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1660

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Level 6, 10 Valentine Ave, Parramatta NSW 2150

16 August 2017

Re: Redevelopment of the UNSW Cliffbrook Campus, 45-51 Beach Street, Coogee (SSD 8126)

Dear Susan,

Narla Environmental Pty Ltd (Narla) have reviewed your letter on behalf of the Office of Environment and Heritage (OEH) (DOC17/318643 SSD8126) seeking comments on the above State Significant Development (SSD) proposal.

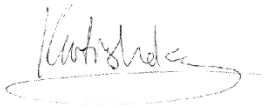
We provide our responses to the OEH comments in the table below.

OEH Comment	Narla Environmental Response
Identification of vegetation types and EECs	We have updated the BAR to more accurately describe the vegetation communities that are present on the subject site, in contrast to those that may have been historically present on the subject site (attached). We have also updated the BMP to reflect the same (attached). Raw plot data sheets and species lists are attached for all plots. Please note that the raw data sheets do not contain all of the species identified in each plot, because at each plot our Ecologists collected several samples of plants to identify back in the office. Unfortunately, the plants that were taken back to the office to identify were not always clearly listed on the sheet. An accompanying excel spreadsheet provides explanation for the species and numbers of each species identified in the field vs in the office.
Site attribute assessment	The data sheet for Plot 3 was provided as an example, with OEH noting several errors in the data sheet. The first error identified that leaf litter was included in the Native Ground Cover (other) measure. Please note that this is not correct. The plot data sheet was incorrectly labelled 'Leaf litter (tally/50 points)', but this is crossed out and replaced with 'other'. The term other is used as shorthand for Native Ground Cover (other), and does not include a count of leaf litter. The second error identified is an incorrect tallying of the Exotic Plant Cover (ground) component. An error has been made in this case, with the total figure suggested by OEH (120.5) correct. Please reallocate the credit calculator to Kurtis Lindsay for correction. Other plot data sheets are attached and the data entered into the Biobanking Credit Calculator (and documented in the BAR) is correct. Please note that

OEH Comment	Narla Environmental Response
	further work was conducted post field assessment on species identification etc. This additional species identification work is contained in the attached spreadsheet, which provides a complete species list for each plot. Overstorey regeneration (calculated as 0.5) was determined by first counting the number of overstorey species observed (<i>Banksia integrifolia</i>, <i>Casuarina glauca</i>, <i>Corymbia maculata</i> and <i>Glochidion ferdinandi</i>) and then the number of these regenerating (<i>Banksia integrifolia</i>, <i>Casuarina glauca</i>).
Offset credit requirements	Eastern Suburbs Banksia Scrub is absent from the subject site and is therefore not impacted by the proposed walkway construction (see above). Therefore, consistent with the BAR, no credits are required to be purchased or retired to offset impacts to biodiversity.
Landscape features	Narla note the comments from OEH and agree that no changes to calculations are required.

If you have any questions, please do not hesitate to contact me on 0414314859 or kurtis.lindsay@narla.com.au.

Yours sincerely,



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Narla Environmental Pty Ltd



NARLA
environmental

Biodiversity Assessment Report

Redevelopment of UNSW Cliffbrook Campus

45-51 Beach Street, Coogee

State Significant Development Application (SSD 8126)

Revision B

Date: 16/08/17



NARLA

environmental

Prepared for:	University of New South Wales
Prepared by:	Narla Environmental Pty Ltd
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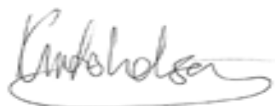
Report Certification

Works for this report were undertaken by:

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Darren James Bsc	DAJ Environmental	Co-author, Biobanking accredited assessor 0032

I, Kurtis Lindsay, certify that:

- this document has been prepared in accordance with the brief provided by UNSW and OEH requirements of a Biodiversity Assessment Report.
- the information presented in this report is a true and accurate record of the study findings in the opinion of the authors.



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Glossary and abbreviations

ACRONYM	DESCRIPTION
BAR	Biodiversity Assessment Report
BioMetric	Refers to the State Government devised methodology for vegetation assessment
BCC	Bio-banking Credit Calculator
DPE	NSW Department of Planning and Environment
Subject site	UNSW Cliffbrook Campus, 45-51 Beach Street, Coogee, 2034
EEC	Endangered Ecological Community
EPBC Act	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
ESBS	Eastern Suburbs Banksia Scrub
FBA	Framework for Biodiversity Assessment
IBRA	Interim Bio-regionalisation of Australia
LGA	Local Government Area
LPI	Land and Property Information
OEH	NSW Office of Environment and Heritage
PCT	Plant Community Type
SEARs	Secretary's Environmental Assessment Requirements
SSD	State Significant Development
m	Metres
km	Kilometres
ha	Hectares
TSC Act	NSW <i>Threatened Species Conservation Act 1995</i>

1. Introduction

1.1 Project background

This Biodiversity Assessment Report (BAR) has been prepared to accompany a Development Application (DA) relating to the proposed redevelopment of the UNSW Cliffbrook Campus, located at 45-51 Beach Street, Coogee, 2034 (the subject site) (Figure 1 and Figure 2).

The proposed works have been classified as a State Significant Development (SSD), and as such Secretary's Environmental Assessment Requirements (SEARs) have been issued by the Department of Planning and Environment (DPE). The SEARs stipulate that the biodiversity impacts for the proposal be assessed in accordance with the Framework for Biodiversity Assessment (FBA) (OEH 2014). The FBA (OEH 2014) assessment and BAR have been prepared by Kurtis Lindsay (accredited BioBanking assessor No.224) and Darren James (accredited BioBanking assessor No.32), and satisfy the requirements of the SEARs.

The subject site for the purpose of the BAR can be divided into two roughly equal parts; to the west the built area covering all buildings, associated paving, car parking lot and ornamental gardens, and to the east a bushland area (Figure 6). In accordance with Section 2.3.1.2 of the FBA, the current assessment provides limited discussion of the works proposed in the western half of the subject site as these are not associated with clearing vegetation (except limited removal of exotic species and ornamental gardens).

BioMetric plot analysis of the development area determined that only one vegetation community was present within the subject site: '*Heath-leaved Banksia - Scrub She-oak heath on sandstone headlands in the Sydney basin* (ME101/PCT 1822)'. The vegetation is not consistent with the description of any currently listed threatened ecological communities under the NSW *Threatened Species Conservation Act 1995* (TSC Act) (OEH 2011) or the Commonwealth Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act).

Although the subject site totals 1.16 ha, the total proposed impact to vegetation is 0.027 ha. This impact will be caused by the development of a ~1.5 m wide walkway and associated rest areas through the present bushland, and has been assessed in the BAR.

1.2 Proposed development

The proposal involves the re-development of the UNSW Cliffbrook Campus, to increase the site's usability. Development works will be focused within the built areas of the subject site and will involve the demolition of two buildings (CC2 and CC4), and construction of replacement buildings contained largely within existing footprints. Associated construction of adapted pathways and a redesigned car parking lot (Figure 3) will also take place. The proposal incorporates an ornamental landscape plan utilising locally indigenous plants (FJMT 2016).

The proposal will involve the construction of a walkway with 'nook' seating areas through the bushland area which occupies the eastern half of the property (Figure 3). It is this element which is the focus of this BAR. The footprint of the walkway will occur through moderate-good condition native bushland with a total area of 0.027 ha. In order to install the walkway, some vegetation will require removal. To mitigate this impact post construction phase, the

client has proposed to undertake increased vegetation management of the entire bushland patch, including weed removal, and installation of native plants which are relevant to the local vegetation community. The detail of the bushland management is captured in the associated Biodiversity Management Plan (BMP) (Narla 2017).

1.3 Site characteristics

1.3.1 Site description and land-use history

The subject site is located on the corner of Beach Street and Battery Street, within the suburb of Coogee in the eastern suburbs of Sydney. The subject site lies 750 m north of Coogee Beach and 7 km south-east of the Sydney Central Business District (CBD), and consists of Lot 1/ DP 109530 and Lot 1/ DP 8162.

The subject site covers an area of approximately 1.16 ha, which is zoned '*SP2 - Infrastructure: Education Establishment*' and '*RE2 - Private Recreation*'. The surrounding area is occupied by R2 - Low Density Residential to all sides, except for downslope to the south where the property is bounded by the Coastal Walkway and Gordons Bay both zoned RE1 - Public Recreation.

