

# Operational Biodiversity Management Plan Glenwood High School

Forman Avenue (Lot 5227 DP868693),  
Glenwood NSW 2768

NCA23R160041

23 January 2024



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Prepared	Reviewed	Endorsed
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# EXECUTIVE SUMMARY

The Glenwood High School (GHS) redevelopment that will include new infrastructure and buildings and associated landscaping required an Operational Biodiversity Management Plan (OBMP). This is required under Condition D27 of the SSD-23512960 for the GHS that requires the OBMP must address, but not be limited to, the conditions in **Table 1**.

**Table 1: Compliance Table for SSD-23512960 Condition D27**

Condition	Compliance
<p>Prior to the commencement of operation, the Biodiversity Management Plan (Excluding sections relating to the construction phase) prepared by Kleinfelder Pty Ltd and dated 20 April 2022 must be amended in consultation with the EHG and submitted to the Planning Secretary for approval. The amended Biodiversity Management Plan must meet the following requirements:</p> <p>a) be consistent with the recommendations of the Biodiversity Development Assessment Report including that the Biodiversity Management Plan must be implemented for the duration of occupation of the development;</p> <p>b) update Sections 1.4.1 and Section 3.1.2 so that the objectives and performance criteria are measurable.</p>	<p>The Biodiversity Development Assessment Report (BDAR, Final; July 15<sup>th</sup>, 2022) was reviewed and informed the update of this Operational Biodiversity Management Plan (OBMP).</p> <p>Sections of the BDAR relating to the construction phase of the development were excluded. This changed 1.4.1 to 1.3.1 Objectives.</p> <p>Sections 1.3.1 and 3.1.2 were updated to reflect the measurability of objectives and performance criteria, per the BDAR benchmarks.</p>



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# 1 INTRODUCTION

## 1.1 BACKGROUND

Kleinfelder Australia Pty Ltd (Kleinfelder) was engaged by Richard Crookes Construction to prepare an Operational Biodiversity Management Plan (OBMP) for the operational stage of Glenwood High School, Forman Avenue (Lot 5227 DP868693), Glenwood NSW 2768 (The 'Subject Site') (see **Figure 1**). The completion of an OBMP for the Subject Site is following a requirement for the occupational certification, a review of information and the conditions for the school provided via email from Richard Crookes Construction (RCC) on 11 October 2023:

*“RCC is currently working towards occupational certification for the Glenwood High School project and looking to close out the OBMP for the project as part of this process. To this extent, RCC asks that the Biodiversity Management Plan is updated to an Operational Biodiversity Management Plan capturing the below requirements so as to satisfy the below Consent Condition requirements (Condition D27)- Prior to the commencement of operation, the Biodiversity Management Plan (Excluding sections relating to the construction phase) prepared by Kleinfelder Pty Ltd and dated 20 April 2022 must be amended in consultation with the EHG and submitted to the Planning Secretary for approval. The amended Biodiversity Management Plan must meet the following requirements: a) be consistent with the recommendations of the Biodiversity Development Assessment Report including that the Biodiversity Management Plan must be implemented for the duration of occupation of the development; and b) update Sections 1.4.1 and Section 3.1.2 so that the objectives and performance criteria are measurable.”*

The following terms are used throughout this report to describe geographical areas (**Figure 1**).

- **Subject Site** – Forman Avenue (Lot 5227 DP868693), Glenwood NSW 2768.
- **Development Site** - The area within the Subject Site to be directly impacted by the proposed development, i.e. the footprint of the school building.
- **Reserve** - areas of Cumberland Plain Woodland within the Subject Site proposed for management.
- **Locality** – land within a 5 km radius of the Subject Site.

This OBMP provides a summary of biodiversity values within the Subject Site, key threats associated with operational phases of the proposed development, and key strategies for the management of biodiversity values, with an implementation period for the operational life of the school. The above implementation period is required to account for indirect impacts, that have not been considered and appropriately offset in the BDAR, which may occur on threatened species, ecological communities and their habitats.

## 1.2 SITE DESCRIPTION

The Subject Site is located within the suburb of Glenwood, approximately 5 km northeast of Blacktown CBD (**Figure 1**). The Subject Site is within the Blacktown City Council Local Government Area (LGA) and is zoned as SP2 – Infrastructure under the *Blacktown Local Environmental Plan 2015* (LEP).



The Subject Site is bound by residential developments to the east via Glenwood Park drive and to the south via Forman Avenue. The northern and eastern boundaries of the school are bound by Glenwood Reserve, which is zoned RE1 – Public Recreation. The majority of Subject Site is either mixed native/exotic gardens or managed exotic grassland and existing infrastructure. There is a small patch of intact native grassy woodland located in the north-eastern portion of the Subject Site (**Figure 2**). The vegetation within this patch is commensurate with *Cumberland Plain Woodland in the Sydney Bioregion* CEEC under the New South Wales Biodiversity Conservation Act 2016 (BC Act).

## 1.3 MANAGEMENT PLAN OBJECTIVES

### 1.3.1 Objectives

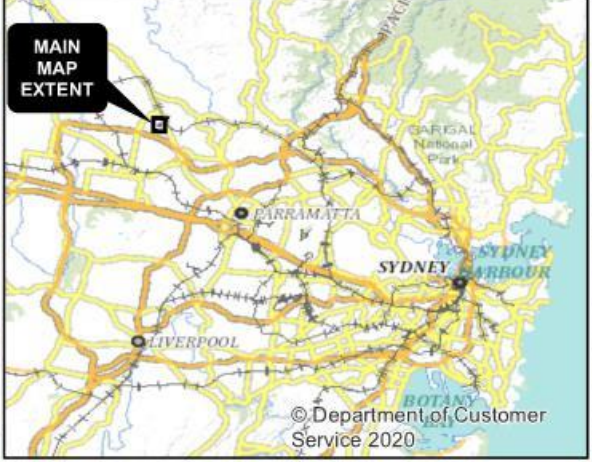
This OBMP is a requirement for the close out of the occupational certificate of the school. The OBMP is required to be prepared by a suitably qualified person (i.e. qualified ecologist or bush regeneration specialist) and provide a continuing strategy for the management and regeneration of the Cumberland Plain Woodland. The key objectives of the OBMP include:

1. To minimise impacts to flora and fauna, and their habitats, during the operational phase of the Glenwood High School development.
2. To improve the condition of the Cumberland Woodland within the Reserve, ensuring that it measures within the vegetation benchmarks set forth in **Section 3.2.2** and no encroachment of high threat weeds or exotic species through mowing.
3. To restore the existing derived grassland areas within the Reserve with commensurate species of Cumberland Plain Woodland and to ensure that it is maintained in a healthy condition.
4. To outline a strategy for the management of key weed species identified within the BDAR (Kleinfelder 2022) as key threats to the vegetation within the Reserve.
5. To augment ground habitat (e.g. ground timber and hollow logs) in the existing derived grassland areas and to maintain such habitat features throughout the Reserve.
6. The condition of the Cumberland Woodland within the Reserve should be measured using the Vegetation Integrity Assessment in the Biodiversity Assessment Operational Manual – Stage 1 (DPE 2020). The proportion of each growth form, that has unhealthy foliage from disease or pest attack, should be estimated; with healthy vegetation containing low proportions of these attributes.
7. The data from site Q02 (Standard BAM Plot) in the BDAR assessment would provide the base line measurement condition for Management Zone 1. However, for future monitoring only 20x20 m quadrat of site Q02 will be used for monitoring. A new 20x20 m quadrat will be required for the baseline assessment in Management Zone 2. The vegetation condition scores will be required to improve in future assessments of both Zones.



Regional Context

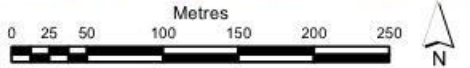
0 2.5 5 10 15 20 25 km



Legend

- Subject Site
- Reserve
- Development Site
- Named Watercourse
- Unnamed Watercourse
- Arterial Road
- Sub-arterial Road
- Local Road

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PROJECT REFERENCE: 20226121  
 DATE DRAWN: 2022/04/07 14:33 Version 1  
 DRAWN BY: G.Joyce

**Locality**

FIGURE:  
**1**



DATA SOURCE:  
 NSW DFSI - 2021  
 Nearmap - 2022

Jacobs Group (Australia) Pty Ltd  
 Biodiversity Management Plan  
 Glenwood High (Lot 5227 DP868693)  
 Forman Avenue, Glenwood NSW





## 2 BIODIVERSITY VALUES

### 2.1 KEY BIODIVERSITY VALUES

A Biodiversity Development Assessment Report (BDAR) was completed for the Glenwood High School development by Kleinfelder following the completion of a site-based assessment (01 June 2021). The key results of the BDAR are detailed below.

