 sites and provided 22 – 30% cover this year. While exotic plants may have been more abundant in numerous sites, all rehabilitation sites, except South Dump 10 and North Dump 01 had an acceptable cover of native plants compared to the RfWood02 reference site this year.

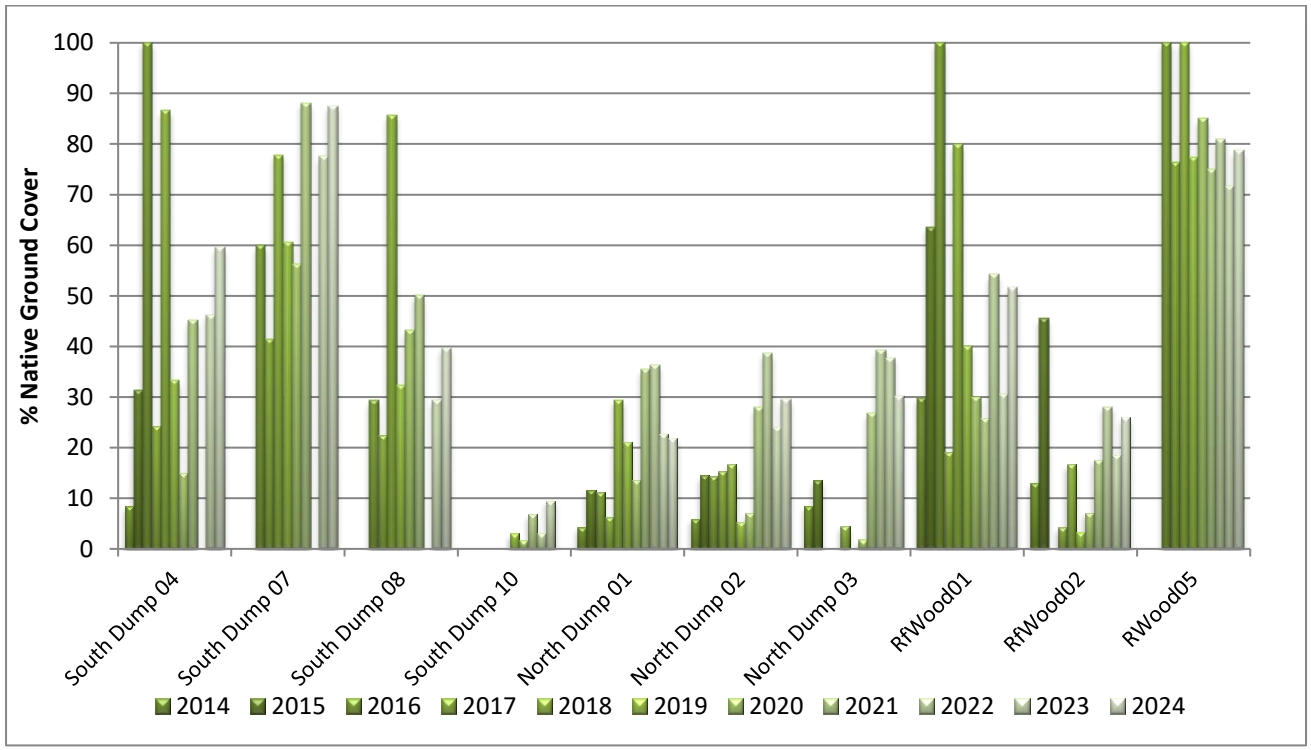


Figure 5-15. Native cover abundance in woodland monitoring sites.

5.3.8 Most common species

The most common species, those that were recorded in at least 6 of the 7 woodland rehabilitation sites in 2024 is given in Table 5-6.

Exotic species *Avena fatua* (Wild Oats), *Modiola caroliniana* (Red-flowered Mallow), *Trifolium subterraneum* (Subterraneum Clover), *Echium plantagineum* (Paterson's curse), *Phalaris aquatica* (Phalaris) and *Rumex acetosella* (Sheep Sorrel) were recorded in most rehabilitation sites. Native species *Acacia buxifolia*, *A. vestita*, *Oxalis perennans* (Yellow Wood-sorrel) and *Rytidosperma racemosum* (Wallaby Grass) were also very common.

Many common species were also recorded in at least one of the woodland reference sites, reflecting their natural distribution within the local area, while some species such as several acacias, were sown as part of the rehabilitation program. A comprehensive list of species recorded in all woodland monitoring sites in 2024 has been included in Appendix 2.

Table 5-6. Most common species in woodland rehabilitation sites in 2024.

exotic	Scientific Name	Common Name	Growth Form	North Dump 01	North Dump 02	North Dump 03	South Dump 04	South Dump 07	South Dump 08	South Dump 10	Total	RfWood01	RfWood02	RWood05
*	*Avena fatua*	Wild Oats	g	1	1	1	1	1	1	1	**7**		1	
*	*Modiola caroliniana*	Red-flowered Mallow	h	1	1	1	1	1	1	1	**7**			
*	*Trifolium subterraneum*	Subterraneum Clover	h	1	1	1	1	1	1	1	**7**	1	1	1
	Acacia buxifolia	Box-leaved Wattle	s	1	1	1	1	1	1		**6**			
	Acacia vestita	Weeping Boree	s	1	1	1	1	1	1		**6**			
*	*Echium plantagineum*	Paterson's Curse	h	1	1	1	1		1	1	**6**			
	Oxalis perennans	Yellow Wood-sorrel	h	1	1	1	1	1	1		**6**	1		1
*	*Phalaris aquatica*	Phalaris	g	1	1		1	1	1	1	**6**		1	1
*	*Rumex acetosella*	Sheep Sorrel	h	1	1	1	1	1	1		**6**	1		1
	Rytidosperma racemosum	Wallaby Grass	g	1	1	1	1	1	1		**6**	1	1	1

Key to growth form legend: t = tree; s = shrub; ss =sub-shrub; h = herb; g = grass, r = reed; v = vine; f = fern; c = cactus

5.3.9 Most abundant species

The most abundant species recorded in each of the rehabilitation monitoring sites this year are provided in Table 5-7. The most abundant species were those that collectively summed to a Braun-Blanquet total of 10 or more from the 5 replicated samples along the vegetation transect. The maximum score that can be obtained by any one species is 30.

Woodland reference sites tended to be dominated by a combination of perennial grasses *Phalaris aquatica* (Phalaris) and *Rytidosperma racemosum* (Wallaby Grass), with annual species being less abundant this year. Ground covers in rehabilitation areas was highly variable, with the most abundant species in South Dump 08 this year being *Rytidosperma racemosum* (Wallaby Grass), with extensive germination of *Trifolium subterraneum* (Subterraneum Clover) occurring after recent autumn rainfall. South Dump 10 and North Dump 02 continue to be dominated by *Phalaris aquatica* (Phalaris), while North Dump 01 and 03 were had an abundance of exotic annuals *Trifolium subterraneum* and *Modiola caroliniana* (Red-flowered Mallow), with *Rytidosperma racemosum* also increasing in abundance in North Dump 03. No species was present in sufficient abundance to minimum abundance criteria in South 04 and 07 this year. Species and their abundance cover recorded at the individual sites is provided in Appendix 3.

Table 5-7. Most abundant species in woodland monitoring sites in 2024.

exotic	Scientific Name	Common Name	Growth Form	South Dump 04	South Dump 07	South Dump 08	South Dump 10	North Dump 01	North Dump 02	North Dump 03	RfWood01	RfWood02	RWood05
*	*Trifolium subterraneum*	Subterraneum Clover	h			12		15		16			
	Rytidosperma racemosum	Wallaby Grass	g			12				18	10		13
*	*Phalaris aquatica*	Phalaris	g				13		15			12	
*	*Modiola caroliniana*	Red-flowered Mallow	h					13		13			

Key to growth form legend: t = tree; s = shrub; ss =sub-shrub; h = herb; g = grass, r = reed; v = vine; f = fern; c = cactus

5.3.10 **Vegetation composition**

The composition of the vegetation as categorised by 8 different growth forms is given in Figure 5-16, with these being highly variable between the sites. The reference sites were comprised by a high diversity of herbs with 14 - 36 species followed by grasses with 4 – 10 species. There were 1 – 4 species of tree and while one site had no shrubs, there were 2 - 8 different shrubs in the other 2 sites. There were 1 - 3 reed species however there were no sub-shrubs, vines or ferns.

In woodland rehabilitation sites, most sites had a composition that was comparable to the reference sites however there continued to be an absence of tree species in South Dump 04 and North Dump 01 and 02. South Dump 07 had a slightly low diversity of grasses, while South Dump 10 had a slightly low diversity of reeds, compared to woodland reference sites.

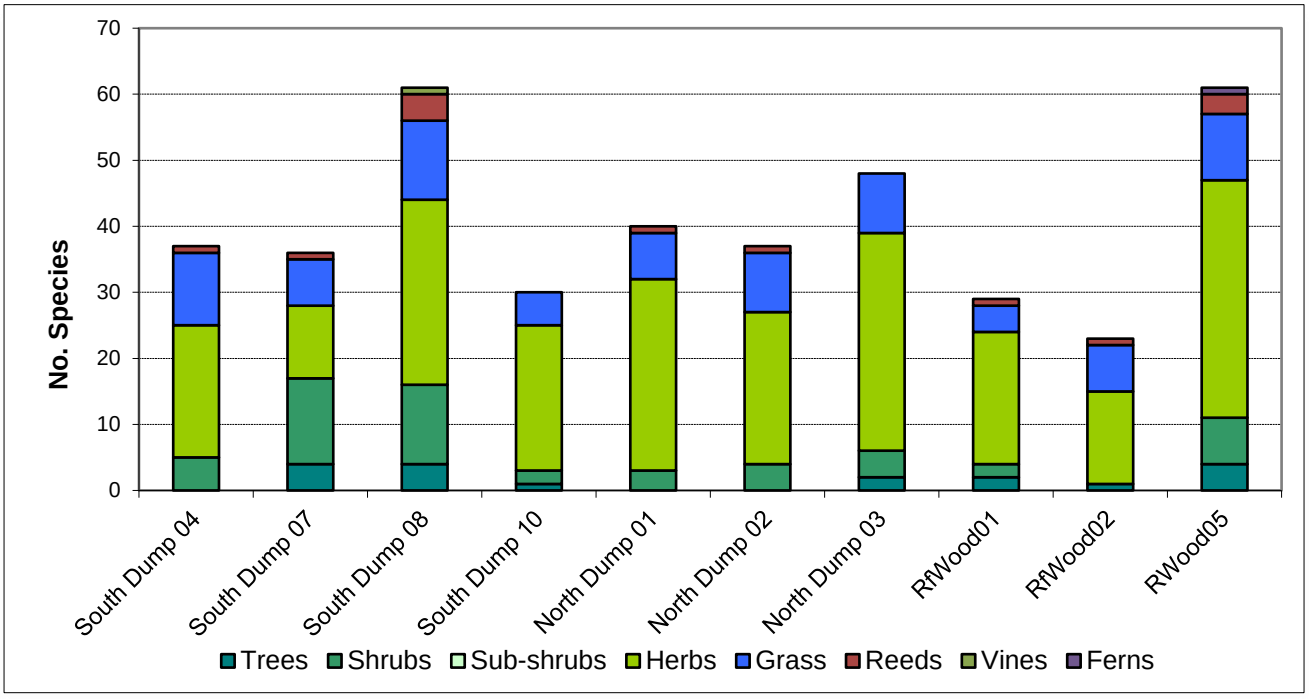


Figure 5-16. Vegetation composition of woodland monitoring sites in 2024.

5.3.11 **Rill Assessment**

"Rills of concern" are those that have minimum dimensions of 10 cm x 30 cm (0.03 m^2) as described by Nichols (2007) and are measured along a 50 m transect along the contour. Minor rilling has previously been recorded in some sites on rehabilitation areas, however these have tended to stabilise as the sites have developed and ground covers became more established. Minor rilling however, continued to be recorded in South Dump 07 which has remained stable with cross-sectional area of 0.081 m^2 (Figure 5-17). North Dump 01 continues to have 2 rills that appeared relatively stable due to high levels of ground cover, although ground cover has decreased over the past year.

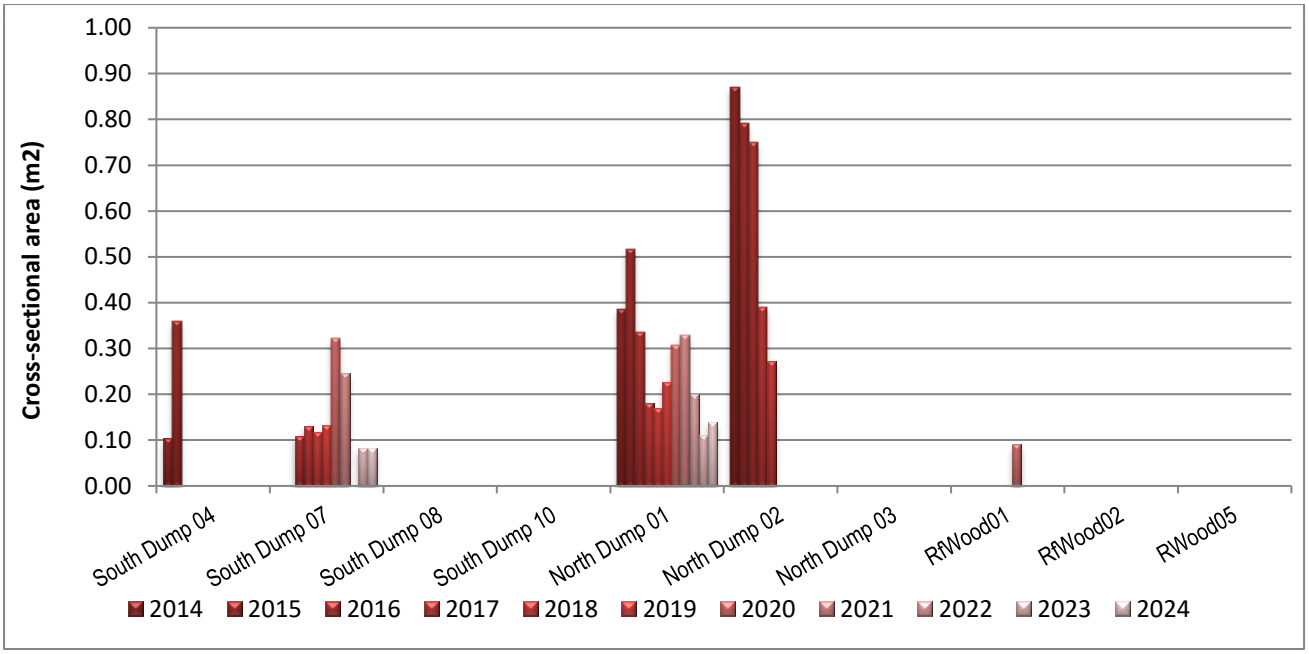


Figure 5-17. Sum of the cross-sectional area of rills recorded in woodland monitoring sites.