The subject site was first occupied as a single, residential estate from 1845 and with other uses from 1941 until the 1990's when it was purchased by the University of NSW (OEH 2011b). Over this time the use of the area has changed greatly. Historical aerial photography taken in 1943 (LPI 2015) depicts a landscape that was highly altered and largely cleared of vegetation. Patchy vegetation is visible within historic imagery, however it is unlikely that much of the native vegetation found on subject site in 2017 can be classed as remnant.

The surrounding area is now occupied by residential properties with few remaining bushland areas of comparable size occurring locally. The bushland is considered to be locally valuable due to the rarity of local patches of comparable size.

At the time of study the bushland was found to be highly affected by 'edge effects' with weed incursions stemming from all sides. Impacts have also occurred throughout the patch from the creation of informal tracks. Volunteer bush regeneration works have occurred within the subject site for approximately 20 years, making it the oldest running Bushcare site in the Randwick LGA (RCC 2015). This work pre-dated many of the current vegetation community descriptions and management strategies; however it appears the management focused on restoring coastal heath. As such, a mixed assemblage of indigenous vegetation has resulted with understorey plants diagnostic of coastal heath in areas which may have once supported a different floristic assemblage.

1.3.2 Soil landscape and geology

The subject site lies close to the transitional boundary between Newport and Hawkesbury soil landscapes (OEH 2016a). This transitional location between the two distinct landscapes was significant, as a key diagnostic feature of local vegetation communities is soil type and depth. Detailed soil profile sampling was undertaken during site survey to gain more detailed understanding of the relationship between soil type and vegetation within the subject site.

Newport soil landscape is characterised by a surface layer of shallow aeolian (wind-blown) sands. The shallow windblown sands of the Newport soil landscape unit usually overlie the Newport and Garie Formations of the Middle Triassic Narrabeen Group, which consist of interbedded laminite, shale and quartz to lithic quartz sandstone. In some instances (such as at the subject site) the aeolian material overlies Hawkesbury Sandstone, a medium to coarse-grained quartz sandstone with minor shale and laminite (Chapman and Murphy, 1989).

Hawkesbury soil landscape is characterised by exposed Hawkesbury Sandstone which fractures in a way to give a distinctive “blocky” appearance, remaining in boulders and rocky outcrops with only skeletal colluvial soils where weathering has occurred.

Newport and Hawkesbury Soil Landscapes are subject to high erosion. Where storm-water runoff is not adequately controlled serious gully erosion is a commonly experienced issue, which can remove Newport aeolian sand layers, leaving behind only Hawkesbury Sandstone.

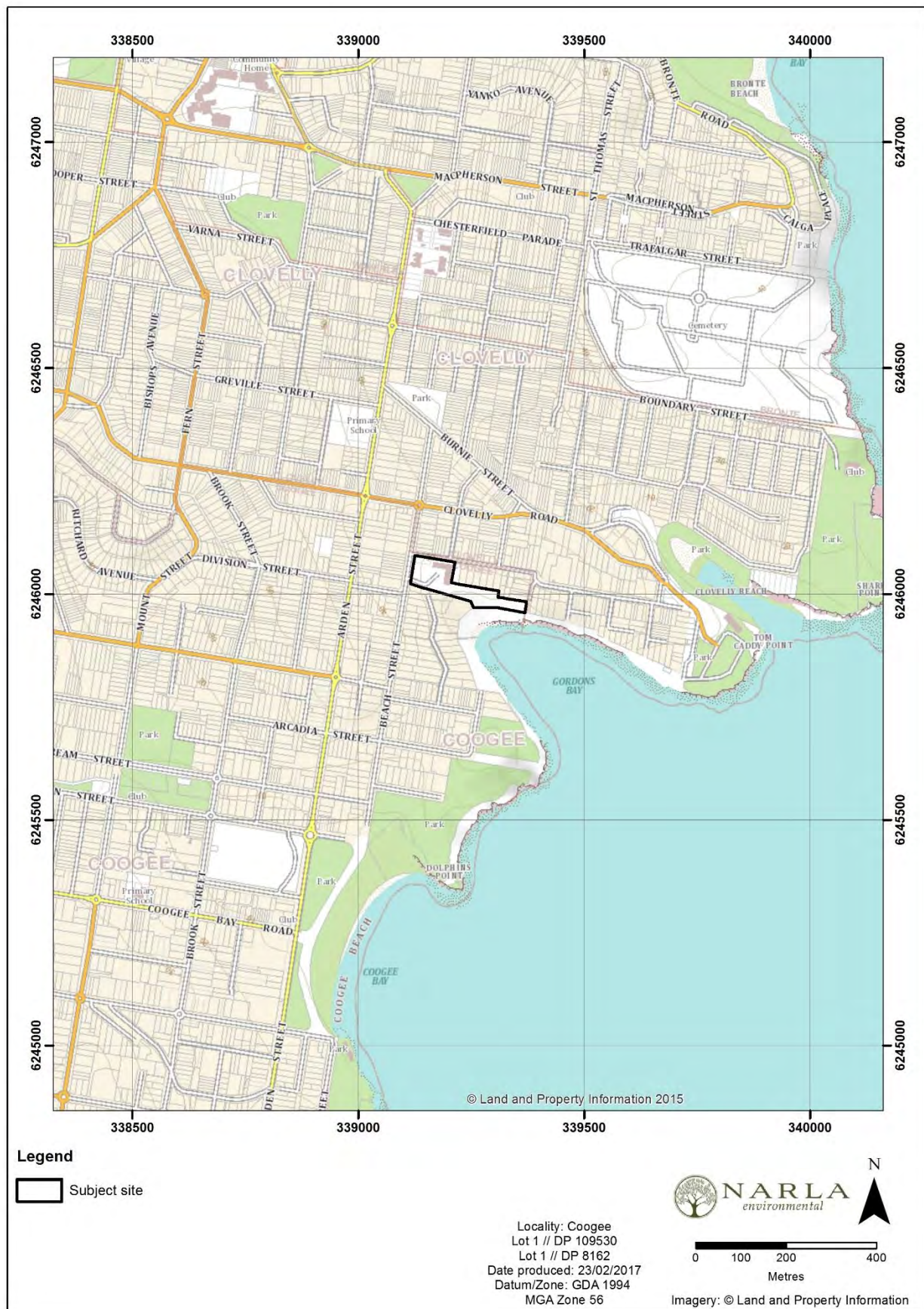


Figure 1: Site location



Figure 2: Subject site



Figure 3: Proposed development footprint

2. Assessing landscape features

2.1 IBRA bioregions, IBRA subregions and Mitchell Landscapes

The subject site is within the NSW Sydney Basin IBRA region (version 7) and Pittwater (Part B) IBRA subregion. The development site occurs entirely within one NSW Mitchell Landscape, 'Port Jackson Basin' (Mitchell Landscapes V3.1).

2.2 Percent native vegetation cover

The change in native vegetation cover is assessed at two scales, which for this assessment are a 100 ha circle and a 1,000 ha circle. The area of vegetation in each circle before development was mapped using the 'The Native Vegetation of the Sydney Metropolitan Area' Vegetation Mapping (OEH 2013), with the extent of vegetation updated using imagery obtained from LPI's SIX Viewer (Figure 4). In using the Native Vegetation of the Sydney Metropolitan Area Vegetation Mapping (OEH 2013), the polygons tagged Urban Exotic/Native were assumed to be largely native based on field observations, and as very little other native vegetation is mapped within the 100 ha or 1,000 ha circles.

The proposed footprint of the development will impact on 0.027 ha, with the after development calculations taking that impact into account.

The results of the assessment are provided in (Table 1). Due to the extremely small amount of clearing no change will occur in either assessment circle, and a score of 0 is allocated for the percent native vegetation score.

Table 1: Change in percent native vegetation for each assessment circle

Assessment circle	Before development (ha)	Before development (%)	After development (ha)	After development (%)
Inner (100 ha)	5.23	<= 5	5.20	<= 5
Outer (1000 ha)	55.89	<= 5	55.86	<= 5

2.3 Connectivity value

2.3.1 Rivers, streams and estuaries

There are no rivers, streams or estuaries identified within the development from topographic map that contains the subject site (1 : 25,000 scale).

Currently the subject site manages storm water runoff through a single drain that runs along the southern boundary. This lines up with a natural, ephemeral gully directly below the south-west corner of the subject site before entering a stormwater drain. An additional area of seepage exists in the far east of the subject site. Neither of these is a mapped waterway and both fall below the criteria for a first order stream under the Strahler system.

2.3.1 Local and important wetlands

There are no wetlands within the subject site. No local or important wetlands are located adjacent to or downstream from the development site or within the 1,000 ha assessment circle.

2.3.2 State, regional and local biodiversity links

The site does not incorporate a state, regional or local biodiversity link.

