

Biodiversity Management Sub-plan

Kingscliff Public School
12 Orient Street, Kingscliff, NSW 2487

NCA21R130244

3 March 2022



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Biodiversity Management

Kingscliff Public School 12 Orient Street, Kingscliff, NSW 2487

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EXECUTIVE SUMMARY

The Kingscliff Public School (KPS) is undertaking a redevelopment that will include new infrastructure and buildings, the refurbishment of buildings, and associated landscaping. A Biodiversity Management Sub-Plan (BMSP) is required for the KPS. This is required under Condition B20 of the SSD-8378620 for the KPS that requires the BMSP must address, but not be limited to, the conditions in **Table 1**.

Table 1: Compliance Table for SSD-8378620 Condition B20

Condition	Compliance
Prepared by a suitably qualified and experienced person	Prepared by Dr Kevin Wormington (PhD Ecology, BAsc (Environmental Science). Kevin has over 25 years of experience in wildlife ecology and wildlife management in Queensland and NSW. CV in Appendix 1.
Identify areas of land where impacts on biodiversity are to be avoided as outlined in the: <ul style="list-style-type: none">• Biodiversity Development Assessment Report (BDAR) prepared by Kleinfelder, dated 6 May 2021.• Set out how these areas will be protected from construction impacts.	Generally, any area of native vegetation that is not in the development footprint will be avoided. However, there are no specific areas to be avoided due to no presence of specific habitat areas (roosting or nesting) for threatened flora and fauna in the BDAR. If any areas are located that do need protection, these will be protected by the management measures in Section 3 .
Set out the measures identified in the Biodiversity Development Assessment Report to minimise, mitigate and manage impacts on biodiversity, including timing and responsibility for delivery of the measures	Measures identified in Section 5.2 of the BDAR have been incorporated onto Section 3 of this BMSP.



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1 INTRODUCTION

1.1 OVERVIEW

The Kingscliff Public School (KPS) is undertaking a redevelopment of outdated infrastructure and buildings to modernise and increase its capacity. Kleinfelder Australia Pty Ltd was engaged by Richard Crookes Constructions Pty Ltd to prepare a Biodiversity Management Sub-Plan (BMSP) for the Kingscliff Public School (KPS). This is required under Condition B20 of the State Significant Development Approval for the KPS. The BMSP must address, but not be limited to, the following:

- Provide information and maps that define the biodiversity values across the site.
- Outline priority investment areas on-site where biodiversity will benefit from active management and restoration.
- Map potential areas for management of threatened and significant species.
- Measures to minimise the loss of key fauna habitat, including tree hollows.
- Measures to minimise the impacts to fauna on site, including conducting fauna pre-clearance surveys prior to vegetation clearing, and building/structure demolition.
- Engagement of an appropriately qualified ecologist with experience in capturing native wildlife, to be on site for all vegetation removal activities.
- Controlling weeds and feral pests.
- An Unexpected Finds Procedure, detailing procedures and management measures to be implemented in the event that flora and fauna is uncovered in any area not identified in the updated Biodiversity Assessment Report (BAR).
- Measures to ensure biodiversity values, not intended to be impacted, are protected, including barriers and mapping of protected/'no-go' areas.
- A program to monitor the effectiveness of the measures in the BMSP.

In addition, under Condition B20 of the SSD- 8378620 Conditions for KPS, the BMSP must address the following:

- Be prepared by a suitably qualified and experienced person/s;
- Identify areas of land where impacts on biodiversity are to be avoided as outlined in the BDAR prepared by Kleinfelder, dated 6 May 2021, and set out how these areas will be protected from construction impacts.
- Set out the measures identified in the Biodiversity Development Assessment Report to minimise, mitigate and manage impacts on biodiversity, including timing and responsibility for delivery of the measures.

1.2 SITE DESCRIPTION

Kingscliff Public School (KPS) is located at 12 Orient Street, Kingscliff NSW 2487 on Lot 1 DP384195 (2 ha) (**Figure 1**). It is within 200 m of Kingscliff Beach and Cudgeon Creek and surrounded by suburbia. The whole allotment has been developed and is zoned *R3 – Medium Density Residential* under the *Tweed Local Environment Plan 2014* (Tweed LEP).

1.3 PROPOSED DEVELOPMENT

The development will remove all existing infrastructure except:

- Building D (D).
- Building G (G).
- Existing Car Park (ECP).