5.3.12 **Soil Analyses**

Soil analyses are undertaken every 3 years and were last sampled in 2023, with these results provided in DnA Environmental (2023).

The results of the 2023 soil analyses indicated that rehabilitation areas typically had a soil chemistry similar to the local reference sites and/or were close to recommended agricultural guidelines, with some exceptions. Soils tended to be slightly acidic to neutral, non-saline and non-sodic and most were low in organic matter and had low Cation Exchange Capacity (CEC). In South Dump 05 and 08 however, the soils were strongly acidic.

The results of the soil analyses also indicated there were numerous elements which occurred at elevated levels in the rehabilitation sites, however some such as sulfur, manganese, iron, copper and silicon and were also recorded at elevated levels in one or more of the woodland reference sites, suggesting they can occur at “naturally” high levels around the local area. However, copper was recorded in particularly high concentrations in South Dump 07 and sites on the 3 monitoring sites on the NWRD. Iron was also recorded in high concentrations in South Dump 05 and 08 compared to soils from the woodland reference sites.

6 Priority weeds

The number of sites that WONS and listed priority weeds of the Central Tablelands (NSW DPI 2022) that were recorded are provided in Table 6-1. In total 6 WONS and priority weeds were recorded across the range of woodland monitoring sites, and these were scattered in limited numbers, including the woodland reference sites. It appears that there may be increasing occurrences of *Hypericum perforatum* (St. John's Wort) and *Nassella trichotoma* (Serrated Tussock).

Table 6-1. WONS and priority weeds recorded at Cadia in 2024.

Scientific Name	Common Name	Growth Form	North Dump 01	North Dump 02	North Dump 03	South Dump 04	South Dump 07	South Dump 08	South Dump 10	RWood01	RWood02	RWood05	Total Sites
Crataegus monogyna	Hawthorn	s										1	**1**
Hypericum perforatum	St. John's Wort	h			1	1		1					**3**
Ligustrum lucidum	Large-leaved Privet	s										1	**1**
Nassella trichotoma	Serrated Tussock	g	1	1	1	1							**4**
Rubus fruticosus	Blackberry	s							1	1		1	**3**
Solanum sisymbriifolium	Sticky Nightshade	h	1						1		1		**3**

Key to growth form legend: t = tree; s = shrub; ss =sub-shrub; h = herb; g = grass, r = reed; v = vine; f = fern; c = cactus

7 Threatened flora

No threatened flora have been identified in the range of monitoring sites.

8 Performance of woodland rehabilitation monitoring sites against completion criteria

The performance of woodland rehabilitation monitoring sites against completion criteria in 2024 is provided in Table 8-1. Completion criteria are considered to be met when primary performance targets fall within the specified target ranges, and these have been represented by a coloured box. A striped coloured box indicates that the soil characteristics may not necessarily be similar to the local soils but fall within acceptable agricultural industry guidelines.

A comprehensive KPI table of woodland rehabilitation monitoring sites against completion criteria and secondary performance indicators in 2024 is provided in Appendix 4.

Table 8-1. Performance of woodland rehabilitation monitoring sites against completion criteria in 2024.

Rehabilitation Phase	Aspect or ecosystem component	Completion criteria	Performance Indicators	Unit of measurement	2024 Woodland ecosystem range		South Dump 04	South Dump 07	South Dump 08	South Dump 10	North Dump 01	North Dump 02	North Dump 03
Performance indicators are quantified by the range of values obtained from replicated reference sites assessed in 2024					Lower KPI	Upper KPI	2024						
Phase 3: Landform Establishment and Stability	Landform slope, gradient	Landform suitable for final land use and generally compatible with surrounding topography and final landform design	Slope	Degrees (<18°)	10	14	18	16	0	17	14	15	2
	Active erosion	Areas of active erosion are limited	No. Rills/Gullies	No.	0	0	0	1	0	0	2	0	0
Phase 4: Growth Medium Development	Soil chemical, physical properties and amelioration	Soil properties are suitable for the establishment and maintenance of selected vegetation species	pH	pH (5.6-7.3)	0.0	0.0	na	na	na	na	na	na	na
			Organic Matter	% (>4.5)	0.0	0.0	na	na	na	na	na	na	na
			Phosphorous	mg/kg (50)	0.0	0.0	na	na	na	na	na	na	na
Phase 5: Ecosystem & Land Use Establishment	Landscape Function Analysis (LFA): Landform stability and organisation	Landform is stable and performing as it was designed to do	LFA Stability	%	68.5	76.3	70.9	69.0	72.1	70.0	68.0	69.5	70.7
			LFA Landscape organisation	%	100	100	100	80	100	100	100	100	88
	Vegetation diversity	Vegetation contains a diversity of species comparable to that of the local remnant vegetation	Diversity of shrubs and juvenile trees	% population	50	100	100	100	100	22	100	100	100

Rehabilitation Phase	Aspect or ecosystem component	Completion criteria	Performance Indicators	Unit of measurement	2024 Woodland ecosystem range		South Dump 04	South Dump 07	South Dump 08	South Dump 10	North Dump 01	North Dump 02	North Dump 03
			Total species richness	No./area	23	61	37	36	61	30	40	37	48
	Vegetation density	Vegetation contains a density of species comparable to that of the local remnant vegetation	Density of shrubs and juvenile trees (< 5 cm dbh)	No./area	0	3	0	8	10	0	0	0	3
				No. eucalypts/area	0	70	97	194	100	2	67	244	19
				No. acacias/area	0	11	0	30	120	0	0	0	152
				<No. Exotic/area	0	32	0	0	0	7	0	0	0
				% eucalypts/ population	0	100	0	3	4	0	0	0	2
	Ecosystem composition	The vegetation is comprised by a range of growth forms comparable to that of the local remnant vegetation	Trees	No./area	1	4	0	4	4	1	0	0	2
			Shrubs	No./area	0	7	5	13	12	2	3	4	4
			Grasses	No./area	4	10	11	7	12	5	7	9	9
Phase 6: Ecosystem & Land Use Development	Landscape Function Analysis (LFA): Landform function and ecological performance	Landform is ecologically functional and performing as it was designed to do	LFA Infiltration	%	56.7	65.6	44.9	34.0	50.6	42.6	46.8	51.2	47.8
			LFA Nutrient recycling	%	54.3	63.6	47.3	35.5	53.3	44.6	44.5	52.4	46.7
	Protective ground cover	Ground layer contains protective ground cover and habitat structure comparable with the local remnant vegetation	Perennial plant cover (< 0.5 m)	%	5	22.5	17	13	25	10	10	20	24
			Total Ground Cover	%	96	100	93	84	96	92	100	100	95
	Ground cover diversity	Vegetation contains a diversity of species per square meter comparable to that of the local remnant vegetation	Native understorey abundance	> species/m^2	1	5.0	2.8	2.4	2.2	0	1.4	1.4	1.2

Rehabilitation Phase	Aspect or ecosystem component	Completion criteria	Performance Indicators	Unit of measurement	2024 Woodland ecosystem range		South Dump 04	South Dump 07	South Dump 08	South Dump 10	North Dump 01	North Dump 02	North Dump 03
	Native ground cover abundance	Native ground cover abundance is comparable to that of the local remnant vegetation	Percent ground cover provided by native vegetation <0.5m tall	%	26	78.7	59.5	87.5	39.7	0.0	21.9	29.5	30.2
	Ecosystem growth and natural recruitment	The vegetation is maturing and/or natural recruitment is occurring at rates similar to those of the local remnant vegetation	shrubs and juvenile trees 0 - 0.5 m in height	No./area	1	62.0	1	8	32	5	30	6	17
			shrubs and juvenile trees 1.5 – 2 m in height	No./area	0	6.0	21	66	60	0	13	60	10
	Ecosystem structure	The vegetation is developing in structure and complexity comparable to that of the local remnant vegetation	Foliage cover 0.5 - 2 m	% cover	0	3	30	58	26	0	1	30	8
			Foliage cover 2 – 4 m	% cover	0	0.5	14	28	10.5	0	0	17	3
			Foliage cover >6 m	% cover	26	44	0	0	0	0	0	0	0
	Tree diversity	Vegetation contains a diversity of maturing tree and shrubs species comparable to the local remnant vegetation	Tree diversity	% endemic	100	100	100	100	100	100	100	100	100
	Tree density	Vegetation contains a density of maturing tree and shrub species comparable to the local remnant vegetation	Tree and mature shrub density (> 5 cm dbh)	No. eucalypts/area	8	38	0	14	12	1	0	0	0
				No. acacias/area	0	2	7	4	10	0	4	30	1
				No. other endemic/area	0	0	0	0	0	0	0	0	0
				<No Exotic/area	0	0	0	0	0	0	0	0	0
				% eucalypts/ population	95	100	0	78	55	100	0	0	0

Rehabilitation Phase	Aspect or ecosystem component	Completion criteria	Performance Indicators	Unit of measurement	2024 Woodland ecosystem range		South Dump 04	South Dump 07	South Dump 08	South Dump 10	North Dump 01	North Dump 02	North Dump 03
	Ecosystem health	The vegetation is in a condition comparable to that of the local remnant vegetation.	Healthy trees	% population	**26**	**88.9**	**71.4**	**33.3**	**100**	**100**	**25**	**52.6**	**0**
			Flowers/fruit: Trees	% population	**50**	**88.9**	**85.7**	**8**	**27**	**0**	**50**	**52.6**	**100**

9 Discussion

Ecological function and stability in the rehabilitation areas has varied significantly, largely as a result of the way the landform was constructed (e.g. substrate depth, soil type, steepness), species that were sown, combined with the ongoing effects of climate and animal disturbance. All rehabilitation sites on the SWRD and NWRD demonstrated a significant increase in functional patch area during the first few years after establishment. In some areas however, there was a loss of many of the original troughs and banks due to natural erosive processes, however these tended to be counteracted by a concurrent increase in plant and litter covers. During 2017 - 2019 drought and increased grazing and disturbance by animals resulted in a decline in many performance indicators, with many of these also being reflected in the range of woodland reference sites.

While some sites were relatively slow to develop (South Dump 04 and 07), all sites on the SWRD have increased in function since 2021 due to improved seasonal conditions that has promoted good growth and development of litter and the herbaceous and shrubby understorey in most areas. There has also been an increased abundance of cryptogams across many areas, although some areas may still be subjected to grazing and disturbance by animals.

On the NWRD rehabilitation area, there continues to be heavy grazing by resident macropods and the majority of the understorey has become dominated by a well-developed and mostly stable exotic annual plant and litter layer, especially in grassy clearings. There continued to be small bare patches which typically occurred on the top of old rip lines where some isolated erosion may have occurred, such as in North Dump 01 and 03. Thinning of patches of acacias undertaken as part of a trial has also resulted in a reduction in overall ecological function in parts of the NWRD (North Dump 01).

Since monitoring in 2023, drier conditions were experienced throughout most of the year and many areas continued to be grazed by macropods, with minor impacts recorded in numerous sites, including the reference sites. Most rehabilitation sites had patch areas and stability comparable to the reference sites, however infiltration and nutrient recycling capacity was low in all rehabilitation sites, largely due to the limited development of the litter layers and resultant soil profile and lack of mature tree cover. Overall, most rehabilitation areas had an ecological functional similar to each other, however the least developed rehabilitation site continued to be South Dump 07.

The sum of the LFA stability, infiltration and nutrient recycling components provides an indication of the most functional to least functional monitoring site, where the maximum score possible is 300 (Figure 9-1). The woodland reference site RWood05 continued to be the most ecologically functional and had a slightly higher sum of scores of 206 compared to last year, followed by the remaining 2 reference sites both with scores of 183. South Dump 08 has overall improved with a sum of scores of 176, followed by North Dump 02 however, this has marginally declined to a total sum of score of 173. North Dump 01 and 03, and South Dump 04 and 10 were overall functionally similar to each other with scores ranging from 165 – 157. The least developed rehabilitation site continued to be South Dump 07 with a total score of 139.