2.3.3 Connectivity assessment

The site does not impact on a connectivity value class such as a riparian buffer of a 4th – 6th Strahler stream order, estuary or important wetland, or State or Regional biodiversity link. Therefore a complete connectivity assessment was required.

The site adjoins contiguous mixed native/exotic vegetation associated with either side of the Coastal Walkway to the south and east of the subject site. This linkage has a narrow width, with the minimum width assessed before development being 0-5m. The small impact of the 1.5 m wide walkway, and associated rest areas, will not impact on the overall width of this connection, therefore 0-5m was also entered after development.

Connectivity condition was also assessed. As with connectivity width, it is anticipated that the impact of a 1.5 m wide walkway will not impact on the overall condition of the entire connected link, which is already degraded. The data entered into the Biobanking Credit Calculator (BCC) is provided in, and is based broadly on the plot data captured on site.

As no change in connectivity width or condition is anticipated a score of 0 is allocated for the connectivity score.

Table 2: Change in connectivity width and condition

Connectivity condition	Before development (ha)	After development (ha)
Connectivity width	0-5m	0-5m
Over storey condition	PFC > 25% of lower BM	PFC > 25% of lower BM
Mid storey / ground cover condition	PFC mid storey/ground cover > 50%	PFC mid storey/ground cover > 50%

2.4 Patch size

Patch size was calculated using the site vegetation map combined with all vegetation within 100 m identified through the vegetation mapping amended from OEH (2013) referred to in Section 2.2.

A total patch size of 2.17 ha was entered into the BCC. When this information is compared with the Port Jackson Basin Mitchell Landscape (85% cleared) a total patch size score of **1** is recorded.

Please note that the Patch Size value is also required when entering vegetation zone information. As the BCC would not accept 2.17 ha on the Vegetation zone page, the Patch Size was rounded up to 3 ha and this was entered. This change does not impact on the overall credit calculations for the project.

2.5 Landscape score

Using the above data, the final landscape score was calculated to be **1**.



Figure 4: Location map

3. Assessing native vegetation

3.1 Description of the native vegetation on the subject site

A review of published mapping and literature of the subject site revealed some disparities between the identified vegetation types. OEH (2013) mapping indicated that the subject site contained only 'Urban exotic/ native' vegetation (Figure 5); however Local Council mapping suggests that a large percentage of this bushland is remnant vegetation (RCC 2016). Aerial images taken in 1943 suggest that historically much of the vegetation was cleared from the subject site (LPI 2015).

Site survey by Narla Ecologists undertaken in February 2017 determined the native vegetation on the subject site was dominated by native flora, interspersed with weed infestations. The flora assemblage was influenced by a history of disturbance, including clearing, urbanisation and introduction of exotic species. Bushcare groups had also influenced the site through historic and ongoing weed removal and revegetation works (RCC 2015).

The native vegetation in the subject site displayed minor floristic and structural variation across its extent. All of the remnant vegetation on the subject site was growing in shallow, sandy soils, perched on Hawkesbury Sandstone. Sandstone was exposed over much of the remnant vegetation patch. In the northern most portion of the vegetation patch, a thin strip of tall, Coastal Banksia (*Banksia integrifolia*) and planted ornamental trees were growing in soils situated adjacent a band of outcropping Hawkesbury Sandstone. To the immediate north of this outcropping was a band of unvegetated, deep, podsolised, sandy soil (occupied by lawns and residential gardens). The presence of this deeper podsolised soil suggested that parts of the subject site may have once supported *Eastern Suburbs Banksia Scrub* (ESBS) (typical of most of the built-up areas in Coogee). ESBS is an Endangered Ecological Community listed under the TSC Act and EPBC Act. The deeper podsolised soils on the subject site were non-vegetated, only the shallower soils perched on Hawkesbury Sandstone were vegetated.

Extensive disturbance to canopy, understorey and ground cover through historical clearing and landscaping on the areas of deeper podsolised soil confirmed that no ESBS occurred on the subject site. Furthermore, the entire shrub layer of the vegetation remnant contained abundant 'maritime shrubs' such as Coastal Rosemary (*Westringia fruticosa*), White Correa (*Correa alba*) and Heath Myrtle (*Baeckea imbricata*). These plants are all characteristic Coastal Headland Heath vegetation and indicate the vegetation is not ESBS (OEH 2013; OEH 2011).

Analysis of Biometric Plot data (including flora inventory and structural data) collected for the site indicated that the vegetation did not meet the criteria to be classified as 'Coastal Sand Mantle Heath' or 'Coastal Sandplain Heath' which are the only two recognised Sydney Metropolitan vegetation types that comprise ESBS (see Appendix 1). The total vegetation patch was determined to be representative of Coastal Headland Banksia Heath (OEH 2013). This community is formally listed as 'PCT 1822 (ME 101): *Heath-leaved Banksia - Scrub She-oak heath on sandstone headlands in the Sydney basin*'. This community is not listed as threatened under state or federal legislation.

Exotic vine and woody weed cover was found across the subject site in varying density. The extensive urban interface adjoining the vegetation patch has promoted 'edge effects' on all sides of the patch. Garden escapees and herbaceous exotics were observed to have colonised areas of the native vegetation patch where it adjoined neighbouring residential properties.

All areas surrounding the site that were not mapped as native vegetation have been identified as *Cleared land and plantings* or *Built structure* (Figure 6 and Table 3).

3.1.1 PCT 1822: Heath-leaved Banksia - Scrub She-oak heath on sandstone headlands in the Sydney basin

Heath-leaved Banksia - Scrub She-oak heath on sandstone headlands in the Sydney basin (PCT 1822) (or simply 'Coastal Headland Banksia Heath') was determined to be the dominant community across the subject site. This community was identified by a floristic assemblage dominated by xeric, coastal shrub species including Coastal Wattle (*Acacia longifolia* subsp. *sophorae*), Heath Myrtle (*Baeckea imbricata*), Heath-leaved Banksia (*Banksia ericifolia*), Dagger Hakea (*Hakea teretifolia*) and Ball Honeymyrtle (*Melaleuca nodosa*) and Coastal Teatree (*Leptospermum laevigatum*) contributed to a limited emergent canopy. A scattered mesic species such as Sweet Pittosporum (*Pittosporum undulatum*), Blueberry Ash (*Elaeocarpus reticulatus*) and cheese tree (*Glochidion ferdinandi*) reflected the low fire frequency, expected in the urban situation. Ground covers were sparse and with low species diversity reflecting over shading from the dense mid-storey cover.



Plate 1: Characteristic sandstone and vegetation used to identify Heath-leaved Banksia - Scrub She-oak heath on sandstone headlands in the Sydney basin within the subject site

Table 3: Mapped Plant Community Types and other features

Vegetation type (OEH 2013)	Plant community type / Other feature (Narla Environmental 2017)	Total area (ha)
Urban exotic/native	PCT 1822 - Heath-leaved Banksia - Scrub She-oak heath on sandstone headlands in the Sydney basin	0.40
Not mapped	Cleared land and plantings	0.50
	Built structure	0.26
Total area (ha)		1.16



Figure 5: Mapped vegetation (OEH 2013)



Figure 6: Field validated vegetation and other features

3.2 Identifying vegetation zones

A single vegetation zone was identified based on the PCT classification described above and an assessment on condition consistent with the requirements of the FBA (OEH 2014). Condition class was determined by the field ecologists based on extensive experience undertaking environmental restoration works within similar coastal heathland environments and in consideration of the small total extent of vegetation within the site.

Localised weed infestations were apparent in parts of the vegetation patch, particularly along the bushland-urban interface where edge effects were prevalent. The level of exotic plant cover did not meet the FBA criteria for the 'low' condition class. Active weed control efforts had contributed to this assessment. Native vegetation was the dominant cover across the subject site and this enabled the whole patch to be classed as '*Moderate-good*'.

The total area of the vegetation zone is provided in Table 4 and displayed in Figure 7. The impact to the vegetation zone is defined by the boundary of the approximately 1.5 m wide walkway, and associated rest areas referred to as 'nooks', to be created during the proposed Cliffbrook Campus Redevelopment Project. No other native vegetation will be impacted by the proposed development on the subject site.