New infrastructure will include:

- Buildings 1-4 (1-4).
- New Playing Court (PC).
- New Bike Store (BS).



- New Fire Diesel Pump Enclosure (FP).
- Raised Area (RA).
- New Electrical Sub-Station (ES).
- Adjoining Concrete Paths, Covered Ways, outdoor Areas and Steps.

Landscaping, including gardens and lawns, will occur where old buildings will be removed. The proposed development activities are detailed in **Figure 1**.

1.4 LEGISLATION AND GUIDELINES

The following Commonwealth and State Government legislation and policies and Local Government environment and control plans have been considered in the preparation of this BMSP:

- *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).
- *Environment Planning and Assessment Act 1979* (EP&A Act).
- *Biosecurity Act 2015* (*Biosecurity Act*).
- *Biosecurity Regulation 2017*.
- *Biodiversity Conservation Act 2016* (*BC Act*).
- *Biodiversity Conservation Regulation 2017* (BCR).
- State Environmental Planning Policy (Koala Habitat Protection) 2019.

Local Environmental Planning Instruments include:

- Tweed Shire Council Vegetation Management Strategy 2004 (Tweed VMS).
- Tweed Coast Comprehensive Koala Plan of Management 2015 (Tweed Coast CKPoM).
- Tweed Local Environment Plan 2014 (Tweed LEP).
- Tweed Development Control Plan 2008 (Tweed DCP).
- Tweed Shire Coastline Management Plan 2005 (Tweed SCMP).

1.5 INFORMATION SOURCES

Information sources utilised in the development of this management plan include:

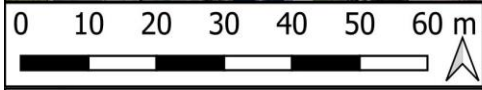
- Biodiversity Development Assessment Report (BDAR) for the Kingscliff Public School (Kleinfelder 2021).
- Threatened Species App (Office of Environment and Heritage NSW 2021a).
- Threatened Species Profile Database (Office of Environment and Heritage NSW 2021b).
- Birds of Australia Digital Edition (Pizzey and Knight 2014).
- SSD-8378620 Conditions for Kingscliff Public School.
- Construction Environmental Management Plan (CEMP) issue checklist
- Generic CEMP environmental safeguards (SINSW Planning Compliance Team).



Legend

- 6181 A20 KPS Building - Floor Plan
- Biodiversity Values
- Existing Infrastructure
- Native Vegetation/Gardens/Lawns
- Lot Boundaries

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Project Reference: 20203914
 Date Drawn: 2021-09-16
 Drawn by: K. Wormington

Kingscliff Public School Development

Figure: **1**



Data Source: Nearmap

Biodiversity Management Sub-plans for Kingscliff Schools



2 BIODIVERSITY VALUES

2.1 VEGETATION COMMUNITIES

A desktop assessment and flora survey were conducted for vegetation communities and threatened plants at the KPS in the BDAR. There were not any threatened vegetation communities mapped in the school grounds and the vegetation at the KPS was limited to planted vegetation including lawns, sporting fields and gardens. The lawns mainly consisted of *Cynodon dactylon* (Green Couch), *Digitaria didactyla* (Qld Blue Couch) and several other exotic species. The planted vegetation and gardens generally contained native trees in the Upper Stratum but the Mid and Ground Strata were dominated by exotics (**Appendix 2** and **Appendix 3**). There was no dominant tree species in the Upper Stratum but the larger trees were *Ficus virens*, *Banksia integrifolia*, *Grevillea baileyana*, *Melaleuca quinquenervia*, and *Eucalyptus tereticornis*.

New disturbance from the proposed development was estimated at 0.45 ha of planted native vegetation comprising 0.09 ha of managed gardens and lawns associated with existing buildings and 0.36 ha of lawns for the new buildings on the sporting oval. Sections 3.1 and 3.2 of the KPS BDAR contain full details.

2.2 FLORA

Habitat for threatened flora species was generally absent within the KPS grounds, given the planted native vegetation comprises maintained lawns and maintained garden beds.

The desktop assessment determined that there were 33 threatened flora species have been recorded in the vicinity (5 km) of the KPS and an Assessment of Impacts was required. The flora survey did not find any threatened flora at the KPS. However, there was a total of 86 flora species were identified during field surveys in three vegetation strata (**Appendix 2**). Thirty-one flora species were native (29 were endemic to region) and 52 species were exotic to the area or considered weed species.