#### 2.1.1 Flora Species

A total of 64 flora species were identified during field surveys, 36 of these were exotic species. No threatened species were identified within the Subject Site. A list of the flora species identified within the Subject Site is provided in **Appendix A**.

A total of seven (7) ‘High Threat Exotics’ and three (3) Priority Weeds for the Greater Sydney Local Land Services Region under the *Biosecurity Act 2015* (NSW) were identified within the site, all of which are also listed as Weeds of National Significance (WoNS) (DAWE 2022). An additional species is listed as a WoNS but not as a Priority Weed is included in the list of species below:

- *Asparagus asparagoides* (Bridal Creeper) [WoNS and Priority Weed]
- *Senecio madagascariensis* (Fireweed) [WoNS and Priority Weed]
- *Olea europaea* subsp. *cuspidata* (Common Olive) [WoNS]
- *Rubus fruticosus* sp. *agg.* (Blackberry complex) [WoNS and Priority Weed]

Notable infestations of other exotic species were also identified within the site, including the following species:

- *Cenchrus clandestinus* (Kikuyu)
- *Setaria parviflora*
- *Sporobolus africanus* (Parramatta Grass)

A comprehensive list of exotic species is presented in **Appendix A**. Discussion of the threat of weed infestations on the area of Cumberland Plain Woodland is provided in **Section 2.2.1**. The only HTW found in Management Zones 1 and 2 (BDAR Appendix 3) was Paspalum (*Paspalum dilatatum*) with a cover of 55%. Mitigation measures to prevent the spread of weeds are presented in **Section 3.2.5**.

#### 2.1.2 Vegetation Communities

One (1) native vegetation community exists within the Reserve. This community is represented by three condition classes within the Subject Site, two (2) of which exist within the Reserve (**Figure 3**), including:

- PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (CEEC - Moderate Condition) - Area within Reserve: 0.34 ha.
- PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Low Condition) - Area within Reserve: 0.49 ha.

The vegetation within the Reserve represents one Critically Endangered Ecological Community (CEEC); *Cumberland Plain Woodland in the Sydney Bioregion* CEEC as listed under the BC Act (see **Figure 3**).



### 2.1.3 Fauna and Habitat Values

Fauna habitat within the Subject Site is characterised by open managed (mown) grassland areas, gardens of dense shrubs (i.e. *Callistemon spp.*, *Acacia spp.* and exotics), mature eucalypts, and a fenced off patch of intact native woodland. Much of the vegetation within the Subject Site is highly managed, as such there is a low abundance of wooden debris, leaf litter and dense shrub cover which would otherwise provide important habitat for ground dwelling native fauna. As such, most of the vegetation within the Subject Site is likely to only constitute habitat for highly mobile threatened species (i.e. birds and bats), and locally occurring species associated with urban/suburban environments.

The exception is the patch of native woodland (The Reserve), which is characterised by a mature canopy of eucalypts, a scattered midstorey of *Melaleuca spp.*, *Acacia spp.*, and *Bursaria spinosa*, hollow-bearing trees, abundant fallen timber, and a drainage depression capable of retaining water (considered likely frog habitat). Conversely, the Reserve is dominated by exotic groundcover species and is only partially connected to scattered patches of vegetation along a watercourse to the north, and streetside vegetation throughout the locality. As such, the Reserve represents habitat for locally occurring woodland birds, common arboreal marsupials, and only highly mobile threatened species (i.e. birds and bats).

Key fauna habitat features identified during the site assessment includes the following:

- Four (4) Hollow-bearing Trees (HBT) either *Eucalyptus tereticornis* (Forest Red Gum) or *Eucalyptus moluccana* (Grey Box) with and additional two (2) dead stags (**Figure 2**).
- Two (2) hollow fallen logs within the Reserve creating habitat for reptiles and mammals (**Figure 2**).
- Mature trees within the Subject Site provide foraging and nesting habitat for several common native bird species. Other species include several microbats and other arboreal mammals may occupy these large mature trees.
- A Drainage Swale occurs within the Reserve, providing habitat suitable for a variety of native fauna species.

No threatened fauna species were identified within the Subject Site during the site assessment. A total of eleven (11) species of fauna were detected within the Subject Site during field surveys. These included eleven (11) bird species, which are common to urban/suburban environments. More commonly encountered species included the Red-rumped Parrot (*Psephotus haematonotus*), Rainbow Lorikeet (*Trichoglossus haematodus*), Eastern Rosella (*Platycercus eximius*), and Noisy Miner (*Manorina melanocephala*).

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Legend		Habitat Features	Plant Community Types
	Subject Site		
	Development Site		
	Reserve		
	Unnamed Watercourse		
	Sub-arterial Road		
	Local Road		

 	PROJECT REFERENCE: 20226121 DATE DRAWN: 2022/04/07 14:42 Version 1 DRAWN BY: G.Joyce	<h3 style="text-align: center;">Vegetation and Biodiversity Values</h3> <p style="text-align: center;">Jacobs Group (Australia) Pty Ltd                  Biodiversity Management Plan                  Glenwood High (Lot 5227 DP868693)                  Forman Avenue, Glenwood NSW</p>	FIGURE:  <b style="font-size: 2em;">2</b>



## 2.2 KEY THREATS

### 2.2.1 Weed Incursions

Weeds are known to compete with native flora species, leading to declines in species diversity and regeneration, and changes to fauna habitat values (DECCW 2010). Cumberland Plain Woodland is considered 'highly vulnerable' to weed invasion due to its position on relatively fertile soils, past land-use practices, and its naturally grassy understory (DEC 2005). A total of three (3) Priority Weed species for the Greater Sydney Local Land Services Region (DPI 2022) were identified within the Subject Site. All three species are also listed as Weeds of National Significance (WoNS) (DAWE 2023). These species included: *Asparagus asparagoides* (Bridal Creeper), *Senecio madagascariensis* (Fireweed) and *Rubus fruticosus sp. agg.* (Blackberry). An additional species *Olea europaea subsp. cuspidata* (Common Olive) is listed exclusively as a WoNS. Of the abovementioned weeds, Bridal Creeper was identified as having the highest cover within the Reserve, however all four occur at a relatively low abundance. Dominant weed species occur in the understorey of the Reserve and include *Cenchrus clandestinus* (Kikuyu), *Ehrharta erecta* (Panic Veldtgrass), *Setaria parviflora* and *Sporobolus africanus* (Parramatta Grass)

African Olive, Bridal Creeper, and Moth Vine (*Araujia sericifera*) are all recorded on site and have been identified as particularly significant weeds of the Cumberland Plain Woodland. These three species have a highly competitive nature and ability to suppress understorey species. Bridal Creeper and Moth Vine are among a suite of exotic vines and scramblers that are listed as a threatening process in NSW which are also considered a specific threat to the ecological community (NSW Scientific Committee, 2006). African Olive is a particularly significant threat to the ecological community. It has an ability to permanently change the structure of the ecological community through dense mid-canopy formation and, like other weeds such as Bridal Creeper, can suppress native plant species in the understorey

Weed incursions will continue to be a threat to biodiversity values during the Operational Stage.

- **Operational Phase:** The proposed educational facility, if unmanaged, may further exacerbate local weed incursions or facilitate the introduction of novel weed species through the dumping of garden waste and changes to nutrient inputs from increase runoff (i.e. due to potential changes to surface hydrology).

### 2.2.2 Vegetation Clearing and Habitat Loss

Vegetation Clearing is considered a primary threat to the conservation of Cumberland Plain Woodland CEEC (BC Act) (DEC 2005). Clearing of the Cumberland Plain Woodland native vegetation has occurred gradually over time resulting in increasingly isolated, small patches of woodland that are more vulnerable to potential impacts and support fewer species. The proposed development will require the clearing of native vegetation to a minor extent, including 0.01 ha of woodland (PCT 849 – Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion). Vegetation clearing will not impact any hollow bearing trees identified within the Subject Site that may represent nesting habitat for a variety of native bird and arboreal mammal species. Incursions into areas of native woodland and grassland may exacerbate existing weed management threats and adversely impact threatened species and ecological communities occurring within the Subject Area.

Vegetation clearing and habitat loss represents a threat to biodiversity values during:



- **Operational Phase:** The proposed development may further exacerbate habitat loss and degradation of vegetation through inappropriate management of retained vegetation.