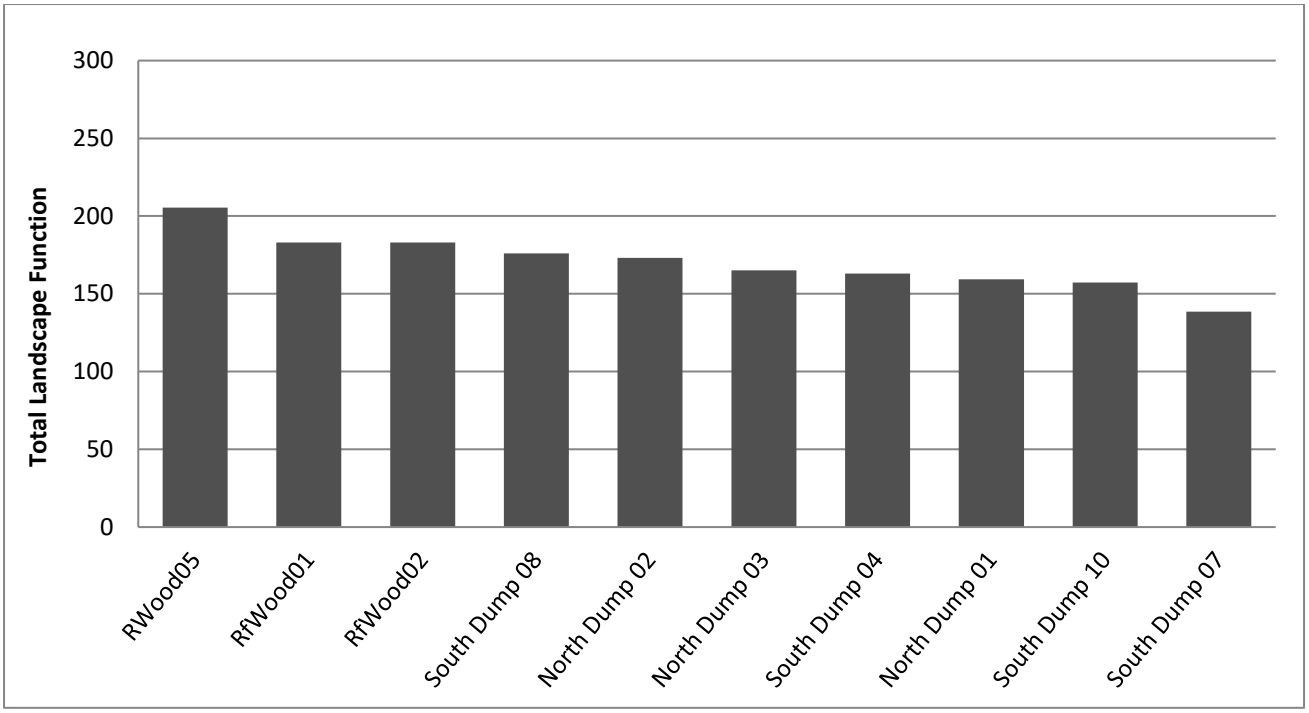


Figure 9-1. Sum of the LFA stability, infiltration and nutrient recycling components indicating the most functional to least functional monitoring site recorded in 2024.

Drought conditions over 3 consecutive years were not conducive to significant developments during the early successional development of rehabilitation areas, however many areas maintained or even slightly improved in ecological function largely due to the establishment of voluntary ground covers. Many volunteer species are exotic annual plants that have successfully colonised large areas of rehabilitation via establishment from the soil seed bank and these have been playing a particularly important role in the ecological development, function and stability of the sites due to the provision of protective ground cover and development of the litter layers, which lead to increased stability and coherency of the soil profile. Many annual weeds have become naturalised within the local area and some of the annual ground covers were clovers or medics which can be useful pasture species and these have also been recorded in the range of reference sites.

All rehabilitation sites met minimum perennial ground cover targets, however many were dominated by exotic pasture species and weeds. As exotic ground covers are prevalent across the local agricultural lands, all rehabilitation sites except South Dump 10 and North Dump 01, had a similar native cover abundance and diversity to the woodland reference sites (RWood02). While these ground cover targets may have been met, competitive exotic pasture species and weeds restrict germination and establishment of native tree and shrub establishment in the short-term, such as that has occurred in South Dump 10, parts of the NWRD (Figure 9-2), as well as older sites South Dump 01 – 03, thus limit natural regeneration and sustainability of the woodlands in the longer-term. This effect can also be observed across the local landscape where natural tree regeneration is limited across vast areas of farmland that have “improved exotic pastures”.

Exotic pasture species and weeds were limited in rehabilitation sites South Dump 07 and South Dump 08, with successful establishment of a high diversity of native woodland species, including native grasses which have become the dominant form of ground cover. Subsequently, all additional rehabilitation programs should utilise weed free topsoil/subsoil and exclude sowing exotic pastures to ensure self-sustaining communities to become established. In addition, Juncus species and a range of other moisture loving species have also naturally colonised moist depressions along contour banks and drainage depressions in some parts of the SWRD (Figure 9-3).

Figure 9-2. South Dump 10 is dominated by exotic species and requires additional rehabilitation in order to meet completion criteria targets.

Figure 9-3. South Dump 07 has had successful establishment of a diversity of native species, including native grasses such as *Austrostipa scabra*, *Rytidosperma* spp. and *Juncus* spp. have been increasing in abundance.

Local grassy Box woodland reference sites had densities of 80 – 400 stems trees per hectare and almost all were mature eucalyptus species. Trees and mature shrubs (>5 cm dbh) were recorded in all rehabilitation sites, with successful establishment of eucalypts and acacias occurring in South Dump 07 and 08. In remaining rehabilitation sites however, overall eucalypt densities were low, with none being recorded in South Dump 04 and 2 sites on the NWRD (North Dump 01 and 02).

There was also high variability in the density of shrubs and/or juvenile trees (<5 cm dbh), with most areas being dominated by acacias however some sites also had volunteer *Cassinia sifton* (Sifton Bush), especially South Dump 08 and North Dump 03. There has also been a declining trend in shrub densities in all sites over the last few years and while some individuals have grown and were now recorded as mature trees in some cases, the majority have been drought mortalities and/or had reached the end of their life span (natural senescence). This

decline continued to be observed and in South Dump 07, semi-mature eucalypts and additional young acacias had recently died, with the cause presently unknown, prompting the need for ongoing monitoring.

Limited establishment of eucalypts (and acacia in some areas) and native grasses may be due to a variety of factors (unviable seed, drought, burial, predation), however most likely, it is due to one to more of the following such as:

1. Use of agricultural topsoil obtained from introduced pastures spread onto rehabilitation areas, resulting in high levels of weed and exotic pasture competition growing from the soil seed bank that limit success of native woodland seed application;
2. Inclusion and successful establishment of exotic perennial pasture species (such as Phalaris, Ryegrass, Cocksfoot and Trifolium species) sown as part of the woodland seed mix. Perennial pasture species provide high competition levels and restrict native seedling establishment.
3. Continued heavy grazing by macropods and other pest animals resulting in a decline in perennial grass cover sown and increased abundance of exotic annual weeds.

High densities of primary colonising species such as acacias and cassinias in native woodland rehabilitation areas have proven to be valuable in the early successional development of mine disturbed woodland rehabilitation, as well as after bushfire or other large natural disturbances. As colonising species, they provide rapid stabilisation, fix nitrogen, provide protection to other more vulnerable species and habitat for wildlife, and over time are valuable contributors in the development of the soil profile. After a period of time (~5 -10 years) and without further major disturbances, mature acacias begin senescence and decline from woodland ecosystems. This process can be observed in some older rehabilitation areas on the SWRD, such as South Dump 05 and older sites South Dump 01 – 03. The opening up of the acacia canopies, accumulation of leaves, barks and spent pods and development of the soil profile, provides optimum conditions for perennial ground covers and other native species which can then regenerate and increase in abundance. Thus, acacias provide valuable ecological benefits in rehabilitation areas especially during the first several years of development.

The declining trend in acacia populations, in conjunction with limited eucalypt densities and high competition from introduced pasture species which suppresses natural tree and shrub regeneration, is anticipated to have implications for some rehabilitation areas to meet various completion targets without additional intervention in the short to medium term. On the NWRD, thinning of acacia saplings and planting of eucalypt tubestock was undertaken in June 2023 as part of a trial program. (Figure 9-4). While increased eucalypt densities are required, removal of acacias resulted in a reduction in ecological function in areas where removal was undertaken and has reduced shrubby habitat that would be beneficial and assist in the successional development of the woodlands.

A range of other primary performance indicators that have not yet been achieved were primarily related to the lack of a mature tree population and targets associated with a mature canopy structure, which will require additional development time in sites in areas with suitable tree densities. It will be critical that eucalypts become established within the rehabilitation areas where they are currently absent. Most of more mature acacias have been capable of reproducing and many were presently developing buds, however high levels of weed competition and heavy grazing may limit the capacity for self-sustainable populations to become established.

Habitat attributes such as tree hollows and mistletoe were also not present due to the relative immaturity of individuals, however there is opportunity for these to be reintroduced into semi-mature populations.

Figure 9-4. Removal of acacia saplings and planting of eucalypt tubestock on the North Dump.

No formal fauna surveys are undertaken by DnA Environmental, however a range of wildlife have been or were observed within the rehabilitation areas. Increased habitat such as large logs, fallen trees and rock piles would further enhance rehabilitation sites. Additional perching sites could also be made available by erecting mature eucalypts that have been cleared for mining, upside down (i.e. tree roots provide the new dead tree canopy) in appropriate locations across the rehabilitation areas. Large rocky outcrops could also be constructed. These practices have been undertaken with very successful outcomes in the Hunter Valley. Birds using the perching sites assist rehabilitation outcomes by introducing native plant seed (especially those with fleshy drupes) that may not otherwise colonise large rehabilitation areas. A range of other wildlife may also assist with the natural dispersal of seeds, create germination niches and micro-sites and assist with nutrient recycling across the wider rehabilitation areas. They may however also distribute weeds and harbour pest animals, thus ongoing monitoring and control will be required.

No soil analyses were undertaken in 2024, however results in 2023 indicated that rehabilitation areas typically had a soil chemistry similar to the local reference sites and/or were close to recommended agricultural guidelines, with some exceptions. In particular, two sites on the SWRD had soils that were strongly acidic, while copper and iron was recorded in high concentrations in some rehabilitation areas, with no obvious effects presently being observed.

Ongoing soil testing is likely to identify any changes in soil chemistry that may adversely affect the establishment of protective ground cover and/or development and sustainability of wider rehabilitation areas. While there were increasing levels of ground cover, minor rilling continued to be recorded in South Dump 07 and North Dump 01. Testing of waste rock materials and topsoils prior to application on rehabilitation areas should continue to be an ongoing part of the progressive rehabilitation programs and regularly undertaken to ensure suitable substrates are used prior to spreading onto rehabilitation areas.

Priority weeds and WONS are being actively controlled through an ongoing weed management program and ongoing control will be required as part of the Cadia land management plans. There may be increasing occurrences of *Hypericum perforatum* (St. John's Wort), *Nassella trichotoma* (Serrated Tussock) and *Rubus fruticosus* (Blackberry). Other exotic shrubs *Ligustrum lucidum* (Privet), *Rosa rubiginosa* (Sweet Briar) and *Crataegus monogyna* (Hawthorn) seedlings also continue to be recorded in reference site RWood05. Previous monitoring has indicated *Salix* species (Willows) were also becoming increasingly more dominant in the Creek Diversion channel. Particular care should be undertaken to avoid spraying of non-target species.

Occurrences of and damage by feral and other pest animal populations will also require ongoing monitoring and control. Rabbit burrows and scats and feral pigs were observed on the SWRD and NWRD rehabilitation areas during the monitoring program this year.

10 Conclusion

Ecological performance is significantly different between rehabilitation sites largely due to difference in the way they were rehabilitate and when they were rehabilitated. All woodland monitoring sites had been affected by 3 consecutive years of drought during 2017 – 2019. Since then, most sites have improved levels of ground cover and have become ecologically stable, however infiltration and nutrient recycling capacities remain low compared to woodland reference sites.

In South Dump 07 and South Dump 08, there has been successful establishment of a high diversity and abundance eucalypts, acacias and other shrubs and native grasses have become dominant. Exotic pasture species and weeds were limited. Remaining rehabilitation areas had variable densities of shrubs, low densities of eucalypts and were dominated by exotic grasses and weeds and require additional rehabilitation intervention in order to meet tree density and diversity targets.

Due to close proximity to farmland and remnant bushland areas, current areas of rehabilitation are likely to be repeatedly overgrazed by macropods and other pest animals. Culling of macropods is likely to be unsustainable in the medium to long-term, subsequently, robust tree guards should be installed during in-fill planting programs and/or exclusion fences constructed until the vegetation is able to withstand impacts of grazing.

Some primary recommendations to improve rehabilitation outcomes on current woodland rehabilitation areas on the NWRD and SWRD include:

- Recognise the benefits of acacias (and other colonising species such as cassinia) and capitalise their colonising and habitat traits that assist in the successional development of woodland rehabilitation areas. Acacias provide protection and a range of other beneficial ecological processes during early successional development in disturbed environments and naturally decline from stable woodland ecosystems. In addition, they provide additional wildlife habitat in an agricultural landscape that is currently deficient;
- Infill tubestock planting of eucalyptus species in sites that have a *stable* herbaceous understorey and limited eucalypt establishment, such as NWRD. Tubestock should be planted at densities of approximately 80 stems per hectare (or a minimum of 40 / ha to meet PCT 1330 benchmarks), targeting grassy clearings and areas with low densities of acacias and/or cassinia's. Prepare planting holes by spot spraying 1 m circles with knockdown herbicide to kill plant competition.
- Re-work rehabilitation areas where native woodland establishment is overall poor (eg South Dump 10). Apply several knockdown herbicide applications, followed by scarification and/or re-ripping and reseeding with a suitable native woodland mix, incorporating high rates of acacias to accelerate the successional development of rehabilitation areas. The simultaneous planting of eucalypt tubestock (and other species) is also recommended or used an alternative option, as establishment success from seed has proven to be limited in some areas of the WRD's particularly when weed competition is high.
- Install robust tree guards and/or exclusion fencing to provide adequate protection for planted eucalypt seedlings and/or new rehabilitation areas from animal disturbance and overgrazing;
- Apply/trial weed-free hay, brush-matting and/or other organic mulches to stabilise and accelerate the development of any areas with minor rilling and/or erosion or areas where ground covers are slow to establish, such as South Dump 04, South Dump 07 and North Dump 01;
- Consider the benefits of constructing exclusion fencing around some larger areas of rehabilitation to manage grazing pressure and increase establishment success;
- Increase wildlife habitat such as large logs, fallen trees and rock piles that would further enhance habitat on rehabilitation areas;
- Follow up surveillance and increased control of *Hypericum perforatum* (St John's Wort), *Nassella trichotoma* (Serrated Tussock) and *Rubus fruticosus*.

- Continue to monitor and control other priority weeds and WONS, including *Salix* species (Willows) which are increasing in abundance along the Creek Diversion Channel; and
- Carry out ongoing monitoring and control of feral and pest animal populations.