The Assessment of Impacts for threatened flora determined that no species would be significantly impacted. Sections 4.1.1, 4.1.3, 4.1.5, and 5.1.2.1 of the KPS BDAR contain the full details for the threatened flora assessments.

One of the exotic species was listed under the Biosecurity Act, *Asparagus aethiopicus* (Sprenger's Asparagus), which is also a Weed of National Significance. This species was found in low abundance within the Development Site.

2.3 FAUNA

2.3.1 Habitat

Fauna habitat values observed during inspections of the Development Site were recorded. Attributes considered important to fauna include hollow-bearing trees, nests, caves, fallen timber/hollow logs, abundance of nectar and fruit resources, water bodies, vegetation cover and structural complexity, fallen timber, leaf litter and connectivity to surrounding vegetation (corridors). However, the KPS grounds have been historically cleared and managed as lawns and gardens and were generally void of distinct fauna habitat. The trees and shrubs may provide foraging and nesting habitat for bird species. One *Eucalyptus tereticornis* (Forest Red Gum) – a preferred Koala feed tree, was observed in the KPS grounds, however it will not be impacted by the development.

No ground debris (i.e. logs, rocks) was detected within the KPS grounds. Small amounts of leaf litter were found throughout the gardens with the mulch, which was applied to the managed gardens. No hollow-bearing trees were identified within the KPS grounds, hence, no roosting or breeding habitat for hollow nesting birds or arboreal fauna was present.

2.3.2 Species

The desktop assessment determined that there were three amphibians, 59 bird, 20 mammal, three reptile, two insects and one mollusc species that have been recorded in the vicinity (5 km) of the KPS and an Assessment of Impacts was required. Additionally, there were 39 migratory bird species modelled to occur within a 5 km radius



of the KPS grounds. During the field survey, one threatened species was recorded by an Anabat bat detector, namely the Little Bent-winged Bat (*Miniopterus australis*) listed as vulnerable under the BC Act (**Appendix 3**). Eight common bird species were also observed.

The habitat constraints for the Little Bent-wing Bat breeding habitat, identified in the Threatened Biodiversity Data Collection, are “Caves, tunnels, mines, culverts or other structures known or suspected to be used for breeding”. These structures were not present within the KPS grounds. However, the bat is likely to be using the KPS grounds for foraging.

The Assessment of Impacts for threatened fauna determined that no threatened fauna would be significantly impacted including the Koala and Little Bent-winged Bat. Sections 4.1.2, 4.1.4, 4.1.6, and 5.1.2.2 of the KPS BDAR contain the full details for the threatened fauna assessments.

2.4 PRIORITY INVESTMENT AREAS

Due to the vegetation at the KPS being planted vegetation with no microhabitat for denning, roosting or nesting for any threatened species, there are no areas that could be considered priority investment areas.



3 BIODIVERSITY MANAGEMENT

3.1 OVERVIEW

Management measures include the generic environmental safeguards from the SINSW Planning Compliance Team and Section 5.2.3 of the BDAR which contains the general mitigation and management measures for biodiversity values of the KPS. In many cases the generic environmental safeguards and the BDAR management measures are aligned. These have been incorporated into this BMSP.

3.2 VEGETATION AND FAUNA MANAGEMENT

There are no threatened vegetation communities or flora in the KPS Development Site but management of the existing areas containing native vegetation is necessary. Although no threatened fauna is likely to be impacted by the development, foraging and nesting habitat for birds, foraging habitat for insectivorous bats (including the vulnerable Little Bent-winged Bat) and general habitat for ground dwelling reptiles could be disturbed. No hollow-bearing trees were identified within the construction area or the school grounds by the KPS BDAR. Management of hollow-bearing trees will not be required. Generic environmental safeguards prior to construction are included in **Table 2**. Management measures shall include:

Table 2: Generic Safeguards for Vegetation and Fauna Prior to Construction

No.	Environmental Safeguard
Vegetation Clearing	
1	Clearing limits will be clearly marked and all site personnel made aware of Exclusion Zones (Figure 1).
2	Trees to be retained on site will be protected with a protective barrier (e.g., paraweb fencing) so that stockpiling, parking of vehicles and other construction activities do not occur within the dripline of trees.
3	A tree protection zone (TPZ) will be established around trees to be retained. The TPZ will extend from the dripline of trees and be erected for the duration of works.
4	Native vegetation cleared from the site shall be mulched and used for revegetation, erosion protection or landscaping works.
5	Weed species shall be disposed of off-site at a nearby legally operating landfill site.
6	Trees to be retained shall be clearly identified for preservation and temporarily protected by "paraweb" fencing placed not less than 3 metres clear of trees where possible, as some retained trees may be less than 3 metres from new and refurbished buildings. There will be no stockpiling or parking of plant/machinery 3 metres from this area.
7	Limits of the site clearing shall be marked by temporary fencing.
8	No vegetation shall be burnt.
9	All trees and stumps on or within the limits of clearing which are unable to be removed by clearing methods, shall be removed by grubbing.
10	Vegetation where practical shall be retained to the greatest extent.
11	Contact shall be made with a trained wildlife handler / ecologist least 2 weeks prior to the commencement of clearing operations to allow them to prepare for the clearing and construction period.
Weed Management	
12	Areas of dense weed infestation are to be treated prior to clearing/construction activities.
13	Confirm that any proposed herbicide will not affect water quality and native flora and fauna.
Inductions	



No.	Environmental Safeguard
14*	Plant operators and employees shall be informed of the above requirement through the induction process for the site.

Note: Safeguards that were also in the BDAR Table 6 are indicated by an *.

Generic environmental safeguards during construction for vegetation and fauna management are listed in **Table 3**.

Table 3: Generic Safeguards for Vegetation and Fauna During Construction.

No.	Environmental Safeguard
Vehicles and Equipment	
1	All vehicles used during the construction process are to stay on existing or constructed roads and tracks, where practicable.
2	All earthmoving machinery accessing the Construction Site be cleaned of all soil and vegetable matter prior to entry.
3	Construction vehicle reduction in speed limits to 10 km/h in areas regarded as having higher levels of fauna activity or considered to have increased safety risk.
Vegetation	
4*	No access to any sensitive habitat areas (Exclusion Zones). All areas to be fenced and sign posted. The only Exclusion Zone is outside of the Construction Site (Figure 1) and already fenced but it may require signage.
5	Monitor works and ensure the TPZ has been appropriately established and protected.
6	All trees to be cleared shall be checked for animals before and after felling.
7	All tree pruning works will be carried out in accordance with AS 4373-1996 Pruning of amenity trees and the Code of Practice Amenity Tree Industry August 1998.
8	If additional tree clearing or substantial tree pruning is required, an arborist will be consulted prior to undertaking the works.
9	In the event of fire or vandalism resulting in the loss of tags or boundary indicators, the Contractor shall re-survey and mark where appropriate.
10	Within temporary disturbance areas that will later be allowed to regenerate, trees are to be cut off at ground level to facilitate coppicing (new growth from the base).
11	The Contractor shall implement protective measures to prevent damage to TPZs and shall ensure that no mechanical damage from plant and equipment occurs to protected areas such as: <ul style="list-style-type: none"> ▪ fencing to restrict access in the immediate vicinity of an area or an individual tree. ▪ barriers to protect trunks and exposed surface roots. ▪ hand digging where excavation by a mechanical digger is likely to cause damage to roots and limbs. ▪ ground cultivation to restore soil within the dripline. ▪ tying back overhanging branches.
Fauna	
12	A wildlife carer shall be promptly notified if any native fauna is inadvertently injured during the construction works
13	The taking of domestic animals, particularly dogs and cats, onto the construction site is prohibited.
14	Ensure ongoing maintenance and monitoring of any threatened species or significant trees within the Construction Site.



No.	Environmental Safeguard
15	If threatened species not identified in previous surveys are found during clearing surveys, and removal of individuals of these species is necessary, liaison with Department of Planning, Industry and Environment (DPIE) and further assessment is required.
16	Appropriate wildlife handling and care equipment such as leather gloves, breathable bags, blankets, ropes/ties and buckets (as recommended by the fauna handling specialist) is to be on site and with each clearing crew prior to the commencement of any clearing.

Note: Environmental Safeguards that were also in the BDAR Table 6 are indicated by an *.

Generic environmental safeguards during construction for regeneration and landscaping in relation to vegetation management are listed in **Table 4**.

Table 4: Generic Safeguards for Vegetation and Fauna Post Construction

No.	Environmental Safeguard
1	Regeneration / Landscaping of appropriate areas to begin as soon as possible after clearing and/or construction.
2	All removed trees shall be replaced with local native species of trees, shrubs and groundcover as part of the rehabilitation / landscaping plan.
3	All exposed earthworks areas shall be revegetated as per the Landscape Plan.
4	Cover plants for the purpose of soil stabilisation will be limited to certified clean seed of non-invasive annuals.