### 2.2.3 Erosion and Sedimentation

Mature vegetation is considered integral in preventing erosion through bank stabilisation and sediment control (DEC 2005). Erosion resulting from earthworks such as the operation of machinery during the construction phase may facilitate the movement of water-borne sediments that have the potential to adversely impact important biodiversity values on site. This may include impacts on the condition of native vegetation, threatened ecological communities (Cumberland Plain Woodland) and threatened species habitat.

### 2.2.4 Urbanisation and Increased Nutrient Loading

Historically, much of the Cumberland Plain was cleared to make way for agricultural practices. Whilst this is still common, the landscape, particularly within the Blacktown LGA has become increasingly urban in nature, with agricultural sites being subdivided to make way for high density urban developments. Urbanisation results in 'site hardening' or the covering of ground surfaces with impervious infrastructure that prevents rainwater from entering the water table (DEC 2005). Site hardening results in increased runoff, most of which ends up flowing overland or via creeks through bushland. Runoff often collects and carries excess sediment and nutrients produced in the urbanised landscape and transports it to native bushland.

The excess nutrient load can negatively impact bushland by encouraging the growth of exotic plant species, some of which may have been introduced via the runoff.

Urbanisation and increased nutrient loading represent a threat to biodiversity values during:

- **Operational Phase:** The proposed education facility may further exacerbate nutrient loading within native vegetation, in turn facilitating habitat degradation through the introduction/facilitation of weed incursions.

### 2.2.5 Lighting, Noise and Water Pollution

Urban developments can result in a number of indirect impacts pertaining to Cumberland Plain Woodlands and the habitat they provide, including increased lighting (light pollution) and noise (noise pollution), and changes to surface water runoff and quality. Threats to local biodiversity values pertaining to the proposed development include the following:

- **Operational Phase:** The proposed development action may result in changes to soil nutrient status from fertilisers and wastewater disposal; increased/inappropriate lighting within the woodland area; and increased noise from traffic.



# 3 BIODIVERSITY MANAGEMENT PLAN

## 3.1 MANAGEMENT ZONES

Four (4) Management Zones pertain to the Subject Site based on current condition/status, management requirements, and proposed future land use. The management zones are shown in **Figure 3**, and detailed in **Table 2**.

- **Management Zone 1:** Reserve (woodland rehabilitation)
- **Management Zone 2:** Reserve (woodland restoration)
- **Management Zone 3:** Development Site
- **Excluded:** Existing School Grounds (not impacted)

**Table 2: Management Zones within the Subject Site**

Management Zone	Description
<p><b>Management Zone 1:</b> Reserve (woodland rehabilitation)</p>	<p><b>Total area within Subject Site:</b> 0.34 ha</p> <p><b>Community:</b> PCT 849 – Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion, Critically Endangered Ecological Community (BC Act) - Moderate Condition</p> <p><b>Form:</b> Grassy Woodland</p> <p><b>Description:</b> The vegetation within this zone was characterised by a canopy dominated by <i>Eucalyptus tereticornis</i> (Forest Red Gum), with the occasional <i>Eucalyptus crebra</i> (Narrow-leaved Ironbark). The midstorey is comprised of <i>Melaleuca decora</i>, <i>Acacia parramattensis</i> (Parramatta Wattle), <i>Bursaria spinosa</i> (Sweet Bursaria), and the occasional <i>Olea europaea</i> subsp. <i>cuspidata</i> (African Olive). The ground layer within this zone is dominated by exotic grasses including <i>Paspalum dilatatum</i>*(Paspalum), <i>Eragrostis curvula</i> (African Lovegrass), and <i>Ehrharta erecta</i> (Panic Veldtgrass). A mix of native grasses and herbs still persist within this vegetation zone, including <i>Microlaena stipoides</i> (Weeping Grass), <i>Einadia hastata</i> (Berry Saltbush), <i>Dichondra repens</i> (Kidney Weed), and <i>Commelina cyanea</i> (Native Wandering Jew).</p> <p><b>Disturbances:</b> Vegetation condition within this zone is impacted by the occurrence of priority weed species and the dominance of an exotic grassy groundlayer. Key exotic species within this zone include the dominance of High Threat Weeds (HTW) in the ground layer (e.g., <i>Paspalum dilatatum</i>, <i>Eragrostis curvula</i>, <i>Ehrharta erecta</i>) and Priority Weeds for the Greater Sydney region including <i>Olea europaea</i> subsp. <i>cuspidata</i>, <i>Rubus fruticosus</i> (Blackberry), <i>Asparagus asparagoides</i> (Bridal Creeper), and <i>Senecio madagascariensis</i> (Fireweed).</p> <p><b>Management Goals:</b> This zone exists outside of the Development Site and will be retained within the proposed Reserve. It will be subject to active management to maintain and restore the CEEC, improve habitat values, reduce weed impacts and extent. Supplementary plantings of Cumberland Plain Woodland species should be completed alongside restoration within Management Zone 2 where needed.</p>
<p><b>Management Zone 2:</b> Reserve (woodland restoration)</p>	<p><b>Total area within Subject Site:</b> 0.49 ha</p> <p><b>Community:</b> PCT 849 – Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion - Low Condition</p> <p><b>Form:</b> Derived Grassland</p> <p><b>Description:</b> Canopy is reduced to scattered canopy trees including <i>Eucalyptus tereticornis</i> (Forest Red Gum), <i>Eucalyptus crebra</i> (Narrow-leaved Ironbark), and <i>Angophora floribunda</i> (Rough-barked Apple). The midstorey, whilst largely reduced, contains <i>Melaleuca decora</i>, <i>Acacia parramattensis</i> (Parramatta Wattle). The groundcover within this zone is highly managed (mown) and dominated by exotic grasses including <i>Cenchrus clandestinus</i> (Kikuyu Grass), <i>Setaria parviflora</i> (Pigeon Grass), <i>Lolium rigidum</i></p>



Management Zone	Description
	<p>(Wimmera Ryegrass), and <i>Sporobolus africanus</i> (Parramatta Grass). Some native grasses and herbs persist within the vegetation zone including <i>Microlaena stipoides</i> (Weeping Grass), <i>Dichondra repens</i> (Kidney Weed), and <i>Oxalis perennans</i>. An intermittently filled swale occurs within the Reserve.</p> <p><b>Disturbances:</b> Historic vegetation clearing and ongoing management (mowing). This management zone is primarily comprised of exotic grasses and forbs.</p> <p><b>Management Goals:</b> The extent of this community within the Reserve will be subject to active management to maintain and restore the community, improve habitat values, reduce weed impacts and extent. Most notably, this will include restoration of canopy vegetation through the planting of tree species associated with PCT 849. Additional planting of sub-aquatic vegetation within the existing swale is recommended to enhance its overall habitat value.</p>
<p><b>Management Zone 3:</b> Development Site</p>	<p><b>Total area within Subject Site:</b> 0.41 ha</p> <p><b>Community:</b> This zone is managed as part of Glenwood High School and is predominantly occupied by existing infrastructure. A small area (approximately 0.01 ha) of low condition PCT 849 - <i>Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion</i>, lies within this management zone. Additionally, a managed exotic grassland occurs within the Development Site.</p> <p><b>Form:</b> Low condition native vegetation to be impacted by development. Managed as open space and occupied by existing infrastructure proposed for removal.</p> <p><b>Description:</b> An area actively managed and occupied by infrastructure associated with Glenwood High School. Management Zone 3 includes a small area (0.01 ha) of PCT 849 as well as managed exotic grasslands.</p> <p><b>Management Goals:</b> This zone will be occupied by a new 3 storey building that will provide contemporary learning spaces for the Students of Glenwood High School. Construction will be managed in a way that minimises potential indirect impacts to the neighbouring Reserve. Here, planting will occur to improve the overall condition of native vegetation within the Subject Site.</p>
<p><b>Excluded:</b> Existing School Grounds (not impacted)</p>	<p><b>Total area within Subject Site:</b> 2.8 ha</p> <p><b>Form:</b> Derived Grassland impacted by development. Managed as parks and open spaces.</p> <p><b>Description:</b> The extent of the Subject Site outside of the Reserve and Development Site. It is predominantly comprised of existing infrastructure associated with the school and exotic grassland. A lesser extent of low condition PCT 849 – <i>Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion</i>, occurs sporadically across the Subject Site. Areas of planted exotic/native vegetation occur within this zone.</p>



### 3.1.1 Management Stages

The timing of management tasks and performance criteria are based on Management Stages defined by the progress of the proposed development. The development stages were defined as the following:

- **Pre-Construction Phase:** Between development approval and the initiation of construction works on site (Completed).
- **Construction Phase:** Between the initiation and completion of construction within the site (Completed).
- **Post Construction Phase:** Between the completion of construction and the first monitoring event (Completed).
- **Adaptive Management/Operational Phase:** Between the first monitoring event (Baseline) following the completion of works to the end of the implementation period, i.e., the cessation of operations at Glenwood High School. This OBMP covers the first 5 years of the operational stage of the development and will require a review at the end of the 5 year period to update the OBMP for another predetermined period of time.