Table 4: Vegetation zones

Vegetation zone ID	PCT ID / Biometric vegetation ID	Common Name	PCT name	Condition	Percent cleared	Area impacted (ha)
1	PCT1822 / ME101	Coastal Headland Banksia Heath	Heath-leaved Banksia – Scrub She-oak heath on sandstone headlands in the Sydney basin	Moderate - Good	62	0.027

3.3 Biometric plots and transects

Biometric plot and transect based surveys (as per the FBA - OEH 2014) were undertaken by Ecologists Emily Strautins and Dean Sugden on the 7th and 9th of February 2017. Both Ecologists were experienced in the undertaking of field assessment and environmental restoration works within the Sydney Basin region, particularly in coastal heathland vegetation.

Field assessment was split across two days. Heavy rains and thunder storms were experienced on 7 February 2017. Weather conditions on 9 February 2017 were hot, dry and sunny (Table 5).

Table 5: Daily weather observation at Sydney NSW (7.3Km away) during field assessment (bold) and in 5 days prior

Date	Temperature (°C)		Rainfall (mm)	Max Wind (gust)	
	Min	Max		Direction	Spd (km/h)
2/2/17	20.8	27.1	4.4	S	50
3/2/17	22.3	26.4	0	NNE	24
4/2/17	22.7	30.4	0	NNE	35
5/2/17	25.8	34.9	0	NW	41
6/2/17	26.2	34.7	0	S	48
7/2/17	21.1	24.9	6.4	-	-
8/2/17	20.7	27.0	85.0	ESE	46
9/2/17	22.5	30.9	5.4	NNE	54

Four plot and transects were established within the subject site to best sample the natural variation of the vegetation across the subject site. This exceeds the requirements of the FBA (OEH 2014), which sets the minimum as 1 plot and transect per 2 ha (or part thereof). Plots were randomly stratified to cover the whole of the bushland region supporting the proposed walkway construction. An example of the plot sheets used is provided in **Appendix 2**.

Owing to the narrow width of the proposed impact to the native vegetation on the subject site (the proposed walkway), no single plot could be fit entirely within the proposed impact footprint. As such, all transect and plot datasets have been entered into the BCC. The summarised results obtained from each plot are provided in Table 6. The four plot and transect locations are shown in Figure 8.

Table 6: Biometric plot and transect results

Plot	1	2	3	4
Native Plant Species Richness	27	22	18	22
Native Over-storey Cover	2	2	6	3.5
Native Mid-storey Cover	33	63.5	19	34.5
Native Ground Cover (Grasses)	70	60	50	70
Native Ground Cover (Shrubs)	56	80	32	30
Native Ground Cover (Other)	20	0	60	12
Exotic Plant Cover	27	59	140	1
Number of Trees with Hollows	0	0	0	0
Over-storey Regeneration (score)	0.5	0.5	0.5	0.5
Fallen Logs (m)	0	35	31	0
Coordinates (Easting)	339367	339314	339231	339257
Coordinates (Northing)	6245971	6245977	6245600	6245994



Figure 7: Vegetation zones within construction footprint



Figure 8: Plot and transect locations

3.4 Current and future site value scores

The current and future site value scores for the single vegetation zone were calculated based on the data from the four plots and transects collected on site and entered into the BCC. The current site value score is 61.67 / 100. A number of values, such as native plant species, ground cover (shrubs and other) and fallen logs are within benchmark. Conversely, some other features (such as over-storey cover, mid-storey cover, ground cover (grasses), exotic plant cover and trees with hollows) are significantly below benchmark.

The future site value score, as complete clearing is required within the track footprint, is 0 / 100. See Table 7.

Table 7: Current and future site value scores

Vegetation zone ID	PCT ID / Biometric vegetation ID	Condition	PCT name	Area impacted (ha)	Current site value	Future site value
1	PCT1822 / ME101	Moderate - Good	Heath-leaved Banksia – Scrub She-oak heath on sandstone headlands in the Sydney basin	0.027	61.67	0

4. Assessing threatened species and populations

4.1 Species credit species

4.1.1 Geographic and habitat questions

Species credit species are those species that cannot be reliably predicted by habitat surrogates, the PCT or distribution, and therefore require additional assessment, and potentially targeted survey.

A component of preparing a candidate species list for survey includes the completion of geographic and habitat questions required by the BCC. The question posed and responses are provided below (Table 8). No impact will occur through the proposal to any species or habitat type listed in the geographic/habitat questions in the BCC.

Table 8: Assessment of geographic and/or habitat features

Common name	Scientific name	Feature	Impacted?
Green and Golden Bell Frog	<i>Litoria aurea</i>	Land within 100 m of emergent aquatic or riparian vegetation.	No, habitat features are not present within the locality.
Rosenberg's Goanna	<i>Varanus rosenbergi</i>	Land within 250 m of termite mounds or rock outcrops.	No, suitable habitat features are not present within the locality.
Giant Burrowing Frog	<i>Heleioporus australiacus</i>	Land within 40 m of heath, woodland or forest with sandy or friable soils.	No, the species has not been recorded within range of the subject site (<10km radius). Soils poorly friable.
Broad-headed Snake	<i>Hoplocephalus bungaroides</i>	Land within 500 m of sandstone escarpments with hollow-bearing trees, rock crevices or flat sandstone rocks on exposed cliff edges and sandstone outcropping.	No, the species has not been recorded within range of the subject site (<10km radius). No hollow bearing trees, limited rock crevices of suitable size.

4.1.2 Candidate list for survey

After answering the geographic and habitat questions the BCC produces a candidate species list for further consideration. Consistent with Section 6.5.1.3 of the FBA (OEH 2014), each species listed was reviewed and a habitat assessment conducted to determine if the species required further assessment, including targeted survey.

Fourteen species and three endangered populations were identified by the BCC as requiring further consideration. Two of these species were subject to targeted survey within the subject site, with no evidence of either occurring within the subject site or surrounding area. The

remaining fifteen candidates were discounted and eligible to be removed from the candidate species list consistent with FBA (OEH 2014) Section 6.5.1.3 (see Table 9 for justification for each species).

The following threatened 'species credit' flora were deemed as having potential to occur on the subject site, Magenta Lillypilly (*Szygyium paniculatum*), Netted Bottle Brush (*Callistemon linearifolius*) and Sunshine Wattle (*Acacia terminalis* subsp. *terminalis*). Targeted searches were conducted for each of these species. The searches were conducted by Narla Ecologist Emily Strautins and Dean Sugden during the field assessment on the 7 and 9th of February 2017, as this aligned with the flowering period (when the species are most conspicuous) and had greatest chance of displaying key diagnostic features. The species were not located within during survey (Table 9).

A threatened flora and fauna likelihood table was prepared for the project and is provided in Appendix 3.

4.1 Ecosystem credit species

4.1.1 Predicted ecosystem credit species

Species that require ecosystem credits have a high likelihood of being present on the development site, based on the data entered into the BCC including PCT details, patch size and the location of the development.

Two ecosystem credit species were identified by the BCC, the Little Lorikeet (*Glossopsitta pusilla*) and Swift Parrot (*Lathamus discolor*). A habitat assessment was conducted for each species to determine if the species should remain in the assessment or be removed consistent with Section 6.3.1.8 of the FBA (OEH 2014).

4.1.2 Presence of habitat components for ecosystem credit species

The habitat components for the Swift Parrot and Little Lorikeet were reviewed and a habitat assessment conducted for the site (Table 10). The habitat assessment found that neither species are likely to occupy the site as the habitat components they require are not present. As such both the Little Lorikeet and Swift Parrot were removed from the assessment. No other ecosystem credit species were predicted by the BCC.

A threatened flora and fauna likelihood table was prepared for the project and is provided in **Appendix 3**.

Table 9: Identifying candidate species for further assessment (species credit species)

Common name	Scientific name	TSC Act status	EPBC Act status	Species require further assessment	Justification / notes
Bauer's Midge Orchid	<i>Genoplesium baueri</i>	Endangered	Endangered	No	This species has not been recorded within a 10km radius of the subject site (OEH 2017). The habitat available within the subject site is considered unsuitable to this species normally found within dry sclerophyll forest and moss gardens over sandstone.
Bynoe's Wattle	<i>Acacia bynoeana</i>	Endangered	Vulnerable	No	This species has not previously been recorded within a 10km radius of the subject site (OEH 2017). The subject site is outside the range of any known populations, and is therefore considered unlikely to naturally occur in the locality. The subject site does not support any of the five canopy species normally associated with this occurrence of this species, thus provides suboptimal habitat conditions.
Camfield's Stringybark	<i>Eucalyptus camfieldii</i>	Vulnerable	Vulnerable	No	This species has not previously been recorded within a 10km radius of the subject site (OEH 2017). The species is known from localised and scattered distribution sites at Norah Head (Tuggerah Lakes), Peats Ridge, Mt Colah, Elvina Bay Trail (West Head), Terrey Hills, Killara, North Head, Menai, Wattamolla and a few other sites in Royal National Park. None of these are within range of the subject site, as such the species is considered unlikely to occur naturally within the locality.
Darwinia biflora	<i>Darwinia biflora</i>	Vulnerable	Vulnerable	No	Recorded distribution is in Ku-ring-gai, Hornsby, Baulkham Hills and Ryde local government areas. The northern, southern, eastern and western limits of the range are at Maroota, North Ryde, Cowan and Kellyville, respectively. The subject site is therefore outside the expected range of this species, with no previous records found to occur within a 10km radius of the subject site (OEH 2017).