In preparation for additional woodland rehabilitation, some of the following recommendations that may result in improved rehabilitation outcomes include:

- Review current rehabilitation strategies to facilitate processes that enhance successional development and accelerate ecological function;
- Review management and application of topsoils/subsoils. Topsoil obtained from areas dominated by introduced pastures are not beneficial for use in woodland rehabilitation areas, while weed-free subsoils result in higher establishment success;
- Ensure ongoing testing of waste rock materials and topsoils prior to and after application onto rehabilitation areas;
- Continue with the targeting seed collection program to ensure adequate seed supply for future rehabilitation requirements, including native grasses and other native ground covers.
- Refine species mixes and adjust sowing rates and methods to maximise eucalypt and native grass establishment and capitalise on the benefits of acacia and other colonising species establishment from seed;
- Discontinue use of sterile cover crops and exotic pasture species in future woodland rehabilitation programs. Cover crops tend to attract additional herbivory leading to failed establishment, while exotic pasture species provide high competition levels, attract herbivory and supress native seed establishment in the short, medium and long-term, affecting the long-term sustainability of woodland areas;
- Consider the addition of perching sites; upside down trees “planted” into newly constructed landforms. Perching sites attract wildlife and assist with natural seed dispersal, pest management and regeneration of a variety of native plants, especially those with fleshy seeds;
- Apply/trial weed-free hay, brush-matting and/or other organic mulches to stabilise and accelerate the development of any areas with minor rilling and/or erosion or are slow to establish; and
- Apply/trial seed-bearing native pasture hay to increase protective soil covers and introduce native grass seed on rehabilitation areas.

Continued monitoring of the rehabilitation sites will provide guidance on further management intervention, in order to trend towards and to meet completion criteria targets.

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Appendix 1. Monitoring site location data

GPS coordinates and other site-specific information for the reference sites.

Site Reference	LFA Start	LFA Finish	LFA slope°	LFA bearing°	Veg transect start	Veg transect finish	Veg transect bearing°
RfWood01 (Ashleigh Park)	55 680871 E 6295705 N	55 680880 E 6295718 N	10	30 NE	55 680875 E 6295715 N	55 680903 E 6295677 N	120 SE
RfWood02 (Bundarra)	55 683151 E 6290452 N	55 683159 E 6290441 N	14	145 SE	55 683154 E 6290447 N	55 683114 E 6290436 N	236 NW
RWood04 (Cadia access) (Right - left transect)	55 687596 E 6296337 N	55 687589 E 6296351 N	10	310 W	55 687591 E 6296345 N	55 687554 E 6296316 N	220 SW
RWood05 (Cadia Cadiangullong Dam)	55 684994 E 6298928 N	55 685013 E 6298922 N	12	94 E	55 685005 E 6298924 N	55 684987 E 6298876 N	184 S
RfPast01 (Bundarra)	55 683406 E 6290780 N	55 683423 E 6290790 N	10	45 NE	55 683415 E 6290785 N	55 683439 E 6290742 N	140 SE
RfPast03 (Willunga)	55 687926 E 6298533 N	55 687911 E 6298546 N	8	300 NW	55 687918 E 6298540 N	55 687948 E 6298579 N	25 N
RrRip02 (Bakers Shaft)	55 686614 E 6279287 N	55 686622 E 6279263 N	10	170 S	55 686622 E 6279272 N	55 686573 E 62792710 N	260 W
RrRip03 (Cadia Cadiangullong Ck)	55 685302 E 6298471 N	55 685314 E 6298478 N	14	44 NE	55 685306 E 6298475 N	55 685327 E 6298431 N	140 SE

GPS coordinates and other site-specific information for the rehabilitation monitoring sites.

Site	LFA Start	LFA Finish	LFA slope°	LFA bearing°	Veg transect start	Veg transect finish	Veg transect bearing°
Ashleigh Park	55 680874 E 6294881 N	55 680864 E 6294899 N	5	320 NW	55 680887 E 6294887 N	55 680873 E 6294904 N	320 NW
South Dump 01	55 685304 E 6294460 N	55 685308 E 6294478 N	22	351 N	55 685307 E 6294468 N	55 685353 E 6294467 N	79 E
South Dump 02	55 685118 E 6294354 N	55 685108 E 6294369 N	17	302 NW	55 685113 E 6294362 N	55 685146 E 6294401 N	33 NE
South Dump 03	55 685250 E 6293838 N	55 685231 E 6293838 N	18	245 W	55 685240 E 6293838 N	55 685239 E 6293886 N	348 NW
South Dump 04	55 686455 E 6293539 N	55 686453 E 6293524 N	18	173 S	55 686454 E 6293535 N	55 686407 E 6293533 N	264 W
South Dump 05	55 687089 E 6294032 N	55 687108 E 6294029 N	18	88 E	55 687100 E 6294032 N	55 687092 E 6293982 N	175 S

Site	LFA Start	LFA Finish	LFA slope°	LFA bearing°	Veg transect start	Veg transect finish	Veg transect bearing°
South Dump 06	55 687551 E 6294645 N	55 687570 E 6294653 N	1	231 SW	55 687561 E 6294649 N	55 687579 E 6294603 N	144 SE
South Dump 07	55 686973 E 6294252 N	55 686991 E 6294252 N	16	76 E	55 686983 E 6294254 N	55 686981 E 6294200 N	168 S
South Dump 08	55 686632 E 6293878 N	55 686643 E 6293860 N	0	142 SE	55 686638 E 6293868 N	55 686594 E 6293845 N	232 SW
South Dump 09	55 685920 E 6294044 N	55 685900 E 6294046 N	16	260 W	55 685911 E 6294045 N	55 685915 E 6294096 N	350 N
South Dump 10	55 684896 E 6293929 N	55 684878 E 6293915 N	17	216 SW	55 684888 E 6293919 N	55 684853 E 6293957 N	305 NW
North Dump 01	55 686596 E 6296978 N	55 686582 E 6296967 N	14	217 SW	55 686589 E 6296973 N	55 686555 E 6297013 N	307 NW
North Dump 02	55 686375 E 6296954 N	55 686362 E 6296942 N	15	220 SW	55 686369 E 6296947 N	55 686339 E 6296986 N	309 NW
North Dump 03	55 687148 E 6297228 N	55 687130 E 6297227 N	1	260 W	55 687139 E 6297226 N	55 687139 E 6297277 N	350 N
Willunga DS01	55 687586 E 6298689 N	55 687579 E 6298710 N	6	320 NW	55 687601 E 6298700 N	55 687568 E 6298737 N	320 NW
Willunga DS02	55 687266 E 6208927 N	55 687260 E 6298910 N	10	180 S	55 687248 E 6298929 N	55 872473 E 6298883 N	182 S
Cadiangullong Creek	55 684249 E 6294028 N	55 684242 E 6294015 N	5	180 S	55 684244 E 6294017 N	55 684199 E 6294037 N	275 W
Creek Diversion	55 685350 E 6297515 N	55 685346 E 6297501 N	8	165 S	55 685346 E 6297511 N	55 685296 E 6297506 N	257 W

Appendix 2. Flora species recorded in woodland monitoring sites 2024

*Note: “1” denotes the presence of that species at a particular site and is not a measure of cover abundance.
Key to growth form legend: t = tree; s = shrub; ss =sub-shrub; h = herb; g = grass, r = reed; v = vine; f = fern; p = parasite

Family	exotic	Scientific Name	Common Name	Growth Form	North Dump 01	North Dump 02	North Dump 03	South Dump 04	South Dump 07	South Dump 08	South Dump 10	RWood01	RWood02	RWood05
Adiantaceae		*Cheilanthes sieberi*	Rock Fern	f										1
Amaranthaceae	*	*Amaranthus albus*	Tumbleweed	h	1									
Amaranthaceae	*	*Amaranthus powellii*	Powell's Amaranth	h	1		1				1			
Araliaceae		*Hydrocotyle laxiflora*	Stinking Pennywort	h										1
Asteraceae	*	*Arctotheca calendula*	Capeweed	h				1	1					
Asteraceae	*	*Bidens subalternans*	Greater Beggars Tick	h				1						
Asteraceae	*	*Carduus tenuiflorus*	Winged Slender Thistle	h	1									1
Asteraceae	*	*Carthamus lanatus*	Saffron Thistle	h	1		1	1						
Asteraceae		*Cassinia sifton [arcuata]*	Sifton Bush	s			1		1	1				1
Asteraceae	*	*Centaurea solstitialis*	St Barnaby's Thistle	h						1				
Asteraceae	*	*Chondrilla juncea*	Skeleton Weed	h		1						1		
Asteraceae	*	*Cirsium vulgare*	Spear Thistle	h		1					1	1	1	1
Asteraceae	*	*Conyza bonariensis*	Fleabane	h			1	1	1		1	1		1
Asteraceae		*Cymbonotus lawsonianus*	Bear's Ear	h										1
Asteraceae		*Euchiton involucratus*	Star Cudweed	h										1
Asteraceae		*Euchiton sp.*	A Cudweed	h						1				
Asteraceae	*	*Hypochaeris radicata*	Flatweed	h				1	1			1		1
Asteraceae	*	*Lactuca serriola*	Prickly Lettuce	h			1					1	1	
Asteraceae		*Senecio prenanthoides*	A Fireweed	h										1

Family	exotic	Scientific Name	Common Name	Growth Form	North Dump 01	North Dump 02	North Dump 03	South Dump 04	South Dump 07	South Dump 08	South Dump 10	RWood01	RWood02	RWood05
Asteraceae		*Senecio quadridentatus*	Cotton Fireweed	h	1			1			1	1	1	1
Asteraceae	*	*Silybum marianum*	Variegated Thistle	h	1	1	1				1	1	1	
Asteraceae	*	*Sonchus asper*	Prickly Sowthistle	h			1				1		1	
Asteraceae	*	*Sonchus oleraceus*	Milk Thistle	h	1	1	1	1	1				1	
Asteraceae		*Vittadinia cuneata*	Fuzzweed	h	1		1	1	1					
Asteraceae		*Vittadinia gracilis*	A Fuzzweed	h						1				
Asteraceae	*	*Xanthium spinosum*	Bathurst Burr	h						1	1		1	
Asteraceae		*Xerochrysum viscosum*	Sticky Everlasting	h										1
Boraginaceae	*	*Echium plantagineum*	Paterson's Curse	h	1	1	1	1		1	1			
Boraginaceae	*	*Echium vulgare*	Vipers Bugloss	h	1	1	1	1		1				1
Brassicaceae	*	*Hirschfeldia incana*	Buchan Weed	h	1		1				1			
Brassicaceae	*	*Lepidium africanum*	Peppercress	h			1			1	1			
Brassicaceae	*	*Sisymbrium officinale*	Hedge Mustard	h						1				
Brassicaceae	*	*Sisymbrium sp.*	A Mustard	h								1	1	
Campanulaceae		*Wahlenbergia luteola*	Australian Bluebell	h								1		
Caryophyllaceae	*	*Petrorhagia nanteuilii*	Proliferous Pink	h	1	1	1							
Chenopodiaceae	*	*Chenopodium album*	Fat Hen	h			1				1			
Chenopodiaceae		*Dysphania [Chenopodium] pumilio*	Small Crumbweed	h			1			1				
Chenopodiaceae		*Einadia nutans*	Climbing Saltbush	h			1					1		
Convolvulaceae		*Dichondra repens*	Kidney Weed	h				1		1		1		1
Cucurbitaceae	*	*Cucumis myriocarpus*	Paddy Melon	h			1							
Cyperaceae		*Carex inversa*	Knob Sedge	r	1	1				1		1	1	1

Family	exotic	Scientific Name	Common Name	Growth Form	North Dump 01	North Dump 02	North Dump 03	South Dump 04	South Dump 07	South Dump 08	South Dump 10	RWood01	RWood02	RWood05
Fabaceae (Faboideae)		*Daviesia leptophylla*	Slender Bitter-Pea	s						1				
Fabaceae (Faboideae)		*Glycine clandestina*	Climbing Glycine	h										1
Fabaceae (Faboideae)		*Grona [Desmodium] varians*	Slender Tick-trefoil	h										1
Fabaceae (Faboideae)		*Hardenbergia violacea*	Happy Wanderer	v						1				
Fabaceae (Faboideae)	*	*Medicago arabica*	Spotted Medic	h	1									
Fabaceae (Faboideae)	*	*Medicago polymorpha*	Burr Medic	h	1									
Fabaceae (Faboideae)	*	*Medicago truncatula*	Barrel Medic	h		1								
Fabaceae (Faboideae)		*Pultenaea procumbens*	Heathy Bush-pea	s					1					
Fabaceae (Faboideae)		*Pultenaea spinosa*	Spiny Bush-pea	s						1				
Fabaceae (Faboideae)	*	*Trifolium angustifolium*	Narrow-leaf Clover	h				1						
Fabaceae (Faboideae)	*	*Trifolium repens*	White Clover	h	1					1				1
Fabaceae (Faboideae)	*	*Trifolium sp.*	A Clover	h								1		1
Fabaceae (Faboideae)	*	*Trifolium subterraneum*	Subterraneum Clover	h	1	1	1	1	1	1	1	1	1	1
Fabaceae (Faboideae)	*	*Vicia sativa*	Common Vetch	h	1	1								1
Fabaceae (Mimosoideae		*Acacia filicifolia*	Fern-leaved Wattle	s					1	1				
Fabaceae (Mimosoideae)		*Acacia buxifolia*	Box-leaved Wattle	s	1	1	1	1	1	1				
Fabaceae (Mimosoideae)		*Acacia dealbata*	Silver Wattle	s	1	1	1	1				1		1
Fabaceae (Mimosoideae)		*Acacia decora*	Western Golden Wattle	s				1			1			
Fabaceae (Mimosoideae)		*Acacia genistifolia*	Early Wattle	s					1	1				
Fabaceae (Mimosoideae)		*Acacia implexa*	Hickory	s				1	1	1				1
Fabaceae (Mimosoideae)		*Acacia melanoxylon*	Blackwood	s					1					
Fabaceae (Mimosoideae)		*Acacia paradoxa*	Kangaroo Thorn	s					1	1				