### 3.1.2 Performance Criteria

The overall performance criterion of this OBMP are as follows:

- **Vegetation Extent:** The area of Cumberland Plain Woodland within the Reserve will increase to encompass areas of Management Zone 1 (0.34 ha) and Management Zone 2 (0.08 ha) through the restoration low condition vegetation (Management Zone 2).
  - The extent of the reserve should be clearly delineated in order to accurately measure the baseline condition for future monitoring events.
- **Vegetation Condition:** The condition of vegetation within Management Zone 1 and 2 will progress towards the community benchmarks for PCT 849, derived from the NSW BioNet Vegetation Classification, by the final monitoring report (DPE 2022). These benchmarks are outlined below:
  - A high diversity of native species commensurate with Cumberland Plain Woodland,
    - Measured by composition, structure, and function; these comprise a vegetation integrity score.
  - A high cover of native species consistent with Cumberland Plain Woodland including:
    - 53% Foliage Percentage Cover (FPC) of tree species (TG)
    - 16% FPC of shrub species (SG)
    - 9% FPC of forb species (FG)
    - 58% FPC of grass and grass-like species (GG)
    - 4% FPC of 'other' species
- The presence of native canopy regeneration within Management Zone 2 of the Reserve, comprising of key species: *Eucalyptus fibrosa* (Red Ironbark), *Eucalyptus tereticornis* (Forest Red Gum) and *Eucalyptus crebra* (Narrow-leaved Ironbark).
  - Measured through sapling presence/absence of key canopy species.





- The presence of native understorey species regeneration within Management Zone 2 of the Reserve, comprising of key species: *Themeda australis* (Kangaroo Grass), *Carex inversa* (Know Sedge), *Bursaria spinosa subsp. spinosa* (Native Blackthorn), *Daviesia ulicifolia* (Gorse Bitter Pea) and *Dodonaea viscosa subsp. cuneata* (Hop Bush).
  - Measured through presence/absence of key understorey species.
- Planting survival of species commensurate of the Cumberland Woodland Patch and weed coverage in the immediate vicinity of planting.
  - Measured through vegetation condition and stressors in the location.
- Absence of Priority Weeds, Weeds of National Significance (WoNS), and High Threat Weeds (HTWs)
- Absence of foliar damage due to disease or pest attack.
- Absence of tree or shrub deaths caused by disease or pest attack.

### 3.1.3 Responsibilities

Implementation and funding of this OBMP is the responsibility of the school who will be the proprietor of the Reserve throughout the operational period. The OBMP will be implemented during the life of the development. Management of the Reserve will adopt an adaptive management process and may be subject to review of monitoring results and recommendations.

Strategies outlined in the OBMP will be undertaken by suitably experienced and qualified persons or companies engaged by the proprietor of the site and Reserve. Any vegetation restoration works (including weed management, plantings and landscaping) will be undertaken by a suitably qualified and experienced professional bush regeneration contractor. The minimum qualifications and experience required for the bush regeneration contractor are a TAFE Certificate IV in Conservation and Land Management (or equivalent) and three years demonstrated experience (for site supervisor) and a TAFE Certificate 2 in Conservation and Land Management and one year demonstrated experience (for other personnel). Monitoring and reporting will be undertaken by suitably qualified Ecologists.

Fire management should only be undertaken by suitable qualified and experienced professionals in the field of ecological burn management.

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Legend	
	Subject Site
	Unnamed Watercourse
	Sub-arterial Road
	Local Road
	<b>Management Zones</b>
	Management Zone 1: Reserve (woodland rehabilitation)
	Management Zone 2: Reserve (woodland restoration)
	Management Zone 3: Development Site
	Excluded

Metres  
0 5 10 20 30 40 50

PROJECT REFERENCE: 20226121
DATE DRAWN: 2022/04/07 15:57 Version 1
DRAWN BY: G.Joyce
DATA SOURCE: NSW DFSI - 2021 Nearmap - 2022

**Management Zones**

Jacobs Group (Australia) Pty Ltd  
Biodiversity Management Plan  
Glenwood High (Lot 5227 DP868693)  
Forman Avenue, Glenwood NSW

FIGURE:

**3**



## 3.2 ADAPTIVE MANAGEMENT/ OPERATIONAL PHASE

### 3.2.1 *Establishment of Reserve*

Existing school fencing occurs along the boundary of the Reserve; however, it is recommended this fencing be replaced with another fencing type of greater durability. This fence replacement needs to be one that can simultaneously restrict access to students, delineate the boundary for general school maintenance (i.e. mowing), and prevent exotic grasses from growing into the Reserve. Suitable fencing could include a post and rail style with a 30cm solid barrier at the base of the fence line to minimise exotic grass infiltration into the Cumberland Plain Woodland.

### 3.2.2 *Restoration of Cumberland Plain Woodland*

Restoration of Cumberland Plain Woodland will occur in Management Zones 1 and 2 within the Reserve. The restoration aims to maintain and enhance biodiversity values within Management Zone 1 and Management Zone 2. Consequently, each zone has specific restoration requirements based on current state (woodland or grassland) and condition. Detailed goals for each management zone are detailed in **Table 2**. Performance criterion for the vegetation condition within the Reserve are summarised in **Section 3.1.2**.

The restoration of Cumberland Plain Woodland CEEC within the Reserve will adopt a strategy of adaptive management, informed by annual monitoring results and recommendations.

Restoration techniques used within the Reserve include restricting entry to the site, weed management, habitat augmentation as well as planting of indigenous plant species through direct seeding, tubestock, and 5 litre (L) pots (McIntosh and Phelps, 2021). These methods are detailed below:

#### **Restriction of Entry**

The Reserve occurs within the grounds of Glenwood High School where it is surrounded by managed exotic grassland and existing education-related infrastructure. Whilst a fence occurs around this community, it has been exposed to various degrading processes that are likely impacting native floristic diversity and structure, canopy regeneration, weed abundance, and resulted in elevated nutrient loads. Several of these impacts, particularly weed abundance, can be exacerbated by foot traffic and seed dispersal. To minimise further degradation of the vegetation, access to the site will be restricted. This restriction shall be achieved through the upgrading of the fence and the installation of signage communicating that entry is only to those permitted.

#### **Weed Management**

Weed management will be undertaken within the Reserve (Management Zones 1 and 2) in accordance with **Section 3.2.5**.

#### **Revegetation and Supplementary Planting**

The Reserve is characterised by sparse mature woodland, scattered native shrubs, and a high cover of exotic groundcover species (i.e. grasses and herbs). The Reserve occurs within a highly developed landscape in a disturbed condition, where it is surrounded by infrastructure and managed exotic grassland. The improvement of fencing and signage aims to further restrict entry by students and reduce weed incursion, in turn aiding the process of natural native regeneration. This regeneration is expected to be further assisted through the control



and suppression of weeds throughout the OBMP implementation period and the planting of native species throughout the Reserve.

The following supplementary planting is recommended:

- **Management Zone 1:** Supplementary planting of shrub and understorey species characteristic of the local vegetation community (PCT 849) and Cumberland Plain Woodland CEEC (see **Appendix B**). Supplementary planting of canopy species is to be completed within this Management Zone to increase canopy cover alongside the species recommendations detailed for Management Zone 2.
- **Management Zone 2:** Revegetation of canopy, shrub and understory species is required within this zone following weed control. These species are to be planted in accordance with planting list in **Appendix B**. A different assemblage of water-tolerant species will be planted within the Drainage Swale to create additional habitat for native fauna. The need (or lack thereof) for supplementary planting following the initial planting event will be communicated in future annual monitoring reports.

All plantings should consider the species listed within **Appendix B**, with preference for local provenance stock. Recommended species include those associated with PCT 849 and Cumberland Plain Woodland CEEC (DPE 2022, DPE 2010). Where these species cannot be sourced, only local species indicative of Cumberland Plain Woodland should be used. Planting will be staged as required, including direct seeding as well as the placement of tubestock and 5L tree stock (Management Zone 2).