Common name	Scientific name	TSC Act status	EPBC Act status	Species require further assessment	Justification / notes
Deane's Paperbark	<i>Melaleuca deanei</i>	Vulnerable	Vulnerable	No	Deane's Paperbark occurs in two distinct areas, in the Ku-ring-gai/Berowra and Holsworthy/Wedderburn areas respectively. There are also more isolated occurrences at Springwood (in the Blue Mountains), Wollemi National Park, Yalwal (west of Nowra) and Central Coast (Hawkesbury River) areas. The subject site is therefore outside the expected range of this species, with no previous records found to occur within a 10km radius of the subject site (OEH 2017).
Eastern Pygmy-possum	<i>Cercartetus nanus</i>	Vulnerable	-	No	This species has not been recorded within a 10km radius of the subject site (OEH 2017). It is presumed to be locally extinct.
Gang-gang Cockatoo population, Hornsby and Ku-ring-gai Local Government Areas	<i>Callocephalon fimbriatum</i> population in the Hornsby and Ku-ring-gai Local Government Areas	Endangered population	-	No	The population is believed to be largely confined to an area bounded by Thornleigh and Wahroonga in the north, Epping and North Epping in the south, Beecroft and Cheltenham in the west and Turramurra/South Turramurra to the east. It is known to inhabit areas of Lane Cove National Park, Pennant Hills Park and other forested gullies in the area. The subject site is therefore outside of the expected range of this species, and holds no suitable foraging or nesting habitat. No previous records are found to occur within a 10km radius of the subject site (OEH 2017).
Hairy Geebung	<i>Persoonia hirsuta</i>	Endangered	Endangered	No	Species records from within a 10km radius detected a single recorded Hairy Geebung, however the accuracy of this record was offset by 2500m (OEH 2017). It is considered unlikely to occur within the highly altered subject site.
Hibbertia puberula	<i>Hibbertia puberula</i>	Critically Endangered	Critically Endangered	No	This species is currently known to occur in only one population at Bankstown Airport in Sydney's southern suburbs, in the Bankstown local government area. Within the Sydney Metro catchment it is considered to be

Common name	Scientific name	TSC Act status	EPBC Act status	Species require further assessment	Justification / notes
					strongly associated with Castlereagh Ironbark Forest or possibly Castlereagh Scribbly Gum, with remnant vegetation essential. No such habitat is available within the subject site or adjoining areas. No previous records are found to occur within a 10km radius of the subject site (OEH 2017).
Little Penguin population, Manly	<i>Eudyptula minor</i> population - endangered population	Endangered Population	-	No	This species has not previously been recorded within a 10km radius of the subject site (OEH 2017). The subject site is located outside of the breeding range of this endangered population and contains no marine foraging habitat suitable for this species.
Long-nosed Bandicoot population, North Head	<i>Perameles nasuta</i> population - endangered population	Endangered Population	-	No	This species has not previously been recorded within a 10km radius of the subject site (OEH 2017). The subject site is located outside of the range of this endangered population.
Netted Bottle Brush	<i>Callistemon linearifolius</i>	Vulnerable	-	Survey conducted – not found	A targeted search was undertaken for this species at optimal flowering times, with no evidence of its presence found within the subject site or the immediately adjoining area. There are no previous records for this species within the targeted area or immediate surrounds (OEH 2017).
Regent Honeyeater	<i>Anthochaera phrygia</i>	Critically Endangered	Critically Endangered	No	Habitat assessment undertaken found that the subject site provided insufficient foraging resources (absence of tall nectar-bearing trees) to attract the Regent Honeyeater. No previous records were found to indicate the species occurrence within a 10km radius (OEH 2017).
Southern Brown Bandicoot (eastern)	<i>Isodon obesulus</i> subsp. <i>obesulus</i>	Endangered	Endangered	No	This species has not previously been recorded within a 10km radius of the subject site (OEH 2017). The subject site is located outside of the range of known populations for this species.

Common name	Scientific name	TSC Act status	EPBC Act status	Species require further assessment	Justification / notes
Sunshine Wattle	<i>Acacia terminalis</i> subsp. <i>terminalis</i>	Endangered	Endangered	Survey conducted – not found	A targeted search was undertaken for this species at optimal flowering times, with no evidence of its presence found within the subject site or the immediately adjoining area.
Tetratheca glandulosa	<i>Tetratheca glandulosa</i>	Vulnerable	-	No	This species has only been identified within woodland communities of Baulkham Hills, Gosford, Hawkesbury, Hornsby, Ku-ring-gai, Pittwater, Ryde, Warringah, and Wyong. There are no previous records for this species within a 10km radius of the subject site (OEH 2017). Thus subject site was therefore considered to provide unsuitable habitat and outside potential range of distribution.
Thick Lip Spider Orchid	<i>Caladenia tessellata</i>	Endangered	Vulnerable	No	There are no previous records for this species within a 10km radius of the subject site (OEH 2017). The species is typically found in cooler regions, with populations occurring in coastal Victoria. Onsite habitat conditions were deemed unsuitable for this species.

Table 10: Identifying candidate species for further assessment (ecosystem credit species)

Common name	Scientific name	TSC Act status	EPBC Act status	Species present in vegetation zone?	Justification for removal from assessment
Little Lorikeet	<i>Glossopsitta pusilla</i>	Vulnerable	-	No	This species only nests in tall, hollow-bearing eucalypt and other myrtaceous trees. Tall, nectar-bearing eucalyptus trees, the primary foraging resource for this species were not found within the subject site. No historical records have been recorded within a 10km radius of the subject site (OEH 2017)
Swift Parrot	<i>Lathamus discolor</i>	Endangered	Critically Endangered	No	This species does not breed in NSW. Tall, nectar bearing eucalyptus trees, the primary foraging resource for this species were not found within the subject site. The nearest historical record of this species is 10km away (OEH 2017).

5. Impact assessment and credit calculations

5.1 Final project footprint

The proposed walkway impacts on 0.027 ha of native vegetation mapped as ME101 / PCT 1822: *Heath-leaved Banksia - Scrub She-oak heath on sandstone headlands in the Sydney basin*. Biometric plot and transect data revealed the native vegetation across the subject site is in moderate to good condition, with some values within benchmark, and others absent or below benchmark. The final project impact is provided in Table 11 and the footprint is displayed in Figure 9.

Table 11: Total impact on native vegetation

Plant community type	Area (ha)	Area impacted (ha)
PCT 1822 - Heath-leaved Banksia - Scrub She-oak heath on sandstone headlands in the Sydney basin	0.40	0.027

5.2 Assessment of direct and indirect impacts

A direct impact will occur to all vegetation within the 0.027 ha footprint of the proposed walkway. This totals 6.75% of the total native bushland area. Vegetation within the footprint is contiguous to the surrounding area as such no significant decrease in native flora species diversity and structure across the subject site is anticipated. The direct impacts of vegetation clearance will be limited to the extent of the walkway and nooks. No additional clearing will be required for the construction of the walkway.

Once constructed the proposed walkway has the potential to increase the manifestation of edge effects by further fragmenting the bushland patch and acting as a potential source of exotic flora propagules. During construction, steps will be taken to ensure exotic propagules are not inadvertently introduced to the site on machinery, tools or equipment, limiting indirect impacts. Vegetation management, including the management of weed species, will be completed on site (see Section 5.3).

As local soils are naturally prone to erosion and disturbance associated with the removal of vegetation, measures will be implemented (both during and post construction) to minimise erosion and sedimentation.

Impacts to sandstone outcrops have been limited; however the proximity of the works to sandstone outcrops means there remains a risk of indirectly impacting on these habitat features. Measures employed during construction will reduce these impacts (see Section 5.3).

5.3 Mitigation of impacts

Several measures will be implemented to reduce impacts where possible. Details are provided below.