Note: Environmental Safeguards that were also in the BDAR Table 6 are indicated by an *.

Additional environmental safeguards associated with the BDAR Table 6 are listed in **Table 5**. However, the requirement to use tree trunks and larger branches (over 10 cm diameter) to be placed within the existing gardens or new landscaping for wildlife habitat will not be followed. This is due to the safety hazards and risk of injury to students and staff at KPS from trips and falls.

Table 5: Additional Environmental Safeguards for Vegetation taken from the BDAR.

No.	Environmental Safeguard
1	<p>Surveys associated with the clearing and conducted by the project ecologist shall include the following procedures:</p> <p>The ecologist will inspect for active nests of passerine birds in trees and shrubs that will be removed or trimmed, roosting or nests for ground dwelling birds such as the Bush Stone-curlew (<i>Burhinus grallarius</i>) in gardens or areas with understorey, and inspect the lawn areas for ground nesting birds such as the Masked Lapwing (<i>Vanellus miles</i>).</p> <ul style="list-style-type: none"> ▪ Active nests in the areas to be cleared shall be marked and discussions between the Ecologist and building contractor to determine the most appropriate actions. ▪ Inspect gardens for reptiles. ▪ Ceiling spaces of buildings to be refurbished, if the ceilings are being removed, should be inspected for use by insectivorous bats, possums or snakes (primarily pythons). ▪ A report of the findings and outcomes for any fauna observed or relocated from the clearance activities shall be delivered by the ecologist to the construction contractor.
2	Trees to be retained in TPZs within the Development Footprint shall have bunting installed around their drip line, to prevent any disturbance that may impact on their health; this must remain around the tree until all construction activities have been completed.
3	The areas of retained vegetation within TPZs shall be marked as 'No Go' zones. All vehicles, construction materials and refuse shall be prohibited from these areas. Compaction and the placement of fill within 5 metres of trees and native vegetation should not occur.



No.	Environmental Safeguard
4	Removal of trees and shrubs: <ul style="list-style-type: none"> ▪ Removal of any vegetation identified as containing nests or dreys should be undertaken carefully under the supervision of a suitable qualified ecologist or wildlife carer. The vegetation should be gently felled with the nest/drey located on the higher side of tree to avoid crushing impacts. ▪ If required, an Ecologist will be onsite where it has been determined necessary by the clearing survey. ▪ Directional clearing shall be undertaken whereby clearing will progress from the most disturbed parts of the site, working outwards towards retained vegetation, to encourage fauna to move into these areas. ▪ During any clearing, the ecologist should rescue and relocate any fauna impacted by the clearing activities to a section of the KPS school grounds with suitable habitat that will not be further disturbed. ▪ If any injured or displaced fauna are encountered onsite in the absence of an ecologist or licensed wildlife carer, the advice of the ecologist and/or a local wildlife rescue group will be sought immediately. ▪ During site inductions, all contractors, sub-contractors, and personnel must be notified of these vegetation protection requirements.
5	Cleared vegetation should be mulched and re-used throughout the site during landscaping.
6	All personnel onsite to be made aware of the sensitivity of the surrounding environmental features (e.g., if any threatened flora is identified onsite) through the induction process and a Notice Board with species known to occur in the vicinity.

3.3 WEEDS AND PEST MANAGEMENT DURING CONSTRUCTION PHASE

Generic environmental safeguards Prior to Construction are in **Table 6**.

Table 6: Generic Safeguards for Weed Management prior to Construction.

#	Environmental Safeguard
1	Weed survey to be undertaken by suitably qualified and experienced persons prior to commencement of any construction activities, including site inspections and survey. The consultant is to advise on best practice weed management techniques.
2	Weed or exotic species shall be identified and removed from the site.
3	Fertilisers and manures to be used sparingly as they can stimulate weed growth, seed set and spread.
4	Vegetation to be cleared carefully to minimise the risk of spreading weed propagules.
5	Care must be taken that weeds are not introduced to the area in manures or as contaminants in seed of the desirable species.

Generic environmental safeguards during Construction are included in **Table 7**

Table 7: Generic Safeguards for Weed Management during Construction.