### **Planting and Maintenance Effort**

Planting of canopy species trees using 5L tree stock should be placed approximately 5 m apart in Management Zone 2. The 5L tree stock should not be placed under the canopy of existing trees. Approximately 30 trees would be required in the 0.08 ha area of Management Zone 2.

The cover of shrub species in Management Zones 1 and 2 would eventually require a cover of 16%. Allowing for a 2 m<sup>2</sup> cover for each shrub at maturity in Management Zones 1 and 2 (0.42 ha), approximately 330 shrub tubestock would be required for planting.

Seed mixes for native ground cover should be sown at the recommended rate by the supplier in any bare soil patches, including those created by the control and spraying of exotic species.

The hole for each tube stock shrub or 5L tree stock should be:

- Twice the depth of the tube stock and minimum 7.5cm diameter to allow for root development.
- Twice the depth of the 5L tree stock and 1.5 its diameter to allow for root development.
- Watered with a minimum of 10 litres at time of installation to remove any air pockets and provide adequate moisture levels for the recently installed plant.
- The plant will be planted with the root/stem interface at the soil surface.
- Create a small depression (bowl) at the surface to allow water flow to infiltrate to the plant root zone.

After planting, the trees and shrubs should be watered with minimum six litres of water at the following intervals:

- Twice a week for the first two weeks.
- Once a week for the next four weeks.
- Once a fortnight for the next six weeks.



Following the above period of watering, the plants will be assessed fortnightly for the next eight months to check if the soil is moist or if the plants are stressed. If either has occurred, the plants should be watered as the maintenance staff see fit. During this period if any plants die, they will require replacement. Any new plants will follow the above maintenance schedule. In the second year, the plants will be checked on a monthly basis and watered if required. During years 3-5 the trees should be checked on a six-monthly basis. After the maintenance phase (5 years) there should be 90% successful establishment of the planted trees. If there is less than 90% of the original trees surviving, the deficit below 90% should be replanted and maintained as per above. Further monitoring and maintenance of the planted trees will be determined for the next period of the operational stage of the development.

### **Habitat Augmentation**

Fallen and standing timber (coarse woody debris and dead branches, snags, stumps etc.) provides essential or important breeding, foraging or shelter habitat for many threatened species. Tree trunks and larger branches (over 10 cm diameter) deemed suitable by the project ecologist supervising clearing can be removed from the development area during vegetation clearing. Where suitable these trunks and larger branches can then be cut up into long pieces (i.e., over 4 m where possible) and carefully placed into woodland and grassland areas within the Reserve. Placement of logs and branches are to be in such a way as to look natural, not add to bushfire risks, and to provide benefit to native fauna (on instruction from the project ecologist).

### **3.2.3 Restoration of Drainage Swale**

An existing drainage swale occurs within Management Zone 2 of the Reserve. This swale intermittently holds water, creating habitat for native fauna. Vegetation within and surrounding the swale is largely comprised of exotic grasses and forbs. The revegetation of the swale will be completed at the same time as revegetation works elsewhere in the Reserve, following the completion of construction. Plant species to be planted in these areas will be characteristic of the local vegetation community (PCT 849) and Cumberland Plain Woodland CEEC, with the addition of suitable wetland species recommended by Blacktown Local Council (See **Table B2, Appendix B**).

### **3.2.4 Landscaping of Parks and Open Spaces**

Landscape planting in open spaces within the Subject Site will include plant species consistent with local vegetation (PCT 849) and the Cumberland Plain Woodland CEEC, in accordance with the Landscape Design Plans (McIntosh and Phelps, 2021). The following measures are to be implemented where suitable and alongside the requirements of the Landscape Design Plans (McIntosh and Phelps, 2021) in the landscaping of parks and open space areas:

- Stockpiled topsoil and mulched vegetation from the development site will be utilised in site landscaping and revegetation works for any areas that require rehabilitation.
- Fertiliser use will be strictly limited to a specifically designed Australian native plant fertiliser or an organic based fertiliser with low levels of phosphorus (P). Artificial and chemical fertilisers are strictly prohibited within proximity to the Reserve.

### **3.2.5 Weed Management**

Weed management within the Reserve will prioritise the management of the following species:



- *Asparagus asparagoides* (Bridal Creeper) [WoNS and Priority Weed]
- *Rubus fruticosus sp. agg.* (Blackberry) [WoNS and Priority Weed]
- *Olea europaea subsp. cuspidata* (Common Olive) [WoNS]
- *Paspalum dilatatum* (Paspalum)
- *Araujia sericifera* (Moth Vine)

Management will adopt the 'Bradley method', which involves the progressive, staged removal of weeds from less disturbed areas (i.e., Management Zone 1) followed by removal from more weed infested areas (i.e. Management Zone 2). This method also aims to remove weeds with minimal disturbance and allow native species to re-establish naturally from the existing seed bank and rootstock. The first stage of weed removal should occur within the Reserve prior to any planting, with an effort made to preserve existing native groundcover species.

The following steps are to be followed when controlling weeds on the site:

1. The weed removal team will require a site-specific induction, to understand what weeds are to be removed, the process of removal, identification of the native species, and the procedures to be followed.
2. Manual weed removal. Due to presence of native groundcover species within Reserve, the manual removal of weeds will be prioritised where possible.
3. Weed propagules collected during weed control activities are to be taken offsite. This will stop weed material smothering native plants and prevent re-establishment. This material is to be taken to an appropriate waste disposal center to prevent further weed spread in the region.
4. Chemical weed control. Chemical should be applied only where application to larger weeds can be isolated (i.e. no broad application).

For concentrations and dosage rates on targeted chemical control, refer to the Department of Primary Industries New South Wales 'WeedWise' webpage (DPI 2022). Any weed spraying should be conducted by an authorised person, having a Chemical Application Certificate or similar qualification. This would ensure that best practice is adhered to in consideration of the sensitive nature of the surrounding ecosystems.

The removal of general exotic species (of which 36 were recorded – see **Appendix A** for full list of exotic plant species recorded within the Subject Site [Kleinfelder 2021]) will be based on the recommendations provided in annual monitoring reports. Follow up weed management may be required as per the recommendations of future reports. It is expected that other restoration tasks including the restriction of entry, upgrading of fence and additional plantings will assist in the natural reduction of general exotic species cover over the duration of the OBMP implementation period until the end of the operational life of the school.

### 3.2.6 Fire Management

Fire Management of Zones 1 and 2 should not be using controlled burns due to the risk of fire to the building that surround those management zones. Instead, the area should be maintained with a low fuel load to prevent dangerous fires in the area. Fuel load will be managed by an annual slashing to 30 cm above ground at the end of winter. By the end of winter the grasses would have shed their seeds replenishing the soil seed bank. The temperatures at the end of winter would still be low and not conducive to fires starting. To maintain a low fuel load, the mown material will be removed from the area and transported to the local rubbish tip.



### 3.3 ADAPTIVE MANAGEMENT/OPERATIONAL PHASE

Adaptive management will be undertaken within the Reserve throughout the implementation period, with monitoring and report recommendations used to continually inform management strategies. Monitoring and reporting requirements under this OBMP are detailed below.

#### 3.3.1 Monitoring Program

A monitoring program will be implemented to ensure that the measures detailed within this OBMP are implemented and successful. The program will be completed throughout the implementation period, a summary of key monitoring events and deliverables are shown in **Table 3**. Monitoring program methods are detailed below. Reporting requirements are detailed in **Section 3.3.2**.

**Table 3: Monitoring and Reporting Summary**

Monitoring Event	Timing	Scope	Deliverable
<b>Baseline Monitoring Survey</b>	Completed within one (1) month following the completion of works	Establishment of two permanent monitoring plots and completion of the Monitoring Programme	Baseline Monitoring Report
<b>Annual Monitoring Survey</b>	Completed one (1) year following the completion of construction. Completed annually until the fourth year of the monitoring program.	Completion of the Monitoring Programme	Annual Monitoring Survey Report
<b>5 Year Final Summary Report</b>	Completed at the end of the 5-year implementation period. Further reports may be required pending the review outcome.	Completion of the Monitoring Programme Summary of the Monitoring Programme throughout implementation period.	Final Annual Summary Report inclusive of Year 5 results. Further reports may be required pending the review outcome.