Family	exotic	Scientific Name	Common Name	Growth Form	North Dump 01	North Dump 02	North Dump 03	South Dump 04	South Dump 07	South Dump 08	South Dump 10	RWood01	RWood02	RWood05
Fabaceae (Mimosoideae)		*Acacia penninervis*	Mountain Hickory	s					1	1				
Fabaceae (Mimosoideae)		*Acacia spectabilis*	Mudgee Wattle	s		1								
Fabaceae (Mimosoideae)		*Acacia verniciflua*	Varnish Wattle	s					1	1				
Fabaceae (Mimosoideae)		*Acacia vestita*	Weeping Boree	s	1	1	1	1	1	1				
Gentaniaceae	*	*Centaurium erythraea*	Common Centaury	h				1						1
Geraniaceae		*Geranium solanderi*	Native Geranium	h	1	1	1			1	1	1	1	1
Haloragaceae		*Gonocarpus tetragynus*	Raspwort	h						1				1
Hypericaceae		*Hypericum gramineum*	Small St. John's Wort	h					1	1				1
Hypericaceae	*	*Hypericum perforatum*	St. John's Wort	h			1	1		1				
Juncaceae		*Juncus aridicola*	Tussock Rush	r						1				
Juncaceae		*Juncus subsecundus*	A Rush	r						1				
Juncaceae		*Juncus usitatus*	A Rush	r				1	1	1				1
Juncaceae		*Luzula flaccida*		r										1
Lamiaceae	*	*Marrubium vulgare*	Horehound	h	1	1	1					1	1	
Lamiaceae		*Scutellaria humilis*	Dwarf Scullcap	h										1
Lomandraceae		*Lomandra multiflora*	Many-flowered Mat-rush	h										1
Malaceae	*	*Crataegus monogyna*	Hawthorn	s										1
Malvaceae	*	*Malva parviflora*	Small-flowered Mallow	h							1			
Malvaceae	*	*Modiola caroliniana*	Red-flowered Mallow	h	1	1	1	1	1	1	1			
Myrtaceae		*Eucalyptus albens*	White Box	t					1	1			1	
Myrtaceae		*Eucalyptus blakelyi*	Blakely's Red Gum	t							1	1		
Myrtaceae		*Eucalyptus bridgesiana*	Apple Box	t			1		1					1

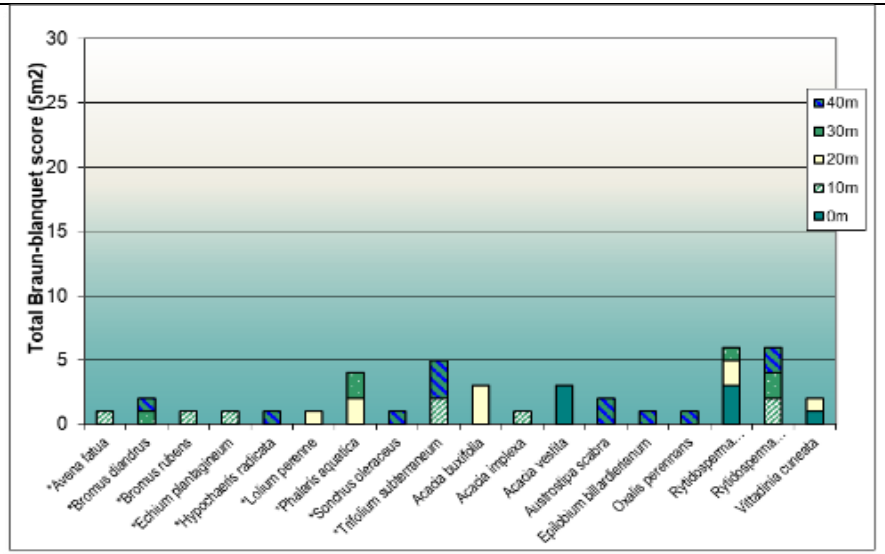
Family	exotic	Scientific Name	Common Name	Growth Form	North Dump 01	North Dump 02	North Dump 03	South Dump 04	South Dump 07	South Dump 08	South Dump 10	RWood01	RWood02	RWood05
Myrtaceae		*Eucalyptus goniocalyx*	Bundy Box	t					1	1				1
Myrtaceae		*Eucalyptus macrorhyncha*	Red Stringybark	t					1					1
Myrtaceae		*Eucalyptus melliodora*	Yellow Box	t						1		1		1
Myrtaceae		*Eucalyptus polyanthemos*	Red Box	t						1				
Myrtaceae		*Eucalyptus viminalis*	Ribbon Gum	t			1							
Myrtaceae		*Leptospermum continentale*	Prickly Tea-tree	s						1				
Oleaceae	*	*Ligustrum lucidum*	Large-leaved Privet	s										1
Onagraceae		*Epilobium billardierianum*	Willow Herb	h	1	1	1	1		1				1
Orobanchaceae	*	*Orobanche minor*	Broomrape	h										1
Oxalidaceae		*Oxalis perennans*	Yellow Wood-sorrel	h	1	1	1	1	1	1		1		1
Plantaginaceae	*	*Plantago lanceolata*	Ribwort	h	1	1	1			1	1			1
Poaceae		*Anthosachne [Elymus] scabra*	Common Wheatgrass	g					1	1				1
Poaceae	*	*Anthoxanthum odoratum*	Sweet Vernal Grass	g			1							
Poaceae		*Austrostipa scabra*	Speargrass	g			1	1	1					
Poaceae	*	*Avena fatua*	Wild Oats	g	1	1	1	1	1	1	1		1	
Poaceae		*Bothriochloa macra*	Red-leg Grass	g			1						1	
Poaceae	*	*Bromus catharticus*	Prairie Grass	g	1	1	1							
Poaceae	*	*Bromus diandrus*	Great Brome	g	1	1		1	1		1	1	1	1
Poaceae	*	*Bromus molliformis*	Soft Brome	g		1								
Poaceae	*	*Bromus rubens*	Red Brome	g				1						
Poaceae		*Chloris truncata*	Windmill Grass	g						1				
Poaceae		*Cynodon dactylon*	Couch	g			1							

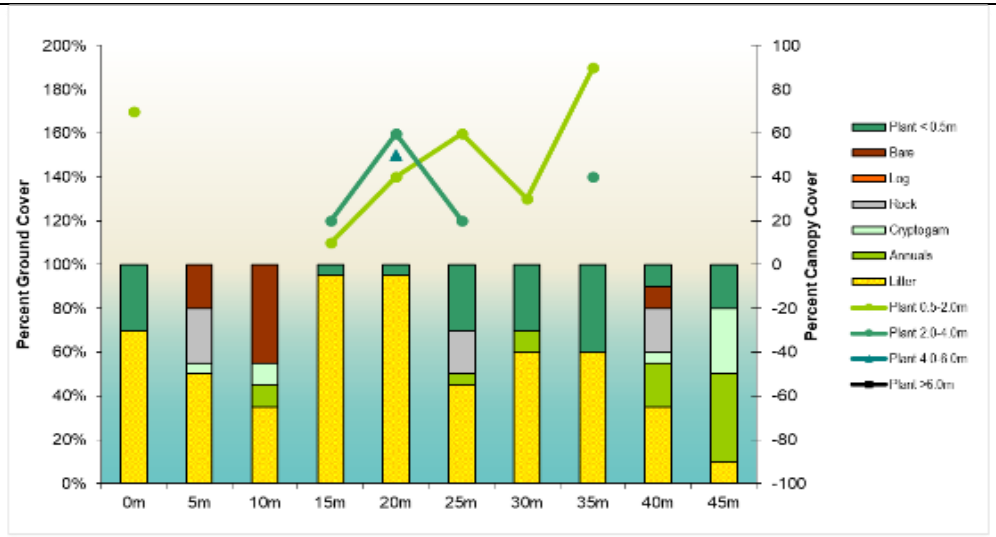
Family	exotic	Scientific Name	Common Name	Growth Form	North Dump 01	North Dump 02	North Dump 03	South Dump 04	South Dump 07	South Dump 08	South Dump 10	RWood01	RWood02	RWood05
Poaceae	*	*Cynosurus echinatus*	Rough Dog's Tail	g										1
Poaceae	*	*Dactylis glomerata*	Cocksfoot	g	1									
Poaceae		*Eragrostis sp.*	Lovegrass	g				1						
Poaceae	*	*Holcus lanatus*	Yorkshire Fog	g						1				1
Poaceae		*Lachnagrostis filiformis*	Blown Grass	g										1
Poaceae	*	*Lolium perenne*	Perennial Ryegrass	g			1	1		1	1	1		
Poaceae		*Microlaena stipoides*	Weeping Rice-grass	g						1	1	1	1	1
Poaceae	*	*Nassella trichotoma*	Serrated Tussock	g	1	1	1	1						
Poaceae	*	*Paspalum dilatatum*	Paspalum	g		1				1			1	
Poaceae	*	*Pennisetum clandestinum*	Kikuyu Grass	g				1						
Poaceae	*	*Phalaris aquatica*	Phalaris	g	1	1		1	1	1	1		1	1
Poaceae		*Poa sieberiana*	Fine-leaf Tussock	g						1				1
Poaceae		*Rytidosperma erianthum*	Hill Wallaby Grass	g		1								
Poaceae		*Rytidosperma racemosum*	Wallaby Grass	g	1	1	1	1	1	1		1	1	1
Poaceae		*Rytidosperma richardsonii*	Wallaby Grass	g				1						
Poaceae		*Rytidosperma sp.*	Wallaby Grass	g					1	1				
Poaceae	*	*Vulpia muralis*	Rats-tail Fescue	g						1				1
Polygonaceae	*	*Polygonum arenastrum*	Wireweed	h		1	1							
Polygonaceae	*	*Polygonum aviculare*	Wireweed	h						1	1			
Polygonaceae	*	*Rumex acetosella*	Sheep Sorrel	h	1	1	1	1	1	1		1		1
Polygonaceae		*Rumex brownii*	Swamp Dock	h	1	1				1		1	1	1
Polygonaceae	*	*Rumex crispus*	Curled Dock	h		1	1				1			

Family	exotic	Scientific Name	Common Name	Growth Form	North Dump 01	North Dump 02	North Dump 03	South Dump 04	South Dump 07	South Dump 08	South Dump 10	RWood01	RWood02	RWood05
Primulaceae	*	*Lysimachia [Anagallis] arvensis*	Scarlet Pimpernel	h	1		1	1		1	1			1
Proteaceae		*Grevillea ramosissima*	Fan Grevillea	s					1					
Proteaceae		*Hakea decurrens*	A Needlewood	s					1					
Resedaceae	*	*Reseda luteola*	Weld	h			1							
Rosaceae		*Acaena novae-zelandiae*	Biddy-biddy	h						1				1
Rosaceae		*Acaena ovina*	Sheep's Burr	h										1
Rosaceae		*Acaena sp.*	Sheep's Burr	h					1					
Rosaceae	*	*Rosa rubiginosa*	Sweet Briar	s										1
Rosaceae	*	*Rubus fruticosus*	Blackberry	s							1	1		1
Rubiaceae	*	*Galium aparine*	Cleavers	h		1								
Rubiaceae		*Galium propinquum*	Maori Bedstraw	h								1		
Scrophulariaceae	*	*Verbascum virgatum*	Twiggy Mullein	h			1			1				
Solanaceae	*	*Solanum nigrum*	Blackberry Nightshade	h	1	1	1			1	1	1	1	1
Solanaceae	*	*Solanum sisymbriifolium*	Sticky Nightshade	h	1						1		1	
Urticaceae	*	*Urtica urens*	Small Nettle	h		1					1			
Verbenaceae	*	*Verbena bonariensis*	Purpletop	h	1		1			1				1
Violaceae		*Viola betonicifolia*	Showy Violet	h										1

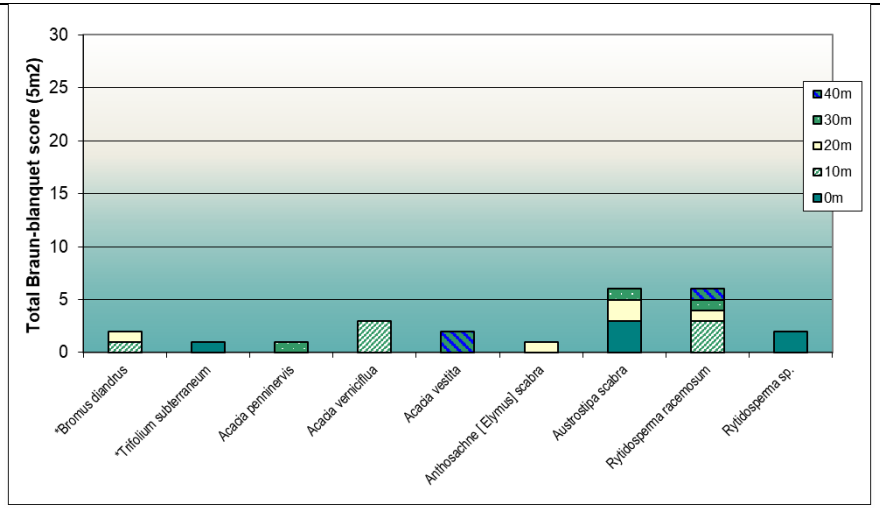
Appendix 3: Species cover abundance and community structure of individual rehabilitation monitoring sites in 2024