#	Environmental Safeguard
1	Where possible, vehicle movement is to proceed from areas that are relatively weed free and undisturbed to more heavily weed infested areas to ensure that weed spread is not facilitated by the movement of vehicles and machinery.
2	Ongoing monitoring of the construction areas and immediate surrounds to be undertaken to check for weed growth and implement eradication measures if required.
3	Any straw bales used for erosion and sediment control must contain no seed or be wrapped in geofabric.
4	All weed species and spoil from heavily weed infested areas to be disposed off-site.



#	Environmental Safeguard
5	Pre-emergent herbicides registered for the application to be used to prevent the growth of weeds. As these may also inhibit the regeneration of native species, pre-emergent herbicides shall only be used in conjunction with planting and where weed growth is likely to be a problem, i.e., in areas with existing infestations of weeds that are significant problems for agriculture or the environment.
6	Selective grass herbicides to be used for grass weeds in areas re-vegetated with non-grass species.
6	Where possible, vehicle movement is to proceed from areas that are relatively weed free and undisturbed to more heavily weed infested areas to ensure that weed spread is not facilitated by the movement of vehicles and machinery.
7	Remove any weed waste material and have a reasonable period of site maintenance so that weeds do not re-establish.

Additional environmental safeguards associated with the BDAR are include in .

Table 8: Additional Environmental Safeguards for Weed Management taken from the BDAR.

#	Environmental Safeguard
1	Weed infestations should be controlled as required during and following construction works. Priority should be given to the control of <i>Asparagus aethiopicus</i> (Sprenger's Asparagus).
2	All weeds removed from the site must be transported in a sealed container or bag and disposed at a waste management facility licensed to accept green waste.
3	In particular, <i>Asparagus aethiopicus</i> , shall be extracted from the ground and taken to landfill as it could spread in green waste. Small plants can be manually removed, and larger plants can be treated by herbicide application.
4	Weed management to be undertaken by an experienced weed manger e.g., a bush regenerator.
5	The use of herbicides should be in accordance with relevant regulation and safety data sheets.
6	Bins shall be placed strategically for food scraps etc. to avoid attracting rodents, snakes, cats and dogs.

3.4 UNEXPECTED FINDS

Unexpected finds of any threatened flora or fauna species shall be recorded and, the location it was found and the location it was translocated to, taken with a GPS. Appropriate actions required will be discussed between the construction contractor and the ecologist and include contact and reporting to the NSW Department of Environment. An Unexpected Finds register shall be kept by Richard Crookes Construction.

3.5 MONITORING PROGRAM

Due the nature of the vegetation and its clearing, the ecologist will assess that no excess vegetation has been removed at the completion of the project, but regular monitoring is not considered necessary and provide the results to the Department of Education. Regular monitoring is not considered necessary.



4 REFERENCES

Kleinfelder (2021) *Biodiversity Development Assessment Report - Kingscliff Public School*. Kleinfelder Australia Pty Ltd, Brisbane, Queensland.

Office of Environment and Heritage NSW (2021a) Threatened Species App
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Office of Environment and Heritage NSW (2021b) Threatened Species Profile Database:
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APPENDIX 1: KEVIN WORMINGTON CV



Dr Kevin Wormington

Senior Ecologist Brisbane

Kevin has over 19 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. 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.

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 application (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.

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 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.

Kevin Whyte
Kleinfelder | 1

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.

Flora and Fauna Assessment of the of the Calliope Ranges Roadway Re-alignment – Department of Main Roads.

A desktop study and site inspection was carried out for a flora and fauna evaluation of the Calliope Ranges highway realignment. Two plants of conservation significance have been reported within five km of the proposed new roadway. However, only *Cycas megacarpa* was observed in the path of the proposed new roadway. Approximately 20% of the area of this species in the path of the new roadway will be impacted by the roadway construction but this should not critically reduce the population. However, it is recommended that measures could be taken to reduce, as much as possible, the area of *C. megacarpa* habitat to be cleared and better protection provided for the remaining plants by purchasing adjacent land and annexing it into the Road Reserve.

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Three species of plants, four reptiles, 21 birds and four mammals of conservation significance were listed as possibly using habitat within five km of the proposed new roadway, but most of these used habitats not found in the pathway of the new roadway. It was considered that it is highly unlikely any fauna of conservation significance will be affected by the project. However, there may be some impact on possums and gliders due to the removal of hollow-bearing trees.