- Keeping the width of the walkway as narrow a width as practicable (no wider than 1.5 m) without reducing its purpose.
- Micro-siting the route of the pathway to avoid habitat which holds high habitat value such as sandstone outcrops, larger shrubs or canopy species. If required route of walkway may be altered a maximum distance of 1m.
- Assigning an Ecologist to undertake a pre-clearing survey of the vegetation prior to track construction. If any significant ecological values such as nests are found, these are to be avoided through shifting the path of the track of waiting until the nest is vacated.
- Assigning an Ecologist to be present on site during the clearing of the access to track. The Ecologist will be able to guide works crews away from sensitive ecological features, and will be on hand to capture and relocate displaced fauna.
- Preventing the inadvertent introduction of exotic flora propagules by following the DEP (2015) 'Arrive Clean, Leave Clean' Guidelines.
- Ensuring the track runs parallel with the contours of the subject site across as little topographic gradient as possible to help reduce erosion risk.
- Ensuring appropriate erosion and sedimentation controls are maintained throughout the construction phase and the period immediately following as outlined in the 'Blue Book' (Landcom 2004).
- Reducing the incidence of multiple informal tracks being cut through the area (as has previously occurred), thus minimising the total area of disturbance. The single established walkway is intended to be the only thoroughfare utilised across the vegetation patch.
- Increasing social value of the bushland through improved public access to the native vegetation on the campus to encourage appreciation of its sensitivity to disturbances such as illegal dumping or clearing (as has previously occurred).
- Maintaining and enhancing bushland revegetation and weed management post construction phase.

The unavoidable impact of clearing vegetation to construct the walkway will be mitigated through an increase in onsite vegetation management across the patch. The condition of the vegetation will be improved by removing weeds and maintaining a weed free patch of bushland. The extent of native vegetation will be increased by revegetating an area currently occupied by exotic turf. Weed management and vegetation restoration will all be outlined in detail within the Biodiversity Management Plan (BMP) (Narla 2017). The BMP will provide a best practice guide to address site specific requirements and recommendation to enhance local biodiversity.



Figure 9: Development footprint and native vegetation extent

5.4 Credit calculations

5.4.1 Ecosystem credits

Ecosystem credits were calculated based on the landscape value assessment, native vegetation assessment and threatened species assessment documented in this report.

In total 0.42 credits are required for the proposed impact of 0.027 ha. As the credit amount is below 0.5 credits, and the credit amount is rounded down, no ecosystem credits are required for the proposal. The ecosystem credit offset requirement is summarised in Table 12, and the final credit report is displayed in Appendix 4.

Table 12: Ecosystem credit requirement

				Offset options	
Plant community type	Condition	Area impacted (ha)	Credits required	Plant community type(s)	IBRA subregion(s)
PCT 1822 - Heath-leaved Banksia - Scrub She-oak heath on sandstone headlands in the Sydney basin	Moderate - Good	0.027	0.42 (rounded to 0)	Heath-leaved Banksia - Scrub She-oak heath on sandstone headlands in the Sydney basin, (PCT 1822 / ME101)	Pittwater (Part B) and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

5.4.1 Species credits

No species credits are required for the proposal. Refer to Section 4.1.

5.5 Thresholds for the assessment and offsetting of unavoidable impacts

Section 9: Table 4 of the FBA (OEH 2014) provides thresholds for the assessment and offsetting for the unavoidable impacts of development. Four thresholds have been defined, including:

- I. Impacts that require further consideration by consent authority
- II. Impacts for which the assessor is required to determine an offset
- III. Impacts for which the assessor is not required to determine an offset
- IV. Impacts that do not require further assessment by the assessor.

The proposed development meets the requirements of (III), as outlined below.

As documented in Section 9.3 of the FBA (OEH 2014) projects which have unavoidable impacts on native vegetation are not required to determine an offset when the impacts to native vegetation are to a PCT that:

- has a site value score <17, or
- are not identified as CEECs / EECs and
- are not associated with threatened species habitat and are not identified as CEECs / EECs

Irrespective of the final credit calculation outcome (which is zero (0) credits) the proposed development is not required to determine an offset as:

- The plant community type being impacted (ME101 / PCT 1822: Heath-leaved Banksia – Scrub She-oak heath on sandstone headlands in the Sydney basin) is not a CEEC / EEC under either the NSW TSC Act or the Commonwealth EPBC Act
- The plant community type being impacted at the development site is not associated with threatened species habitat. As outlined previously in the report, the two predicted species on site (Little Lorikeet and Swift Parrot) were both removed from the assessment after a habitat assessment was conducted. This resulted in no threatened species being associated with the PCT at the development site.

6. Conclusion

The proposed development has been assessed consistent with the FBA, including the preparation of a site scale vegetation map and completion of the four Biometric plots and transects. The results of the assessment found that zero (0) ecosystem credits were required to offset 0.027 ha of impact to native vegetation from the proposed walkway. No species credits are required for the proposal.

The application of threshold III in the FBA (OEH 2014) means the development is not required to determine an offset. It is therefore proposed that the development proceeds without the purchase or retirement of ecosystem or species credits irrespective of the credit calculation results.

Existing site condition will be enhanced through the application of a site specific BMP. This will guide specific on-site vegetation management to both minimise and mitigate any impacts associated with the proposed development and to address issues such as weed infestations and erosion already present within the subject site (Narla 2017).

References

Benson D & Howell J 1990. Taken for Granted - The Bushland of Sydney and its suburbs. Kangaroo Press, Kenthurst.

Chapman and Murphy (1989) Soil Landscapes of the Sydney 1:100 000 Sheet, Soil Conservation Service of NSW, Sydney.

Commonwealth of Australia Threatened Species Scientific Committee (TSSC) (2015) Conservation Advice for Eastern Suburbs Banksia Scrub of the Sydney Region, s266B of the Environment Protection and Biodiversity Conservation Act 1999, approved by the Delegate of the Minister on 01 October 2015.

Department of the Environment (DEP) (2015) Arrive Clean, Leave Clean: Guidelines to help prevent the spread of invasive plant diseases and weeds threatening our native plants, animals and ecosystems, The Commonwealth of Australia

Department of Environment and Climate Change NSW (2009a) Best Practice Guidelines Eastern Suburbs Banksia Scrub, Accessed May 2016
<http://www.environment.nsw.gov.au/resources/threatenedspecies/0942eastsubsbanksiascrubpg.pdf>

Department of Environment and Climate Change NSW (2009b) Protecting and restoring Eastern Suburbs Banksia Scrub, Accessed May 2016
<http://www.environment.nsw.gov.au/resources/threatenedspecies/0968tsdsesbanksiascrub.pdf>

NSW Land and Property Information (LPI) (2015). SIX Maps. <https://maps.six.nsw.gov.au/>

Francis-Jones Morehen Thorp Studio (FJMT) (2016a) SK-5.02 Tree Management Plan – UNSW Cliffbrook Campus (Preliminary Plans)

Francis-Jones Morehen Thorp Studio (FJMT) (2016b) SK-5.03-4 Landscape Plans: East and West– UNSW Cliffbrook Campus (Preliminary Plans)

Herbert, C. (1983) Geology of the 1:100 000 Sheet 9130. Geological Survey of NSW, Sydney.

Landcom (2004) Managing urban stormwater: harvesting and reuse 'The Blue Book'

Narla Environmental Pty Ltd (2017) Biodiversity Management Plan: UNSW Cliffbrook Campus. Commissioned by the University of New South Wales. March 2016

NSW Department of Primary Industries (DPI) (2016) Weeds declared in the Local Control Authority area of Randwick City Council, Weeds Wise, [February 2017]
<http://weeds.dpi.nsw.gov.au/WeedDeclarations?RegionId=95>

NSW Office of Environment and Heritage (2017) Atlas of NSW Wildlife database (Bionet). [February- March 2017].

NSW Office of Environment and Heritage (OEH) (2011a) NSW Scientific Committee - final determination: Eastern Suburbs banksia scrub in the Sydney Basin Bioregion - endangered

ecological community listing, [February 2017]

<http://www.environment.nsw.gov.au/determinations/EasternSuburbsBanksiaScrubEndComListing.htm>

NSW Office of Environment and Heritage (OEH) (2011b) Heritage places and items search: Cliffbrook, Date significance updated: 09 Sep 11,

<http://www.environment.nsw.gov.au/heritageapp/ViewHeritageItemDetails.aspx?ID=5045282>

NSW Office of Environment and Heritage (OEH) (2013) The Native Vegetation of the Sydney Metropolitan Area, Volume 2: Vegetation Community Profiles, Version 2.0, NSW Office of Environment and Heritage, Sydney.

NSW Office of Environment and Heritage (OEH) (2014) Framework for biodiversity assessment. State of NSW and Office of Environment and Heritage, Sydney.