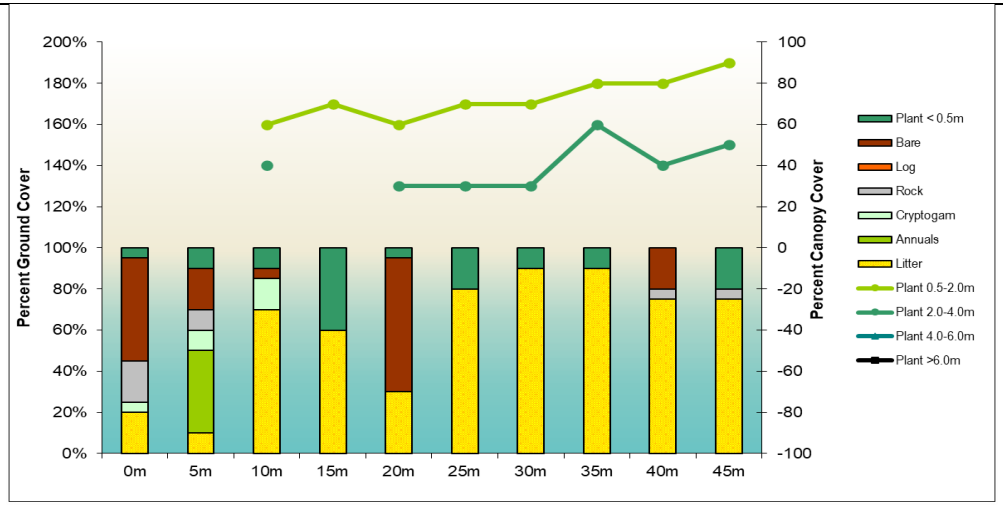
South Dump 04



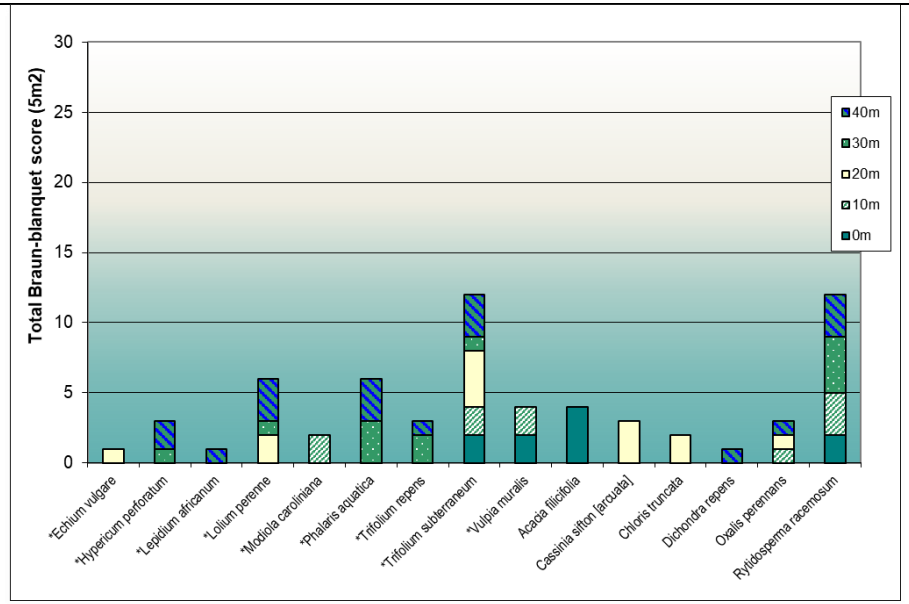


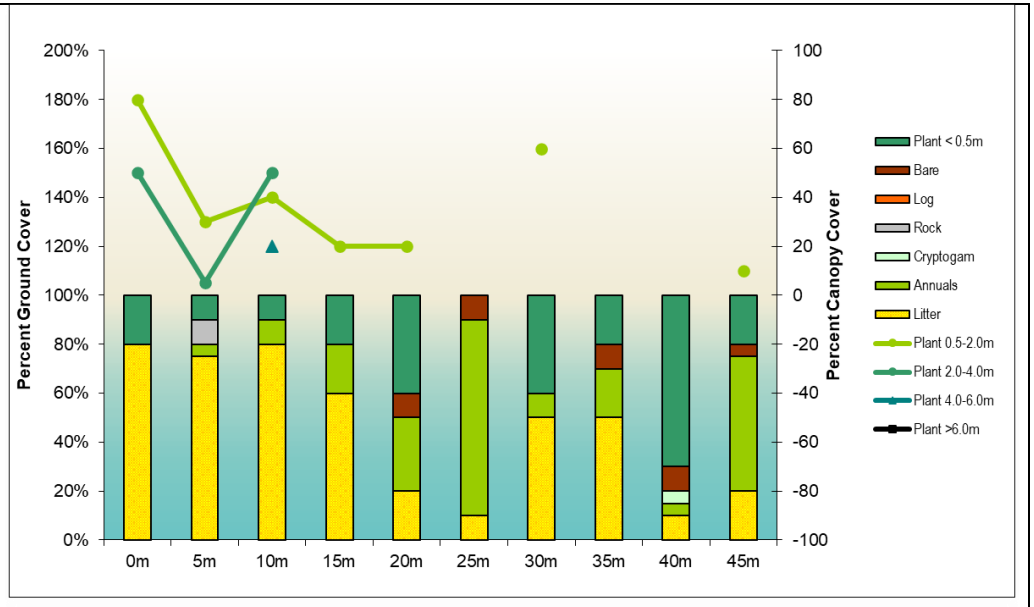
South Dump 07



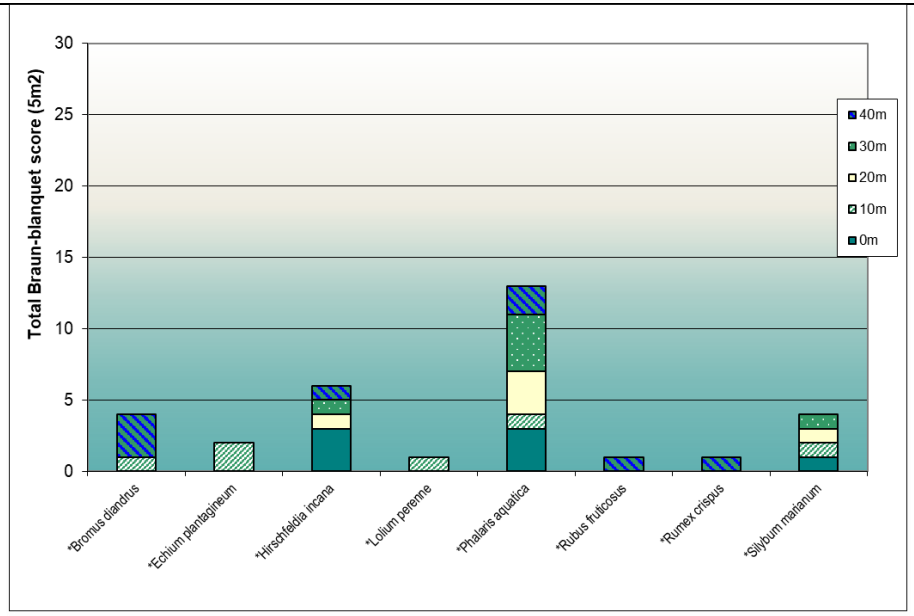


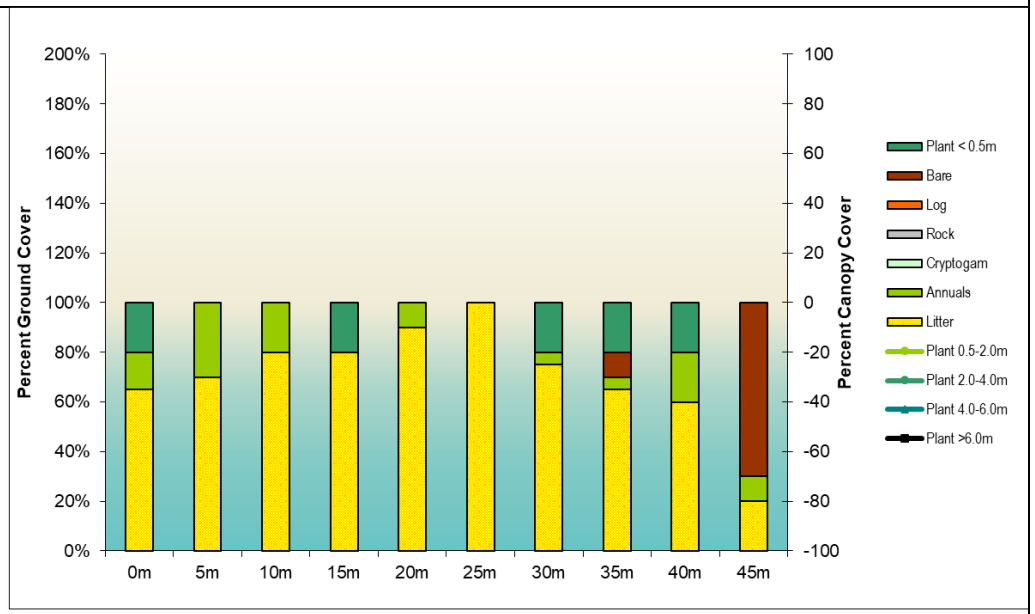
South Dump 08



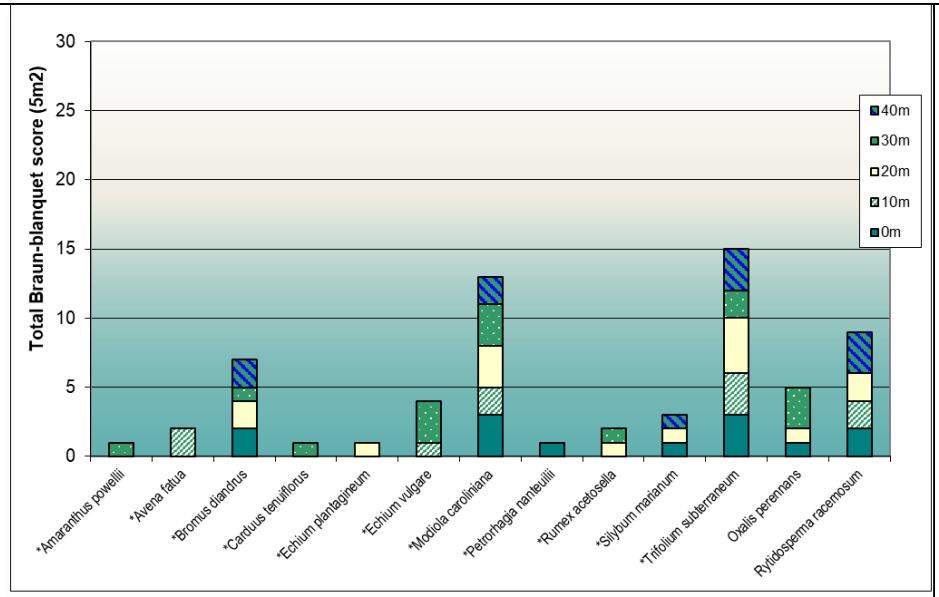


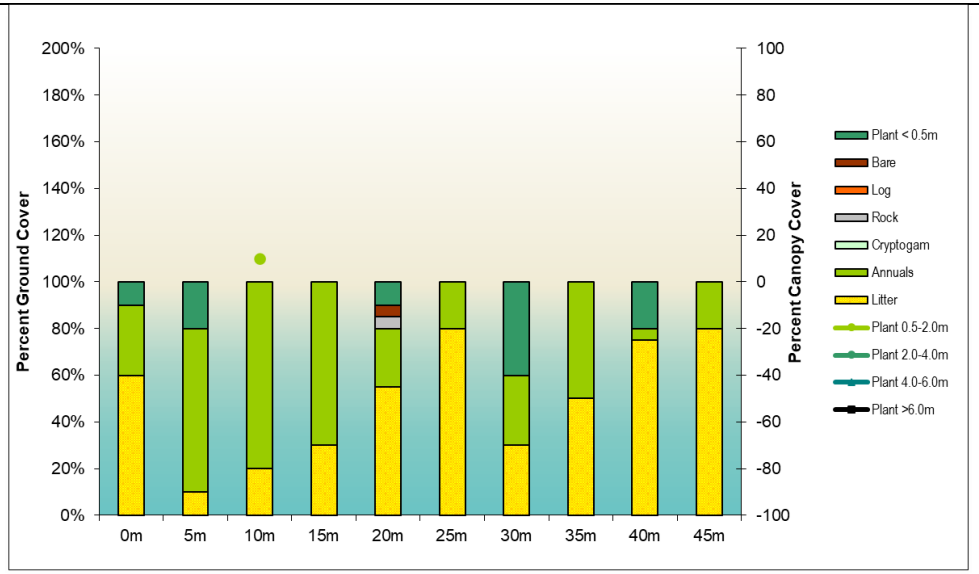
South Dump10



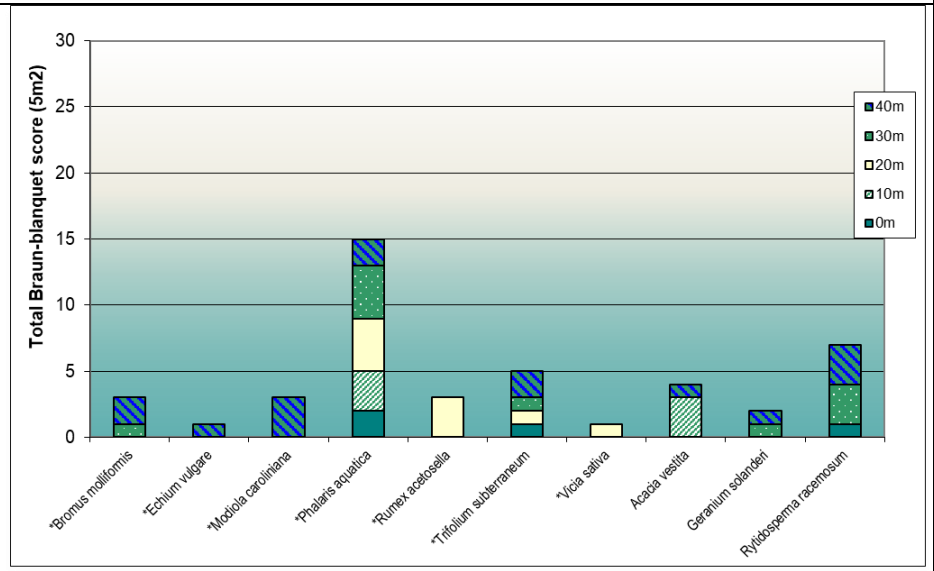


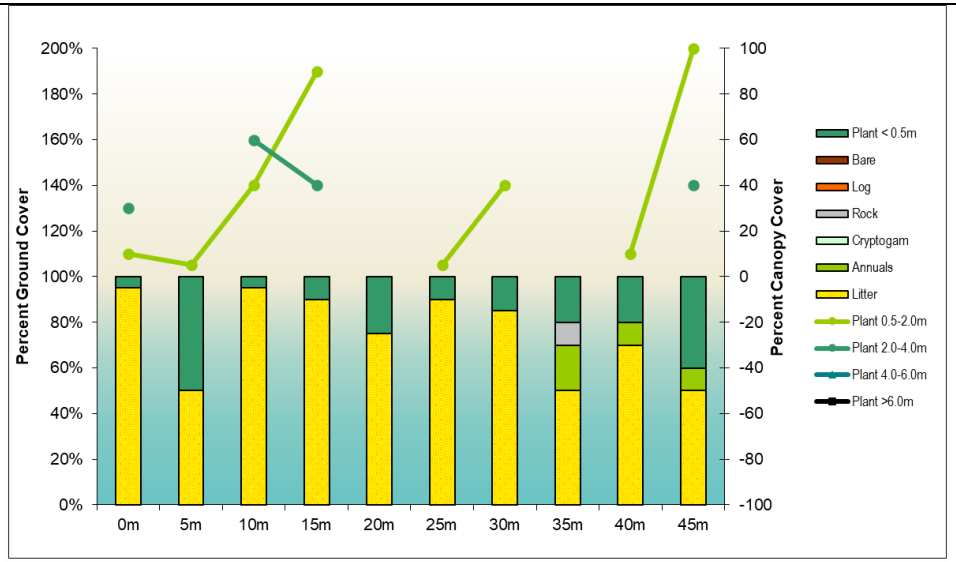
North Dump 01





North Dump 02





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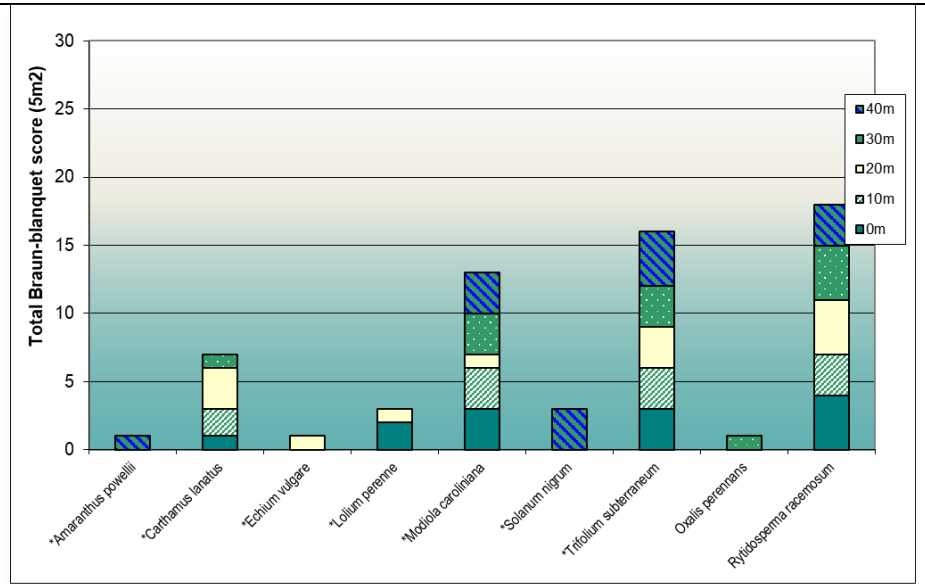

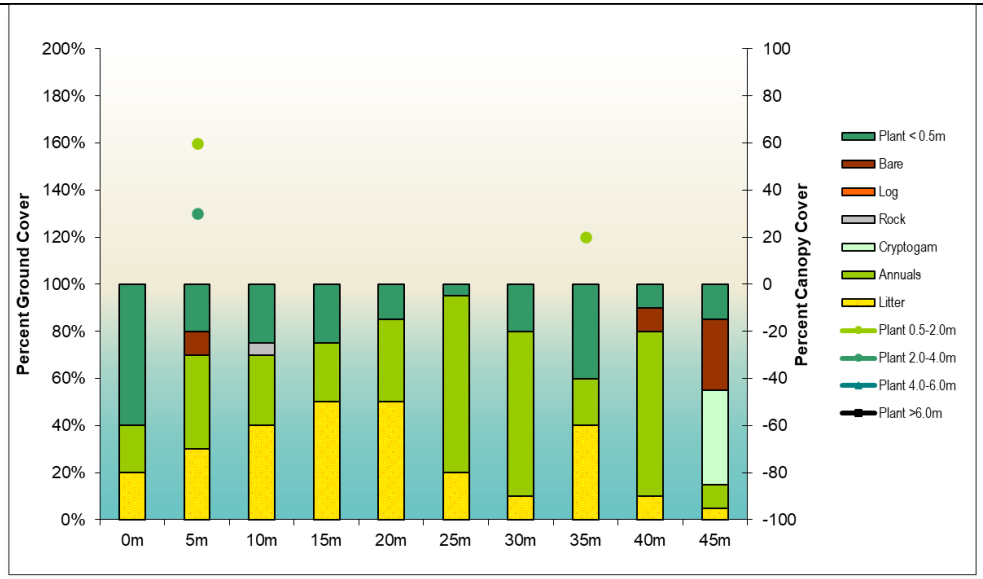

Appendix 4: Woodland rehabilitation site performance towards meeting ecological performance indicators

The table below indicates the performance of woodland revegetation monitoring sites against primary and secondary performance in 2024. Performance indicators have been presented in order of rehabilitation phases and ecosystem succession, beginning with landform establishment and stability (orange) and ending with indicators of ecosystem and land use development (blue).

Rehabilitation sites meeting or exceeding the range values of woodland reference sites have been identified with a shaded colour box and have therefore been deemed to meet the ecological targets. In the case of "growth medium development", upper and lower soil property indicators are also based on results obtained from the respective reference sites. In some cases, the site may not fall within ranges based on these data but may be within "desirable" levels as prescribed by the agricultural industry. If this scenario occurs the rehabilitation site has been identified using a striped shaded box to indicate that it falls within "desirable" agricultural ranges.

Performance of woodland rehabilitation monitoring sites against primary and secondary ecological performance indicators in 2024.

Rehabilitation Phase	Aspect or ecosystem component	Completion criteria	Performance Indicators	Primary Performance Indicators	Secondary Performance Indicators	Unit of measurement	RfWood01 2024	RfWood02 2024	RWood05 2024	2024 Woodland ecosystem range		South Dump 04	South Dump 07	South Dump 08	South Dump 10	North Dump 01	North Dump 02	North Dump 03
Performance indicators are quantified by the range of values obtained from replicated reference sites assessed in 2024							Ashleigh Park	Bundarra	Cadia Cadiangullong	Lower KPI	Upper KPI	2024						
Phase 3: Landform Establishment and Stability	**Landform slope, gradient**	Landform suitable for final land use and generally compatible with surrounding topography and final landform design	Slope	Landform is generally compatible within the context of the local topography and final landform design.		Degrees (<18°)	**10**	**14**	**12**	**10**	**14**	**18**	**16**	**0**	**17**	**14**	**15**	**2**
	Active erosion	Areas of active erosion are limited	No. Rills/Gullies	Number of gullies or rills >0.3m in width or depth in a 50m transect are limited and stabilising		No.	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**2**	**0**	**0**
			Cross-sectional area of rills		Provides an assessment of the extent of soil loss due to gully and rill erosion and that it is limited and/or is stabilising	m^2	**0**	**0**	**0**	**0**	**0**	**0**	**0.081**	**0**	**0**	**0.140**	**0**	**0**
Phase 4: Growth Medium Development	**Soil chemical, physical properties and amelioration**	Soil properties are suitable for the establishment and maintenance of selected vegetation species	pH	pH is typical of that of the surrounding landscape or falls within desirable ranges provided by the agricultural industry		pH (5.6-7.3)	**na**	**na**	**na**	**0.0**	**0.0**	**na**	**na**	**na**	**na**	**na**	**na**	**na**
			EC		Electrical Conductivity is typical of that of the surrounding landscape or fall within desirable ranges provided by the agricultural industry	< dS/m (<0.150)	**na**	**na**	**na**	**0.000**	**0.000**	**na**	**na**	**na**	**na**	**na**	**na**	**na**
			Organic Matter	Organic Matter levels are typical of that of the surrounding landscape, increasing or fall within desirable ranges provided by the agricultural industry		% (>4.5)	**na**	**na**	**na**	**0.0**	**0.0**	**na**	**na**	**na**	**na**	**na**	**na**	**na**
			Phosphorous	Available Phosphorus is typical of that of the surrounding landscape or fall within desirable ranges provided by the agricultural industry		mg/kg (50)	**na**	**na**	**na**	**0.0**	**0.0**	**na**	**na**	**na**	**na**	**na**	**na**	**na**