Management for Biodiversity in Fenced Riparian Zones on Grazing Properties – Fitzroy Basin Association

Kevin designed, managed and reported on the project for the flora, mammals, birds and reptiles. The project assessed if the fencing of Riparian Zones enhanced biodiversity within the riparian zone and adjacent area. Forty sites were established in five sub-catchment areas of the Fitzroy River Basin that contained a range of riparian and adjacent sites that had been traditionally managed or managed for biodiversity values, i.e. fenced riparian zone. There was evidence that in areas where grazing regimes had changed in conjunction with fencing for a period exceeding 5 years, vegetation structure was more complex and exotic plants were less numerous. Other factors influencing vegetation structure were sub-catchment, the land zone and level of clearing. The overall diversity of non-bird vertebrate species was positively influenced by the fencing and associated changed grazing regimes. Reptile and ground mammal diversity of native species was greater in the fenced riparian zones and their adjacent forested areas than the equivalent non-fenced riparian zones. Complexity of habitat was also a positive influence. In contrast, exotic vertebrates were negatively influenced by the grazing management associated with fencing of riparian zones. Generally, birds were not sensitive to the grazing management, although bird species richness, abundance and assemblages were influenced by landscape position and vegetation.

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APPENDIX 2: FLORA SPECIES LIST

No.	Scientific Name	Common Name
Upper Stratum (6m-20)		
1.	<i>Auranticarpa rhombifolia</i>	Diamond Leaf Pittosporum
2.	<i>Alectryon coriaceus</i>	Beach Bird's Eye
3.	<i>Banksia integrifolia</i>	Coastal Banksia
4.	<i>Callitris columellaris</i>	Bribie Pine
5.	<i>Casuarina glauca</i>	Swamp She-oak
6.	<i>Cupaniopsis anacardioides</i>	Tuckeroo
7.	<i>Eucalyptus tereticornis</i>	Blue Gum
8.	<i>Ficus virens</i>	White Fig
9.	<i>Flindersia bennettiana</i>	Bennett's Ash
10.	<i>Flindersia schottiana</i>	Bumpy Ash
11.	<i>Grevillea baileyana</i>	White Oak
12.	<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark
13.	<i>Melaleuca viminalis</i>	Weeping Bottlebrush
14.	<i>Neolitsea australiensis</i>	Green Bolly Gum
15.	<i>Podocarpus elatus</i>	Brown Pine
16.	<i>Syzygium luehmannii</i>	Small Leaf Lillypilly
17.	* <i>Syagrus romanzoffiana</i>	Cocos Palm
Mid Stratum (1-6m)		
1.	<i>Archontophoenix cunninghamiana</i>	Bangalow Palm
2.	<i>Alectryon coriaceus</i>	Beach Bird's Eye
3.	<i>Brachychiton australis</i>	Broad-leaf Bottle Tree
4.	<i>Cupaniopsis anacardioides</i>	Tuckeroo
5.	<i>Macaranga tanarius</i>	Heart Leaf
6.	<i>Neolitsea dealbata</i>	Hairy-leaved Bollygum
7.	<i>Podocarpus elatus</i>	Brown Pine
8.	* <i>Schefflera actinophylla</i>	Umbrella Tree
9.	<i>Syzygium luehmannii</i>	Small Leaf Lillypilly
10.	<i>Syzygium australe</i>	Bush Cherry
11.	* <i>Beaucarnea recurvata</i>	Ponytail
12.	* <i>Bauhinia Alba</i>	Bauhinia