NSW Office of Environment and Heritage (OEH) (2016a) NSW soil and land information, eSPADE Online Database, <http://www.environment.nsw.gov.au/eSpadeWebapp/>

PlantNET (The NSW Plant Information Network System) (2016), 'NSW Flora Online: Plant Species Profiles' Royal Botanic Gardens and Domain Trust, Sydney. [February 2017]
<http://plantnet.rbgsyd.nsw.gov.au>

Ralph, M. (2003) 'Growing Australian Native Plants from Seed – For Revegetation Tree Planting and Direct Seeding', Second Edition, Bushland Horticulture Publications

Randwick City Council (RCC) (2015) Gordon's Bay Reserve Bushcare
http://www.randwick.nsw.gov.au/community/whats-on/events/2015/regular/gordons-bay-reserve-bushcare?SQ_CALENDAR_DATE=2015-03-08

Richardson, F, Richardson, R., Shepard, R. (2011) 'Weeds of the South-East – An Identification Guide for Australia', Second Edition, R.G. and F.J Richardson

Robinson, L. (2003) 'Field Guide to the Native Plants of Sydney', Third Edition, Kangaroo Press

Appendix

Appendix 1 – Flora inventory

Appendix 2 - Sample Survey Pro-forma

Appendix 3 - Threatened Biota Occurrence Likelihood Tables

Appendix 4 – Biodiversity credit report

Appendix 1 -Flora list for the subject site

Scientific Name	Common Name	Candidate Vegetation Communities (OEH 2013)			
		ESBS: Coastal Sand Mantle Heath S_HL03; PCT 664; ME022	ESBS: Coastal Sandplain Heath S_HL04; PCT 1061; ME011	Coastal Dune Heath: Coastal Foredune Wattle Scrub S_HL05; PCT 772; ME006	Coastal Headland Heath: Coastal Headland Banksia Heath S_HL06; PCT 1822; ME101
Presence on site		Not present	Not present	Not present	Confirmed
<i>Acacia longifolia sophorae</i>	Coastal Wattle	*	*	*	*
<i>Acacia myrtifolia</i>	Red-stemmed Wattle				
<i>Acemena smithii</i>	Common Lilly Pilly				
<i>Adiantum aethiopicum</i>	Maidenhair Fern				
<i>Allocasuarina distyla</i>	Black She-oak	*	*		*
<i>Araucaria het erophylla</i>	Norfolk Island Pine				
<i>Asplenium australasicum</i>	Birds Nest Fern				
<i>Baeckea imbricata</i>	Heath Myrtle				*
<i>Banksia ericifolia</i>	Heath-leaved Banksia	*			*
<i>Banksia integrifolia</i>	Coastal Banksia			*	
<i>Bauera rubioides</i>	Dog Rose				
<i>Breynia oblongifolia</i>	Coffee Bush				
<i>Callistemon citrinus</i>	Crimson Bottlebrush				
<i>Calochlaena dubia</i>	Common Ground Fern				
<i>Carpobrotus glauescens</i>	Pigface			*	
<i>Casuarina glauca</i>	Swamp She-Oak				
<i>Christella dentata</i>	Binung Fern				
<i>Commelina cyanea</i>	Scurvy Weed				
<i>Correa alba</i>	White Correa				
<i>Corymbia maculata</i>	Spotted Gum				
<i>Crinum pendeculatum</i>	Swamp Lily				
<i>Cupaniopsis anacardioides</i>	Tuckeroo				
<i>Cyperus brevifolius</i>	Mullumbimby Couch				
<i>Cyrtomium fal catum</i>	Holly Fern				
<i>Dianella caerulea</i>	Blue Flax Lily				*
<i>Dianella revoluta</i>	Blue Flax Lily				

Scientific Name	Common Name	Candidate Vegetation Communities (OEH 2013)			
		ESBS: Coastal Sand Mantle Heath S_HL03; PCT 664; ME022	ESBS: Coastal Sandplain Heath S_HL04; PCT 1061; ME011	Coastal Dune Heath: Coastal Foredune Wattle Scrub S_HL05; PCT 772; ME006	Coastal Headland Heath: Coastal Headland Banksia Heath S_HL06; PCT 1822; ME101
Presence on site		Not present	Not present	Not present	Confirmed
<i>Dichelachne crinita</i>	Longhair Plume Grass				
<i>Dicksonia antarctica</i>	Soft Tree Fern				
<i>Dodonaea triquetra</i>	Common Hoppush				
<i>Eleaocarpus reticulatus</i>	Blueberry Ash				
<i>Eragrostis brownii</i>	Browns Love Grass				
<i>Eucalyptus botryoideis</i>	Southern Mahogany				
<i>Ficinia nodosa</i>	Knotted Club-rush			*	
<i>Ficus rubiginosa</i>	Port Jackson Fig				
<i>Gahnia sp</i>					
<i>Glochidion ferdinandi</i>	Cheese Tree				
<i>Grevilea hookeriana</i>	Hookers Grevillea				
<i>Hakea gibbosa</i>	Needlebush				
<i>Hakea teretifolia</i>	Dagger Hakea				*
<i>Hardenbergia violacea</i>	Purple Coral Pea				
<i>Hibbertia scandens</i>	Snake Vine				
<i>Histiopteris incisa</i>	Bats Wing Fern				
<i>Imperata cylindrica</i>	Blady Grass				
<i>Juncus continuus</i>	Juncus				
<i>Kunzea ambigua</i>	Tick Bush				*
<i>Leptospermum laevigatum</i>	Coastal Teatree	*	*	*	*
<i>Livistona australis</i>	Cabbage Palm				
<i>Lobelia ancepslata</i>	Angled lobelia				
<i>Lomandra longifolia</i>	Spiny Mat Rush		*		*
<i>Melaleuca armillaris</i>	Bracelet Honey-myrtle				*
<i>Melaleuca nodosa</i>	Ball Honeymyrtle	*	*		*
<i>Microlaena stipoides</i>	Weeping Grass				
<i>Opercularia aspera</i>	Course Stinkweed				
<i>Oplismenus imbecillis</i>	Basket Grass				
<i>Oxalis rubens</i>	Coastal Oxalis				

Scientific Name	Common Name	Candidate Vegetation Communities (OEH 2013)			
		ESBS: Coastal Sand Mantle Heath S_HL03; PCT 664; ME022	ESBS: Coastal Sandplain Heath S_HL04; PCT 1061; ME011	Coastal Dune Heath: Coastal Foredune Wattle Scrub S_HL05; PCT 772; ME006	Coastal Headland Heath: Coastal Headland Banksia Heath S_HL06; PCT 1822; ME101
Presence on site		Not present	Not present	Not present	Confirmed
<i>Pittosporum undulatum</i>	Sweet Pittosporum				*
<i>Portulaca oleracea</i>	Pigweed				
<i>Pteridium esculentum</i>	Bracken Fern		*		
<i>Sigesbeckia orientalis</i>	Common St. Paul's Wort				
<i>Stephania japonica</i>	Tape Vine				
<i>Tetragonia tetragonoides</i>	New Zealand Spinach				
<i>Viola hederacea</i>	Native Violet				
<i>Westringia fruticosa</i>	Coastal Rosemary				
Count of Positive Diagnostic Species:		5	6	5	12
Vegetation community determinant (OEH 2013) :		A 0.04 hectare site located in this map unit is expected to contain at least 9 positive diagnostic species (95 per cent confidence interval) provided the total number of native species in the site is 24 or greater.	A 0.04 hectare site located in this map unit is expected to contain at least 12 positive diagnostic species (95 per cent confidence interval) provided the total number of native species in the site is 27 or greater.	A 0.04 hectare site located in this map unit is expected to contain at least 3 positive diagnostic species (95 per cent confidence interval) provided the total number of native species in the site is 5 or greater.	A 0.04 hectare site located in this map unit is expected to contain at least 5 positive diagnostic species (95 per cent confidence interval) provided the total number of native species in the site is 24 or greater.