Rehabilitation Phase	Aspect or ecosystem component	Completion criteria	Performance Indicators	Primary Performance Indicators	Secondary Performance Indicators	Unit of measurement	RfWood01 2024	RfWood02 2024	RWood05 2024	2024 Woodland ecosystem range		South Dump 04	South Dump 07	South Dump 08	South Dump 10	North Dump 01	North Dump 02	North Dump 03
			Nitrate		Nitrate levels are typical of that of the surrounding landscape or fall within desirable ranges provided by the agricultural industry	mg/kg (>12.5)	na	na	na	0.0	0.0	na	na	na	na	na	na	na
			CEC		Cation Exchange Capacity is typical of that of the surrounding landscape or fall within desirable ranges provided by the agricultural industry	Cmol+/kg (>14)	na	na	na	0.0	0.0	na	na	na	na	na	na	na
			ESP		Exchangeable Sodium Percentage (a measure of sodicity) is typical of that of the surrounding landscape or fall within desirable ranges provided by the agricultural industry	% (<5)	na	na	na	0.0	0.0	na	na	na	na	na	na	na
Phase 5: Ecosystem & Land Use Establishment	**Landscape Function Analysis (LFA): Landform stability and organisation**	Landform is stable and performing as it was designed to do	LFA Stability	The LFA stability index provides an indication of the sites stability and is comparable to or trending towards that of the local remnant vegetation		%	68.5	72.0	76.3	68.5	76.3	70.9	69.0	72.1	70.0	68.0	69.5	70.7
			LFA Landscape organisation	The Landscape Organisation Index provides a measure of the ability of the site to retain resources and is comparable to that of the local remnant vegetation		%	100	100	100	100	100	100	80	100	100	100	100	88
	Vegetation diversity	Vegetation contains a diversity of species comparable to that of the local remnant vegetation	Diversity of shrubs and juvenile trees		The diversity of shrubs and juvenile trees with a stem diameter < 5 cm is comparable to that of the local remnant vegetation.	species/area	2	1	9	1	9	5	11	15	2	3	4	6
				The percentage of shrubs and juvenile trees with a stem diameter < 5 cm dbh which are local endemic species and these percentages are comparable to the local remnant vegetation		% population	50	100	72	50	100	100	100	100	22	100	100	100

Rehabilitation Phase	Aspect or ecosystem component	Completion criteria	Performance Indicators	Primary Performance Indicators	Secondary Performance Indicators	Unit of measurement	RfWood01 2024	RfWood02 2024	RWood05 2024	2024 Woodland ecosystem range		South Dump 04	South Dump 07	South Dump 08	South Dump 10	North Dump 01	North Dump 02	North Dump 03
			Total species richness	The total number of live plant species provides an indication of the floristic diversity of the site and is comparable to the local remnant vegetation		No./area	29	23	61	23	61	37	36	61	30	40	37	48
			Native species richness		The total number of live native plant species provides an indication of the native plant diversity of the site and that it is greater than or comparable to the local remnant vegetation	>No./area	14	8	36	8	36	15	26	38	5	11	11	16
			Exotic species richness		The total number of live exotic plant species provides an indication of the exotic plant diversity of the site and that it is less than or comparable to the local remnant vegetation	<No./area	15	15	25	15	25	22	10	23	25	23	26	32
			Ratio of native to exotic species		The ratio of live native species compared to live exotic plant species provides an indication of the relative native species richness of the site and that it is more than or comparable to the local remnant vegetation	>	0.9	0.5	1.4	1	1	0.7	2.6	1.7	0.2	0.5	0.4	0.5
	Vegetation density	Vegetation contains a density of species comparable to that of the local remnant vegetation	Density of shrubs and juvenile trees (< 5 cm dbh)		The total density of shrubs and/or juvenile trees with a stem diameter < 5 cm is comparable to that of the local remnant vegetation	No./area	2	3	116	2	116	97	232	230	9	67	244	174
				The density of eucalypts is comparable to the local remnant vegetation		No./area	0	3	3	0	3	0	8	10	0	0	0	3
				The density of acacias is comparable to the local remnant vegetation		No./area	1	0	70	0	70	97	194	100	2	67	244	19
				The density of other endemic shrubs is comparable to the local remnant vegetation		No./area	0	0	11	0	11	0	30	120	0	0	0	152
				The density of exotic / non endemic species is comparable to the local remnant vegetation		<No./area	1	0	32	0	32	0	0	0	7	0	0	0