## Monitoring Program Methods

Monitoring will be completed within the Reserve throughout the implementation period as per the schedule detailed in **Table 3**. Monitoring methods address key performance criterion listed in **Section 3.1.2**, and are informed by the following resources:

- The Biodiversity Assessment Method 2020 (DPE 2020); and
- Vegetation Benchmarks for PCT 849 as per the NSW BioNet Vegetation Classification (DPE 2022)

The Monitoring Program is comprised of three (3) key components: *Vegetation Extent*, *Vegetation Condition*, and *Reserve Maintenance* detailed below.

### Vegetation Extent

The mapped extent of native woodland (comprising native canopy species; Management Zone 1) and weed infestation are to be updated during every monitoring event using a hand-held GPS.

### Vegetation Condition

A total of two (2) 20 m x 20 m quadrats are to be established within the Reserve during baseline monitoring, with one (1) quadrat placed within Management Zone 1, and the other (1) within Management Zone 2. The quadrats are to be sampled as per Section 5.3.4 of the NSW Biodiversity Assessment Method (BAM), excluding the implementation of a central 50 m transect (DPE, 2020). The midline at the starting point of each quadrat is to be marked with a stake to ensure accuracy of repeat monitoring. The location and bearing of the quadrats are to be recorded in a GPS device.

Within each plot the following metrics are collected:

- Floristic diversity (number of native and exotic species within the nested 20 m x 20 m quadrat)
- Floristic cover and abundance for each species in accordance with the BAM (20 m x 20 m quadrat).
- Stem size classes and the presence of native canopy regeneration (as per BAM 2020) (within the 20 m x 20 m quadrat)
- Cover of litter and bare ground (as per adjusted BAM method) (within the 20 m x 20 m quadrat)
- Total length of fallen logs (dbh <10 cm) (as per adjusted BAM method) (within the 20 m x 20m quadrat)
- Photo monitoring: a single photo is to be taken at the staked point facing into the quadrat.

Monitoring for the absence of foliar damage due to disease or pest attack in each plot:

- Remove a twig with leaves from five different trees.
- Estimate the percentage damage on ten leaves of each twig.
- Average the percentage damage on the 10 leaves from each tree.
- Average the percentage damage over the five trees.

Monitoring for the absences of tree or shrub deaths caused by disease or pest attack;

- On the first monitoring session identify and GPS locate all living trees and shrubs within Management Zones 1 and 2.
- On subsequent monitoring check each of the trees and shrubs and note if any have died.
- If a death has occurred takes notes the may establish the reason for the death.
- Take a GPS location of any trees or shrubs that have died.
- Trees or shrubs planted for the restoration of the Cumberland Plains Woodland will not be included as the monitoring of these trees is include in the "Restoration and Supplementary Planting Section'.





## Reserve Maintenance

The monitoring program will assess condition of the Reserve through a general meander of the site and notes on the following features:

- Condition of boundary fencing and signage around the Reserve
- Signs of degradation e.g., dumping of waste (inc. garden waste), infiltration of exotic species and priority weeds.
- Condition of habitat features (i.e. existing hollows)
- Condition and composition of native vegetation within the Drainage Swale.

### 3.3.2 Reporting

Reporting requirements and timing of deliverables are summarised within **Table 3**, all monitoring and reporting will be completed by a suitably qualified person (i.e., Ecologist), content of reporting deliverables are detailed below:

- **Baseline Monitoring Survey Report:** This report will provide details on location of monitoring points, baseline measurements of key extent and condition variables within the Reserve.
- **Annual Monitoring Survey Report:** This report will detail the results of annual monitoring, with comparison to baseline results and preceding survey events. Reporting will provide recommendations for future monitoring and management within the Reserve. These reports are to be submitted annually to the consent authority.
- **Final Summary Report:** The final Annual Monitoring Survey Report for the post-construction period of the school, inclusive of the monitoring results of Year 5 as well as a summary the results of the Monitoring Programme throughout. This is to be delivered 5 years post completion of works. The outcomes from the Annual Monitoring and Final Summary Reports will be used to update the OBMP for another predetermined period of time.



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# APPENDIX A FLORA SPECIES LIST





**Table A1: Subject Site Flora Species List**

Number	Family	Scientific Name	Common Name	Form
1.	<b>Apiaceae</b>	<i>Daucus glochidiatus</i>	Native Carrot	Forb (FG)
2.	<b>Campanulaceae</b>	<i>Lobelia purpurascens</i>	Whiteroot	Forb (FG)
3.	<b>Chenopodiaceae</b>	<i>Einadia hastata</i>	Berry Saltbush	Forb (FG)
4.	<b>Chenopodiaceae</b>	<i>Einadia trigonos</i>	Fishweed	Forb (FG)
5.	<b>Commelinaceae</b>	<i>Commelina cyanea</i>	Native Wandering Jew	Forb (FG)
6.	<b>Convolvulaceae</b>	<i>Dichondra repens</i>	Kidney Weed	Forb (FG)
7.	<b>Fabaceae (Faboideae)</b>	<i>Glycine tabacina</i>	Variable Glycine	Other (OG)
8.	<b>Fabaceae (Mimosoideae)</b>	<i>Acacia parramattensis</i>	Parramatta Wattle	Tree (TG)
9.	<b>Juncaceae</b>	<i>Juncus subsecundus</i>	Finger Rush	Grass & Grass-like (GG)
10.	<b>Lamiaceae</b>	<i>Westringia fruticosa</i>	Coastal Rosemary	Shrub (SG)
11.	<b>Lomandraceae</b>	<i>Lomandra longifolia</i>	Spiny-headed Mat-rush	Grass & Grass-like (GG)
12.	<b>Myrtaceae</b>	<i>Angophora floribunda</i>	Rough-barked Apple	Tree (TG)
13.	<b>Myrtaceae</b>	<i>Callistemon citrinus</i>	Crimson Bottlebrush	Shrub (SG)
14.	<b>Myrtaceae</b>	<i>Eucalyptus crebra</i>	Narrow-leaved Ironbark	Tree (TG)
15.	<b>Myrtaceae</b>	<i>Eucalyptus moluccana</i>	Grey Box	Tree (TG)
16.	<b>Myrtaceae</b>	<i>Eucalyptus tereticornis</i>	Forest Red Gum	Tree (TG)
17.	<b>Myrtaceae</b>	<i>Melaleuca decora</i>	-	Shrub (SG)
18.	<b>Oxalidaceae</b>	<i>Oxalis perennans</i>	-	Forb (FG)
19.	<b>Pittosporaceae</b>	<i>Bursaria spinosa</i>	Native Blackthorn	Shrub (SG)
20.	<b>Poaceae</b>	<i>Cynodon dactylon</i>	Common Couch	Grass & Grass-like (GG)
21.	<b>Poaceae</b>	<i>Microlaena stipoides</i>	Weeping Grass	Grass & Grass-like (GG)
22.	<b>Proteaceae</b>	<i>Grevillea spp.</i>	-	Shrub (SG)
23.	<b>Proteaceae</b>	<i>Grevillea spp.</i>	-	Shrub (SG)
24.	<b>Vitaceae</b>	<i>Cayratia clematidea</i>	Native Grape	Other (OG)