No.	Scientific Name	Common Name
13.	* <i>Calliandra haematocephala</i>	Red Calliandra
14.	* <i>Cinnamomum camphora</i>	Camphor Laurel
15.	* <i>Citrus elastica</i>	Mandarin Tree
16.	* <i>Citrus limon</i>	Lemon
17.	* <i>Dracaena marginata</i>	Dragon Tree
18.	* <i>Hibiscus rosa-sinensis</i>	Anne Cheers Hibiscus
19.	* <i>Hibiscus spp1</i>	Variegated Hibiscus
20.	* <i>Metrosideros thomasi</i>	New Zealand Christmas Tree
21.	* <i>Monstera deliciosa</i>	Swiss Cheese Plant
22.	* <i>Ochna serrulata</i>	Ochna
23.	* <i>Olea europaea</i>	Olive
24.	* <i>Passiflora edulis</i>	Passionfruit
25.	* <i>Philadelphus spp.</i>	Mock Orange
26.	* <i>Senna pendula</i>	Easter Cassia
27.	* <i>Syagrus romanzoffiana</i>	Cocos Palm
Ground Stratum (0-1m)		
1.	<i>Commelina cyanea</i>	Scurvey Weed
2.	<i>Cynodon dactylon</i>	Green Couch Grass
3.	<i>Digitaria didactyla</i>	QLD Blue Couch Grass
4.	<i>Lomandra longifolia</i>	Spiny-head Mat-rush
5.	<i>Macaranga tanarius</i>	Heart Leaf
6.	<i>Melaleuca viminalis</i>	Weeping Bottlebrush
7.	# <i>Nephrolepis cordifolia</i>	Fishbone Fern
8.	<i>Platynerium bifurcatum</i>	Elkhorn Fern
9.	<i>Viola hederacea</i>	Native Violet "Kidney Leaf"
10.	* <i>Agave attenuata</i>	Century Plant
11.	* <i>Alpinia spp</i>	Exotic Ginger
12.	* <i>Artemisia absinthium</i>	Wormwood
13.	** <i>Asparagus aethiopicus</i>	Sprenger's Asparagus
14.	* <i>Aspidistra elator</i>	Cast Iron Plant
15.	* <i>Axonopus compressus</i>	Carpet Grass
16.	* <i>Bidens pilosa</i>	Black-jack / Cobbler's Pegs
17.	* <i>Catharanthus roseus</i>	Vinca



No.	Scientific Name	Common Name
18.	* <i>Codiaeum spp</i>	A Croton
19.	* <i>Cordyline spp.</i>	
20.	* <i>Cyperus brevifolius</i>	Mullumbimby Couch
21.	* <i>Cyperus rotundus</i>	Nut Grass
22.	* <i>Dietes grandiflora</i>	Wild Iris
23.	* <i>Dracaena trifasciata</i>	Mother-in-law Tongue
24.	* <i>Eleusine indica</i>	Crowsfoot
25.	* <i>Emilia sonchifolia</i>	Emilia
26.	* <i>Eragrostis tenuifolia</i>	Elastic Grass
27.	* <i>Festuca spp.</i>	A Rye Grass
28.	* <i>Liriope muscati</i>	Monkey Grass
29.	* <i>Neomarica northiana</i>	Walking Iris
30.	* <i>Nephrolepis exaltata</i>	Fishbone Fern
31.	* <i>Ophiopogon japonicus</i>	Mondo Grass
32.	* <i>Panicum maximum var. trichoglume</i>	Green Panic
33.	* <i>Paspalum dilatatum</i>	Crowngrass
34.	* <i>Passiflora spp.</i>	Wild Passionfruit
35.	* <i>Pennisetum clandestinum</i>	Kikuyu
36.	* <i>Saccharum officinarum</i>	Sugarcane
37.	* <i>Salvia rosmarinus</i>	Rosemary
38.	* <i>Solanum nigrum</i>	Black Nightshade
39.	* <i>Stenotaphrum secundatum</i>	Sapphire Buffalo Grass
40.	* <i>Stephania japonica</i>	Tape Vine
41.	* <i>Syngonium podophyllum</i>	Arrowhead Plant
42.	* <i>Taraxacum officinale</i>	Dandelion
43.	* <i>Tradescantia spathacea</i>	Moses in a Basket
44.	* <i>Trifolium subterraneum</i>	Subterranean Clover

* Garden ornamental/weed species, ** Restricted weeds Biosecurity Act, # Native species not endemic to region.



APPENDIX 3: FAUNA LIST

No.	Common Name	Species	BC Act	EPBC Act	Number/Probability
	Birds				
1.	Australian Magpie	<i>Cracticus tibicen</i>			1
2.	Magpie-lark	<i>Grallina cyanoleuca</i>			1
3.	Masked Lapwing	<i>Vanellus miles</i>			6
4.	Noisy Miner	<i>Manorina melanocephala</i>			1
5.	Pied Currawong	<i>Strepera graculina</i>			1
6.	Pied Butcherbird	<i>Cracticus nigrogularis</i>			1
7.	Rainbow Lorikeet	<i>Trichoglossus haematodus</i>			5
8.	Welcome Swallow	<i>Hirundo neoxena</i>			6
	Mammals				
1.	Little Bent-winged Bat	<i>Miniopterus australis</i>	V		Confident

V = Vulnerable