Rehabilitation Phase	Aspect or ecosystem component	Completion criteria	Performance Indicators	Primary Performance Indicators	Secondary Performance Indicators	Unit of measurement	RfWood01 2024	RfWood02 2024	RWood05 2024	2024 Woodland ecosystem range		South Dump 04	South Dump 07	South Dump 08	South Dump 10	North Dump 01	North Dump 02	North Dump 03
				The percentage of eucalypts is comparable to the local remnant vegetation		% population	0	100	3	0	100	0	3	4	0	0	0	2
					The total density of endemic shrubs and/or juvenile trees (< 5 cm) is comparable to the local remnant vegetation	No./area	1	3	84	1	84	97	232	230	2	67	244	174
	Ecosystem composition	The vegetation is comprised by a range of growth forms comparable to that of the local remnant vegetation	Trees	The number of tree species regardless of age comprising the vegetation community is comparable to that of the local remnant vegetation		No./area	2	1	4	1	4	0	4	4	1	0	0	2
			Shrubs	The number of shrub species regardless of age comprising the vegetation community is comparable to that of the local remnant vegetation		No./area	2	0	7	0	7	5	13	12	2	3	4	4
			Sub-shrubs		The number of sub-shrub species comprising the vegetation community is comparable to that of the local remnant vegetation	No./area	0	0	0	0	0	0	0	0	0	0	0	0
			Herbs		The number of herbs or forb species comprising the vegetation community is comparable to that of the local remnant vegetation	No./area	20	14	36	14	36	20	11	28	22	29	23	33
			Grasses	The number of grass species comprising the vegetation community is comparable to that of the local remnant vegetation		No./area	4	7	10	4	10	11	7	12	5	7	9	9
			Reeds		The number of reed, sedge or rush species comprising the vegetation community is comparable to that of the local remnant vegetation	No./area	1	1	3	1	3	1	1	4	0	1	1	0
			Vines		The number of vines or climbing species comprising the vegetation community is comparable to that of the local remnant vegetation	No./area	0	0	0	0	0	0	0	1	0	0	0	0

Rehabilitation Phase	Aspect or ecosystem component	Completion criteria	Performance Indicators	Primary Performance Indicators	Secondary Performance Indicators	Unit of measurement	RfWood01 2024	RfWood02 2024	RWood05 2024	2024 Woodland ecosystem range		South Dump 04	South Dump 07	South Dump 08	South Dump 10	North Dump 01	North Dump 02	North Dump 03
			Ferns		The number of ferns comprising the vegetation community is comparable to that of the local remnant vegetation	No./area	0	0	1	0	1	0	0	0	0	0	0	0
			Aquatic		The number of aquatic plants comprising the vegetation community is comparable to that of the local remnant vegetation	No./area	0	0	0	0	0	0	0	0	0	0	0	0
Phase 6: Ecosystem & Land Use Development	**Landscape Function Analysis (LFA): Landform function and ecological performance**	Landform is ecologically functional and performing as it was designed to do	LFA Infiltration	LFA infiltration index provides an indication of the sites infiltration capacity and is comparable to or trending towards that of the local remnant vegetation		%	58.7	56.7	65.6	56.7	65.6	44.9	34.0	50.6	42.6	46.8	51.2	47.8
			LFA Nutrient recycling	LFA nutrient recycling index provides an indication of the sites ability to recycle nutrient and is comparable to or trending towards that of the local remnant vegetation		%	55.8	54.3	63.6	54.3	63.6	47.3	35.5	53.3	44.6	44.5	52.4	46.7
	Protective ground cover	Ground layer contains protective ground cover and habitat structure comparable with the local remnant vegetation	Litter cover		Percent ground cover provided by dead plant material is comparable to that of the local remnant vegetation	%	89.0	69.0	81.8	69	89	56	60	46	71	49	75	27.5
			Annual plants		Percent ground cover provided by live annual plants is comparable to that of the local remnant vegetation	<%	1.5	0.5	0.5	1	1.5	9	4	24	12	40	4	39.5
			Cryptogam cover		Percent ground cover provided by cryptogams (e.g. mosses, lichens) is comparable to that of the local remnant vegetation	%	0	0	0	0	0	5	3	1	0	0	0	4
			Rock		Percent ground cover provided by stones or rocks (> 5 cm diameter) is comparable to that of the local remnant vegetation	%	0.0	0.5	0.0	0	0.5	7	4	1	0	1	1	1
			Log		Percent ground cover provided by fallen branches and logs (>5 cm) is comparable to that of the local remnant vegetation	%	0.5	7.5	2.2	1	7.5	0	0	0	0	0	0	0

Rehabilitation Phase	Aspect or ecosystem component	Completion criteria	Performance Indicators	Primary Performance Indicators	Secondary Performance Indicators	Unit of measurement	RfWood01 2024	RfWood02 2024	RWood05 2024	2024 Woodland ecosystem range		South Dump 04	South Dump 07	South Dump 08	South Dump 10	North Dump 01	North Dump 02	North Dump 03
			Bare ground		Percentage of bare ground is less than or comparable to that of the local remnant vegetation	< %	4	0	0	0	4	8	16	5	8	1	0	5
			Perennial plant cover (< 0.5 m)	Percent ground cover provided by live perennial vegetation (<0.5 m in height) is comparable to that of the local remnant vegetation		%	5.0	22.5	15.5	5	22.5	17	13	25	10	10	20	24
			Total Ground Cover	Total groundcover is the sum of protective ground cover components (as described above) and that it is comparable to that of the local remnant vegetation		%	96	100	100	96	100	93	84	96	92	100	100	95
	Ground cover diversity	Vegetation contains a diversity of species per square meter comparable to that of the local remnant vegetation	Native understorey abundance	The abundance of native species per square metre averaged across the site provides an indication of the heterogeneity of the site and that it is has more than or an equal number of native species as the local remnant vegetation		> species/m^2	2.2	0.8	5.0	1	5.0	2.8	2.4	2.2	0	1.4	1.4	1.2
			Exotic understorey abundance		The abundance of exotic species per square metre averaged across the site provides an indication of the heterogeneity of the site and that it is has less than or an equal number of exotic species as the local remnant vegetation	< species/m^2	2.6	2.2	1.6	2	2.6	2.4	0.6	3.8	3.8	5.2	3	3.8
	Native ground cover abundance	Native ground cover abundance is comparable to that of the local remnant vegetation	Percent ground cover provided by native vegetation <0.5 m tall	The percent ground cover abundance of native species (<0.5m) compared to exotic species is comparable to that of the local remnant vegetation		%	51.6	25.9	78.7	26	78.7	59.5	87.5	39.7	0.0	21.9	29.5	30.2

Rehabilitation Phase	Aspect or ecosystem component	Completion criteria	Performance Indicators	Primary Performance Indicators	Secondary Performance Indicators	Unit of measurement	RfWood01 2024	RfWood02 2024	RWood05 2024	2024 Woodland ecosystem range		South Dump 04	South Dump 07	South Dump 08	South Dump 10	North Dump 01	North Dump 02	North Dump 03
	Ecosystem growth and natural recruitment	The vegetation is maturing and/or natural recruitment is occurring at rates similar to those of the local remnant vegetation	shrubs and juvenile trees 0 - 0.5 m in height	The number of shrubs or juvenile trees <0.5 m in height provides an indication of establishment success and/or natural ecosystem recruitment and that it is comparable to that of the local remnant vegetation		No./area	**2**	**1**	**62**	**1**	**62.0**	**1**	**8**	**32**	**5**	**30**	**6**	**17**
			shrubs and juvenile trees 0.5 – 1 m in height		The number of shrubs or juvenile trees 0.5-1 m in height provides an indication of establishment success, growth and/or natural ecosystem recruitment and that it is comparable to that of the local remnant vegetation	No./area	**0**	**0**	**23**	**0**	**23.0**	**11**	**10**	**46**	**4**	**12**	**0**	**68**
			shrubs and juvenile trees 1 - 1.5m in height		The number of shrubs or juvenile trees 1-1.5 m in height provides an indication of establishment success, growth and/or natural ecosystem recruitment and that it is comparable to that of the local remnant vegetation	No./area	**0**	**1**	**23**	**0**	**23.0**	**10**	**28**	**52**	**0**	**4**	**22**	**77**
			shrubs and juvenile trees 1.5 – 2 m in height	The number of shrubs or juvenile trees 1.5-2 m in height provides an indication of establishment success, growth and/or natural ecosystem recruitment and that it is comparable to that of the local remnant vegetation		No./area	**0**	**0**	**6**	**0**	**6.0**	**21**	**66**	**60**	**0**	**13**	**60**	**10**
			shrubs and juvenile trees >2 m in height		The number of shrubs or juvenile trees >2 m in height provides an indication of establishment success, growth and/or natural ecosystem recruitment and that it is comparable to that of the local remnant vegetation	No./area	**0**	**1**	**2**	**0**	**2.0**	**54**	**120**	**40**	**0**	**8**	**156**	**2**

Rehabilitation Phase	Aspect or ecosystem component	Completion criteria	Performance Indicators	Primary Performance Indicators	Secondary Performance Indicators	Unit of measurement	RfWood01 2024	RfWood02 2024	RWood05 2024	2024 Woodland ecosystem range		South Dump 04	South Dump 07	South Dump 08	South Dump 10	North Dump 01	North Dump 02	North Dump 03
	Ecosystem structure	The vegetation is developing in structure and complexity comparable to that of the local remnant vegetation	Foliage cover 0.5 - 2 m	Projected foliage cover provided by perennial plants in the 0.5 – 2 m vertical height stratum indicates the community structure is comparable to that of the local remnant vegetation		% cover	**0.0**	**0.0**	**3.0**	**0**	**3**	**30**	**58**	**26**	**0**	**1**	**30**	**8**
			Foliage cover 2 – 4 m	Projected foliage cover provided by perennial plants in the 2 – 4 m vertical height stratum indicates the community structure is comparable to that of the local remnant vegetation		% cover	**0**	**0**	**1**	**0**	**0.5**	**14**	**28**	**10.5**	**0**	**0**	**17**	**3**
			Foliage cover 4 – 6 m		Projected foliage cover provided by perennial plants in the 4 -6 m vertical height stratum indicates the community structure is comparable to that of the local remnant vegetation	% cover	**1**	**2**	**4**	**1**	**4**	**5**	**0**	**2**	**0**	**0**	**0**	**0**
			Foliage cover >6 m	Projected foliage cover provided by perennial plants >6 m vertical height stratum indicates the community structure is comparable to that of the local remnant vegetation		% cover	**44**	**26**	**27**	**26**	**44**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	Tree diversity	Vegetation contains a diversity of maturing tree and shrubs species comparable to the local remnant vegetation	Tree diversity		The diversity of trees or shrubs with a stem diameter >5 cm is comparable to the local remnant vegetation	species/area	**2**	**1**	**5**	**1**	**5**	**1**	**4**	**5**	**1**	**1**	**1**	**1**
				The percentage of maturing trees and shrubs with a stem diameter >5 cm dbh which are local endemic species and these percentages are comparable to the local remnant vegetation		% endemic	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Rehabilitation Phase	Aspect or ecosystem component	Completion criteria	Performance Indicators	Primary Performance Indicators	Secondary Performance Indicators	Unit of measurement	RfWood01 2024	RfWood02 2024	RWood05 2024	2024 Woodland ecosystem range		South Dump 04	South Dump 07	South Dump 08	South Dump 10	North Dump 01	North Dump 02	North Dump 03
	Tree density	Vegetation contains a density of maturing tree and shrub species comparable to the local remnant vegetation	Tree and mature shrub density (> 5 cm dbh)		The total density of live trees and/or mature shrubs with a stem diameter > 5 cm is comparable to that of the local remnant vegetation	No./area	**23**	**8**	**40**	**8**	**40**	7	18	22	1	4	30	1
				The density of eucalypts is comparable to that of the local remnant vegetation		No./area	**23**	**8**	**38**	**8**	**38**	0	14	12	1	0	0	0
				The density of acacias is comparable to the local remnant vegetation		No./area	**0**	**0**	**2**	**0**	**2**	7	4	10	0	4	30	1
				The density of other endemic species is comparable to the local remnant vegetation		No./area	**0**	**0**	**0**	**0**	**0**	0	0	0	0	0	0	0
				The density of exotic / non endemic species is comparable to the local remnant vegetation		<No./area	**0**	**0**	**0**	**0**	**0**	0	0	0	0	0	0	0
				The percentage of eucalypts is comparable to the local remnant vegetation		% population	**100**	**100**	**95**	**95**	**100**	0	78	55	100	0	0	0
			Average dbh		Average tree diameter of the tree population provides a measure of age, (height) and growth rate and that it is trending towards that of the local remnant vegetation.	cm	**33**	**69**	**26**	**26**	**69**	14	10	8	7	12	8	10
	Ecosystem health	The vegetation is in a condition comparable to that of the local remnant vegetation.	Live trees		The percentage of the tree population which are live individuals and that the percentage is comparable to the local remnant vegetation	% population	**92**	**89**	**87**	**87**	**92.0**	100	75	100	100	100	79	100
			Healthy trees	The percentage of the tree population which are in healthy condition and that the percentage is comparable to the local remnant vegetation		% population	**68**	**89**	**26**	**26**	**88.9**	71.4	33.3	100	100	25	52.6	0

Rehabilitation Phase	Aspect or ecosystem component	Completion criteria	Performance Indicators	Primary Performance Indicators	Secondary Performance Indicators	Unit of measurement	RfWood01 2024	RfWood02 2024	RWood05 2024	2024 Woodland ecosystem range		South Dump 04	South Dump 07	South Dump 08	South Dump 10	North Dump 01	North Dump 02	North Dump 03
			Medium health		The percentage of the tree population which are in a medium health condition and that the percentage is comparable to the local remnant vegetation	% population (if greater than dieback)	20	0	41	0	41.3	28.6	42	0	0	50	26.3	100
			Advanced dieback		The percentage of the tree population which are in a state of advanced dieback and that the percentage is comparable to the local remnant vegetation	% population	4	0	20	0	19.6	0	0	0	0	25	0	0
			Dead Trees		The percentage of the tree population which are dead (stags) and that the percentage is comparable to the local remnant vegetation	% population	8	11	13	8	13	0	25	0	0	0	0	0
			Mistletoe		The percentage of the tree population which have mistletoe provides an indication of community health and habitat value and that the percentage is comparable to the local remnant vegetation	% population	0	0	0	0	0	0	0	0	0	0	0	0
			Flowers/fruit: Trees	The presence of reproductive structures such as buds, flowers or fruit provides evidence that the ecosystem is maturing, capable of recruitment and can provide habitat resources comparable to that of the local remnant vegetation		% population	80	89	50	50	88.9	85.7	8	27	0	50	52.6	100
			Hollows		The presence of hollows provides evidence that the ecosystem is maturing, and can provide habitat resources comparable to that of the local remnant vegetation	% population	4	44	13	4	44.4	0	0	0	0	0	0	0