**Table A2: Subject Site Exotic Flora Species List**

No.	Family	Scientific Name	Common Name	Form	Status
1.	Agavaceae	<i>Yucca aloifolia</i>	Spanish Bayonet	Exotic	
2.	Apocynaceae	<i>Araujia sericifera</i>	Moth Vine	HTW - Manageable	
3.	Apocynaceae	<i>Plumeria rubra</i>	Frangipani	Exotic	
4.	Asparagaceae	<i>Asparagus asparagoides</i>	Bridal Creeper	HTW	Priority Weed and WoNS
5.	Asteraceae	<i>Bidens pilosa</i>	Cobbler's Pegs	Exotic	
6.	Asteraceae	<i>Dimorphotheca ecklonis</i>	Cape Daisy	Exotic	
7.	Asteraceae	<i>Senecio madagascariensis</i>	Fireweed	Exotic	Priority Weed and WoNS
8.	Asteraceae	<i>Soliva sessilis</i>	Bindyi	Exotic	
9.	Asteraceae	<i>Sonchus asper</i>	Prickly Sowthistle	Exotic	
10.	Asteraceae	<i>Taraxacum officinale</i>	Dandelion	Exotic	
11.	Brassicaceae	<i>Brassica fruticulosa</i>	Twiggy Turnip	Exotic	
12.	Caryophyllaceae	<i>Stellaria media</i>	Common Chickweed	Exotic	
13.	Fabaceae (Faboideae)	<i>Medicago polymorpha</i>	Burr Medic	Exotic	
14.	Fabaceae (Faboideae)	<i>Trifolium repens</i>	White Clover	Exotic	
15.	Lamiaceae	<i>Marrubium vulgare</i>	White Horehound	Exotic	
16.	Malvaceae	<i>Modiola caroliniana</i>	Red-flowered Mallow	Exotic	
17.	Malvaceae	<i>Sida rhombifolia</i>	Paddy's Lucerne	Exotic	
18.	Oleaceae	<i>Fraxinus spp.</i>	-	Exotic	
19.	Oleaceae	<i>Olea europaea</i>	Common Olive	HTW - Manageable	WoNS
20.	Plantaginaceae	<i>Plantago lanceolata</i>	Lamb's Tongues	Exotic	
21.	Plantaginaceae	<i>Plantago major</i>	Large Plantain	Exotic	
22.	Plumbaginaceae	<i>Plumbago auriculata</i>	Cape Leadwot	Exotic	
23.	Poaceae	<i>Cenchrus clandestinus</i>	Kikuyu Grass	Exotic	
24.	Poaceae	<i>Ehrharta erecta</i>	Panic Veldtgrass	HTW	
25.	Poaceae	<i>Eragrostis curvula</i>	African Lovegrass	HTW	
26.	Poaceae	<i>Lolium rigidum</i>	Wimmera Ryegrass	Exotic	



No.	Family	Scientific Name	Common Name	Form	Status
27.	Poaceae	<i>Paspalum dilatatum</i>	Paspalum	HTW	
28.	Poaceae	<i>Poa annua</i>	Winter Grass	Exotic	
29.	Poaceae	<i>Setaria parviflora</i>	-	Exotic	
30.	Poaceae	<i>Sporobolus africanus</i>	Parramatta Grass	Exotic	
31.	Rosaceae	<i>Rubus fruticosus sp. agg.</i>	Blackberry complex	Exotic	Priority Weed and WoNS
32.	Rubiaceae	<i>Galium aparine</i>	Goosegrass	Exotic	
33.	Rubiaceae	<i>Galium murale</i>	Small Bedstraw	Exotic	
34.	Sapindaceae	<i>Acer negundo</i>	Box Elder	HTW - Manageable	
35.	Solanaceae	<i>Solanum nigrum</i>	Black-berry Nightshade	Exotic	
36.	Solanaceae	<i>Solanum pseudocapsicum</i>	Madeira Winter Cherry	Exotic	



# APPENDIX B RECOMMENDED PLANTING LISTS





**Table B1: Reserve Recommended Planting List**

Stratum	Scientific Name	Common Name	Management Zone 1	Management Zone 2
<b>Canopy</b>	<i>Eucalyptus crebra</i>	Narrow-leaved Ironbark		✓
	<i>Eucalyptus moluccana</i>	Grey Box		✓
	<i>Eucalyptus tereticornis</i>	Forest Red Gum		✓
<b>Shrubs</b>	<i>Bursaria spinosa subsp. spinosa</i>	Native Blackthorn	✓	✓
	<i>Acacia decurrens</i>	Black Wattle	✓	✓
	<i>Acacia implexa</i>	Hickory Wattle	✓	✓
	<i>Acacia parramattensis</i>	Parramatta Wattle	✓	✓
	<i>Dodonaea viscosa subsp. cuneata</i>	Hop Bush	✓	✓
	<i>Daviesia ulicifolia</i>	Gorse Bitter Pea	✓	✓
<b>Ground/ Climbers</b>	<i>Aristida ramosa</i>	Purple Wiregrass	✓	✓
	<i>Aristida vagans</i>	Threeawn Speargrass	✓	✓
	<i>Cheilanthes sieberi</i>	Poison Rock Fern	✓	✓
	<i>Clematis glycinoides var. glycinoides</i>	Headache Vine	✓	✓
	<i>Cymbopogon refractus</i>	Barbed Wire Grass	✓	✓
	<i>Cyperus gracilis</i>	Slender Flat-sedge	✓	✓
	<i>Dianella longifolia</i>	Blue Flax Lily	✓	✓
	<i>Echinopogon caespitosus</i>	Bushy-hedgehog Grass)	✓	✓
	<i>Goodenia hederacea</i>	Ivy Goodenia	✓	✓
	<i>Lomandra filiformis</i>	Mat Rush	✓	✓
	<i>Lomandra multiflora</i>	Many-flowered Mat-rush	✓	✓
	<i>Microlaena stipoides</i>	Weeping Grass	✓	✓
	<i>Poa labillardieri var. labillardieri</i>	Tussock Grass	✓	✓
	<i>Themeda triandra</i>	Kangaroo Grass	✓	✓
<i>Wahlenbergia gracilis</i>	Sprawling Bluebell	✓	✓	





**Table B2: Drainage Swale Recommended Planting List**

Stratum	Scientific Name	Common Name
<b>Ground</b>	<i>Bolboschoenus caldwellii</i>	
	<i>Carex appressa</i>	Tall Sedge
	<i>Cymbopogon refractus</i>	Barbed-wire Grass
	<i>Cyperus polystachyos</i>	
	<i>Juncus kraussii</i>	Sea Rush
	<i>Lomandra longifolia</i>	Spiny Mat-Rush
	<i>Lomandra filiformis</i>	Mat Rush
	<i>Themeda triandra</i>	Kangaroo Grass
	<i>Poa labillardieri</i> var. <i>labillardieri</i>	Tussock Grass



# APPENDIX C STAFF CONTRIBUTIONS

The following staff were involved in the compilation of this report.

Name	Qualification	Title/Experience	Contribution
Dr Cassandra Bugir	PhD Conservation Science	Ecologist	Update BMSP to OBMP
Dr Kevin Wormington	PhD Ecology	Senior Ecologist	OBMP Review



## Dr Kevin Wormington

### Senior Ecologist Brisbane

Kevin has over 20 years of experience as an environmental consultant. Kevin joined Kleinfelder in 2019 as an experienced Senior Ecologist where he specialised in field ecological assessment, project management and reporting for flora, fauna and freshwater projects. Having also undertaken training in spatial services, Kevin is a experienced and capable in the GIS functions required for his ecological reporting including vegetation mapping.

Prior to joining Kleinfelder, Kevin ran his own small company out of Bundaberg as a means of staying in Bundaberg until his children finished their High School certificate. Kevin was also the Terrestrial Ecology Team leader in the Centre for Environmental Management at CQ University for 12 years. The CEM was a consultancy and research arm of the university.

### Education

PhD Ecology, The University of Queensland, Brisbane, Australia

Bachelor of Applied Science (Environmental Science) with 1<sup>st</sup> Class Honours, The University of Queensland, Brisbane, Australia

### Training & Certifications

Standard 11 Surface Mining Induction

Mining Supervisor (S123)

G2 Risk Facilitator

First Aid

Operate a 4x4 Vehicle Off-road and Advanced Recovery Techniques

He has 20 years of experience in Commonwealth and Queensland legislation and policies associated with the environment and ecology. The above has included Matters of National Environmental Significance, Matters of State Environmental Significance and environmental offsets. Kevin also has 3 years of experience in New South Wales legislation and policies for environment and ecology.

Kevin has a high level of statistical analysis skills using a variety of univariate analysis techniques for his PhD and later learning multivariate analysis techniques using Primer 7 for freshwater ecology work.

### Project Experience

#### Ecological assessment of four schools in Northern NSW.

The ecological assessment for the Kingscliff High School (KHS), Kingscliff Public School (KPS), Tweed River High School (TRHS) and Tweed Heads South Public School THSPS began in early 2020 with an ecological constraints assessment of the above four schools. The ecological constraints required a desktop assessment and a preliminary field survey to determine if there were any constraints associated with the schools. The outcomes of the constraints assessment was delivered in a separate report

for each school, which determined that there were ecological constraints associated with schools.

Following the outcomes of the ecological constraints and the development of plans for each school, a flora and fauna assessment for the areas that would be developed at the schools was required. This required some further desktop assessments, detailed flora and fauna surveys and a Flora and Fauna Assessment Report (FFAR) for a development applications (DA) at each school.

At the completion of the FFARs an assessment of the construction programs decided that the major sections of the KHS, KPS and TRHS would be State Significant Developments and a Biodiversity Development Assessment Report (BDAR) would be required for the three above schools. The BDARS were completed along with the DA for THSPS. In addition to the BDARS and DA, there were small sections of each school developed under a different criteria and required a Review of Environmental Factors (REF) report for each the four Schools. All reports were completed successfully. Management plans for the Bush-stone Curlew, Koala Offset Management Plans and Biodiversity Management Sub-plans were also completed for the schools.

#### Ecological Assessment of the Ettamogah Army Stores Depot – Australian Department of Finance

A desktop analysis and field survey of the disused explosives stores at Ettamogah to determine biodiversity values of the site. Kevin participated in the flora and fauna field surveys.

A total of 73 flora species were identified within the study area during the field surveys. Thirty-one of the above were exotic species and one is a non-endemic native species. The exotic species *Rubus fruticosus* sp. agg. (Blackberry) is a listed Weed of National Significance (WoNS) and a Priority Weed for the Murray Region (relevant

Kevin Wormington

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to the NSW Biosecurity Act 2016). One Threatened Ecological Community listed as Critically Endangered under the EPBC Act and Endangered under the BC Act was identified within the study area. This was the Box – Gum Woodland / Riparian Red Gum Woodland consistent with the Box Gum Grassy Woodlands and Derived Native Grasslands CEEC listed under the EPBC and The Box – Gum Woodland and the Riparian Red Gum Woodland are consistent with the White Box – Yellow Box – Blakely’s Red Gum Woodland EEC listed under the BC Act.

A total of 64 fauna species were detected during the field surveys, comprising 36 birds, 16 native mammals, three vertebrate pest animals, eight reptile and one amphibian species. Two species are listed Vulnerable under the BC Act, *Petaurus norfolkensis* (Squirrel Glider) and *Scoteanax rueppellii* (Greater Broad-nosed Bat).

#### **Desktop Assessment of the Groundwater Dependent Ecosystems associated with Olive Downs A Mining Lease – Peabody Energy Australia**

Kleinfelder undertook this project to determine the potential impacts if the planned open-cut mine would have any significant impacts on Groundwater Dependent Ecosystems (GDEs). Any action that may adversely affect the GDEs could result in a Significant Impact MNES under the EPBC Act or MSES under the Queensland Environmental Offset Policy (QEOP). Kevin used the information available on the rooting depths and drought tolerance of the dominant tree types in the area and compared them to the known depth of groundwater. The vegetation types included Brigalow on cracking clay soils and alluvial soils, Poplar Box woodland and Blue Gum woodlands on alluvial soils. The above information and a desktop review, using aerial photography, GIS and climate history, of similar vegetation types associated with other open-cut mines in the immediate region determined that that it was unlikely that any of the GDEs associated with the project would be significantly impacted.

#### **Ecological Assessment of the exploration activities in EPC770 / MDL174 near Wilkie Creek Coal Mine – Peabody Energy Australia.**

Kleinfelder were engaged to undertake an ecological assessment (desktop) of the exploration activities in Exploration Permit for Coal (EPC) 770 and Mineral Development License (MDL) 174 5 km north-west of Dalby in the Darling Downs region of Queensland.

A desktop analysis of the study area was conducted to determine if the planned exploration activities would have any Significant Impacts on MNES under the EPBC Act or MSES under the Queensland Environmental Offset Policy (QEOP). In addition, the exploration activities would need to comply to the Eligibility Criteria and Standard Conditions for Exploration and Mineral Development – V2 which takes into account Environmentally Sensitive Areas (ESA). The assessment determined the best layout for the Drill Pads and associated tracks to minimize any impacts. An associated field survey looking at micro-habitat for fauna was able to determine location placements to minimize impacts.

#### **Flora, Fauna and Freshwater Ecology Assessment for the EIS for the Meteor Downs South Coal Mining Lease – U & D Coal Limited**

Kevin designed and implemented the site layout and methods for the desktop assessment and field survey for this project. Methods followed the guidelines in the Generic Terms of Reference, Methodology for Regional Ecosystem Mapping, Queensland Fauna Survey Guidelines, and Queensland and Federal Targeted Survey Guidelines and Ausriivas macroinvertebrate sampling procedures.

The desktop reporting detailed the vegetation communities, flora and fauna known or likely to be in area and the impacts that could occur. Freshwater ecosystems were included in the above assessment and Water Quality Objectives were identified. The terrestrial field surveys ground-truthed the vegetation communities allowing accurate mapping of those communities. The field surveys also identified flora and fauna observed in the project area. The above information was used to determine the threatening processes and where Significant Impacts on Matters of National and State Environmental Significance (MNES & MSES) would occur allowing the area where ecological offsets to be identified.

The freshwater ecology surveys also identified aquatic flora or fauna so the threatened aquatic species could be included in the above threatening processes. The freshwater ecology surveys also provided baseline data on water and habitat quality to compare to the mine influences after mining activities had begun.

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## Cassandra Bugir, PhD

### Ecologist

Cassandra Bugir is a new Ecologist at Kleinfelder with over five years' previous experience in flora and fauna research- predominantly surrounding micro- and mega- bats, as well as wetlands. Previous projects have involved a variety of technical disciplines including surveying methods- anabat and echolocation call recognition, camera trapping, capture-mark-release, visual surveys, and auditory surveys, reporting, and fauna handling. Prior to the research experience, Cassandra worked internationally in conservation, animal husbandry, and public outreach/education for six years. Her career emphasizes threatened terrestrial and aquatic fauna, focusing on bats, birds, reptiles, and amphibians, and their habitat requirements.

### Project Experience

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#### Education

PhD in Conservation Science  
MSc in Anthrozoology  
BSc in Ecology and Evolutionary Biology

#### Training & Certifications

NSW White Card  
First Aid/CPR Certification

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#### Fulton Hogan

- Flora and fauna surveying methods using random data points, transects, nestbox monitoring, visual, photographic recognition, auditory, and scat/pellet surveys to determine the presence of threatened species for post-disturbance monitoring. The data from these surveys is used for writing the subsequent reports.

#### Cessnock City Council

- Flora and fauna surveying methods using visual, photographic recognition, auditory, floristic, and scat surveys to determine the presence of threatened species for road stabilization works. The data from these surveys is used for writing the subsequent Flora and Fauna reports.
- Flora and fauna survey implementing anabat microbat call recognition, camera trap surveillance as well as walking transects (diurnally and nocturnally) of visual encounter surveys (VES) determining the impacts of environmental remediation.

#### Kingfisher consultancy

- Prior to development clearing in Sydney, Cardiff, and Rankin Park, flora and fauna surveying methods were implemented using visual, spotlighting, aquatic invertebrate, photographic recognition, auditory, floristic, and scat surveys to determine the assemblage of species on site, including bats. The data collected from each survey was used to compile EIS, Flora and Fauna reports, and BDARs for each project.

#### University of Newcastle

- Flora and fauna survey implementing anabat microbat call recognition, walking VES transects through wetlands, auditory and visual bird surveys for ecological restoration work at Warabrook Station.
- Supportive teaching role for ENV5 3001- Environmental Conservation in Watagans and Barrington Tops, teaching 50+ students how to trap fauna in survey efforts using Harp Traps (microbats), Elliot traps, aquatic nets, and Pipe traps. Taught students how to properly install and bait camera traps and sand plots, they were also shown how to interpret anabat microbat call recognition data and ID species in spotlighting surveys. Out of the trapping survey efforts, we showed students how to handle *Antechinus* sp., bandicoots, rat sp., various frog species, skinks/lizards including Goanna, Gliders, and Quolls.
- Research assistant for Kooragang and Ash Island wetland study- captured and handled various species of frogs (in various developmental stages- from tadpole to adult) for surveys, Chytrid swabbing, microchipping (capture/recapture data), and biobanking (hormonal induction of genetic material and web punches). The main target was threatened species, Green and Golden Bell Frog (*Litoria aurea*). Other survey methods were installing audio moths, anabats, and camera traps set up for feral species, bats, birds, and frog calls for species diversity within this former BHP site. Vegetation surveys, weather conditions, watercourse ephemerality, and water quality tests were also conducted for habitat conditions. Data collected from these survey methods were used for report and publication writing. Some of the data collected was used to create ponds for environmental restoration works and implement frog exclusion fences for construction work on the island.



## APPENDIX D      LICENSE AND PERMITS

Kleinfelder employees involved in the current study are licensed or approved under the *Biodiversity Conservation Act 2016* (License Number: SL100730, Expiry: 31 March 2024) and the *Animal Research Act 1985* to harm/trap/release protected native fauna and to pick for identification purposes native flora and to undertake fauna surveys.