Appendix 2 - Sample site plot and transect pro-forma

Monitoring Plot Data Sheet (Biometric)											Site Sheet No.				
Plot Information			Recorders				ES/DS				Date		9/2/17		
Site Name/Code			UNSW2												
Start Easting			20m Easting				50m Easting								
Start Northing			20m Northing				50m Northing								
Orientation of transect plot (direction and degrees)			ESE				Photo No. start				✓				
			Photo No. end of 50m transect				✓				Slope (degrees)		15° → S		
* Record Easting and Northing of each stake, from the start, 20m mark and end of 50m transect															
Vegetation Zone Identification															
Location			P3												
Vegetation Community															
Condition (Low or Mod-Good)			Mod-Good (leading to low?)												
Habitat Features (rocks etc.)															
Comments			edge close to lawn, active regeneration / planting bed												
			5	10	15	20	25	30	35	40	45	50	Sum /10	%	
Native 50m transect - 10 points (at 5m spaces)	Native overstorey cover (%)		0	0	0	55	0	5	0	0	0	0	60/10	6	
	Native midstorey cover (%)		10	45	0	65	0	0	2	15	0	55	192	19	
Native 50m transect - 50 Points (at 1m spaces)	Native ground cover (tally hits/50 points)												Sum x 2	%	
	- shrubs												= 16	32/	0.64
	Native ground cover (tally hits/50 pts)												Sum x 2	%	
	- grasses												= 25	50/	1
	- cryptogam		0										Sum x 2	%	
	Leaf litter (tally/ 50 pts)												= 15	30/	0.6
	Leaf litter (tally/50 pts)												= 30	60/	1.2
	other														
Exotic: 50m transect - 50 points	Ground cover (tally hits/50 points)												= 60	Sum x 2	%
	- grasses or shrubs												120	120	
Exotic: 50m transect - 10 points (at 5m spaces)	Exotic overstorey cover (%)		0	0	0	0	0	0	0	0	0	0	Sum/10	%	
	Exotic midstorey cover (%)		0	0	0	0	0	0	0	100	85	20	205	20.5	
20m x 50m Quadrat	Number of individual trees with hollows (only hollow >5cm diameter): 0													Total length fallen logs in metres (only logs >10cm width) 10+4+11+2+4 = 31	
Whole Veg. Zone	Over-storey regeneration	Over-storey Species	Little evidence											Regenerating (<5cm)	Comments
		except planted													

Cover: <1, 1,2,3,4,5, 15,20,25,30,35 etc foliage cover %

Appendix 3 - Threatened Biota Occurrence Likelihood Tables

Threatened Species Occurrence Tables Key

Likelihood of occurrence

	Potential criteria
High	Have a high incidence of previous records in the Project Area and locality · Populations are known in the Project Area or locality · There are infrequent recorded for the species in the Project Area and locality · Preferential habitats of the species are present in the Project Area but these are mainly in a poor or modified condition · Are cryptic flowering flora species that were not seasonally targeted during survey
Moderate	Have not been recorded previously in the Project Area or locality and the Project Area is beyond the known distribution or range · Are dependent on a narrow range or specific habitats that do not or are not likely to occur in the Project Area · Are considered locally extinct · Are a non-cryptic perennial flora species that were targeted during field surveys · Are flora species that have a very limited range and highly specific dispersal mechanisms
Low	Habitat not present on site · Habitat present but sufficient targeted survey has been conducted at an optimal time of year and species wasn't recorded
Negligible	

Status Codes

E	Endangered
V	Vulnerable
CE	Critically Endangered
X	Extinct
C	China Migratory Bird Agreement (CAMBA)
J	Japan Migratory Bird Agreement (JAMBA)
K	Republic of Korea Migratory Bird Agreement (ROKAMBA)

Threatened Fauna Occurrence Likelihood Table. List Generated through Bionet Search of records within a 10km radius centred on subject site.

Scientific Name	Common Name	NSW status	Commonwealth status	Habitat Description	Likely Occurrence in subject Site	Rationale for Likelihood Ranking
Amphibians						
<i>Pseudophryne australis</i>	Red-crowned Toadlet	V		Red-crowned Toadlets are quite a localised species that appear to be largely restricted to the immediate vicinity of suitable breeding habitat. Red-crowned Toadlets are usually found as small colonies scattered along ridges coinciding with the positions of suitable refuges near breeding sites. Occurs in open forests, mostly on Hawkesbury and Narrabeen Sandstones. Inhabits periodically wet drainage lines below sandstone ridges that often have shale lenses or cappings.	Negligible	Unsuitable habitat
<i>Litoria aurea</i>	Green and Golden Bell Frog	E	V	Inhabits marshes, dams and stream-sides, particularly those containing bullrushes (<i>Typha</i> spp.) or spikerushes (<i>Eleocharis</i> spp.). Optimum habitat includes water-bodies that are unshaded, free of predatory fish such as Plague Minnow (<i>Gambusia holbrooki</i>), have a grassy area nearby and diurnal sheltering sites available.	Negligible	Unsuitable habitat
Reptiles						
<i>Chelonia mydas</i>	Green Turtle	V	V	Ocean-dwelling species spending most of its life at sea. Widely distributed in tropical and sub-tropical seas. Usually found in tropical waters around Australia but also occurs in coastal waters of NSW, where it is generally seen on the north or central coast, with occasional records from the south coast. Eggs laid in holes dug in beaches throughout their range.	Negligible	Unsuitable habitat within subject site - animal is marine.
Birds						

Scientific Name	Common Name	NSW status	Commonwealth status	Habitat Description	Likely Occurrence in subject Site	Rationale for Likelihood Ranking
<i>Anseranas semipalmata</i>	Maggie Goose	V		The Magpie Goose is still relatively common in the Australian northern tropics, but had disappeared from south-east Australia by 1920 due to drainage and overgrazing of reed swamps used for breeding. Mainly found in shallow wetlands (less than 1 m deep) with dense growth of rushes or sedges.	Negligible	Unsuitable habitat
<i>Stictonetta naevosa</i>	Freckled Duck	V		Prefer permanent freshwater swamps and creeks with heavy growth of Cumbungi, Lignum or Tea-tree. During drier times they move from ephemeral breeding swamps to more permanent waters such as lakes, reservoirs, farm dams and sewage ponds. Generally rest in dense cover during the day, usually in deep water. Feed at dawn and dusk and at night on algae, seeds and vegetative parts of aquatic grasses and sedges and small invertebrates	Negligible	Unsuitable habitat (no large waterbody within subject site)
<i>Ptilinopus superbus</i>	Superb Fruit-Dove	V		The Superb Fruit-dove occurs principally from north-eastern in Queensland to north-eastern NSW. It is much less common further south, where it is largely confined to pockets of suitable habitat as far south as Moruya. Inhabits rainforest and similar closed forests where it forages high in the canopy, eating the fruits of many tree species such as figs and palms. It may also forage in eucalypt or acacia woodland where there are fruit-bearing trees. Part of the population is migratory or nomadic. There are records of single birds flying into lighted windows and lighthouses, indicating that birds travel at night. At least some of the population, particularly young birds, moves south through Sydney, especially in autumn.	Low (vagrant)	Unsuitable habitat

Scientific Name	Common Name	NSW status	Commonwealth status	Habitat Description	Likely Occurrence in subject Site	Rationale for Likelihood Ranking
<i>Apus pacificus</i>	Fork-tailed Swift		C,J,K	In NSW, the Fork-tailed Swift is recorded in all regions. Many records occur east of the Great Divide. In Australia, they mostly occur over inland plains but sometimes above foothills or in coastal areas. They often occur over cliffs and beaches and also over islands and sometimes well out to sea. They also occur over settled areas, including towns, urban areas and cities. They mostly occur over dry or open habitats, including riparian woodland and tea-tree swamps, low scrub, heathland or saltmarsh	Moderate (fly over)	Potential to fly over only. No suitable habitat.
<i>Hirundapus caudacutus</i>	White-throated Needletail		C,J,K	In eastern Australia, it is recorded in all coastal regions of Queensland and NSW. During the non-breeding season the species has also occurred as a vagrant on various outlying islands, including Christmas Island and possibly the Cocos-Keeling Islands in the Indian Ocean, Norfolk and Lord Howe Islands in the Pacific Ocean, and Macquarie Island in the Southern Ocean	High (fly over)	Potential to fly over only. No suitable habitat.
<i>Diomedea exulans</i>	Wandering Albatross	E	E,J	Wandering albatross spend the majority of their time in flight, soaring over the southern oceans. They breed on a number of islands just north of the Antarctic Circle. The Wandering Albatross visits Australian waters extending from Fremantle, Western Australia, across the southern water to the Whitsunday Islands in Queensland between June and September. It has been recorded along the length of the NSW coast.	Low	Potential to fly over only. No suitable habitat.

Scientific Name	Common Name	NSW status	Commonwealth status	Habitat Description	Likely Occurrence in subject Site	Rationale for Likelihood Ranking
<i>Thalassarche chrysostoma</i>	Grey-headed Albatross		E	The Grey-headed Albatross is marine, pelagic and migratory. Its habitat includes subantarctic, subtropical, and occasionally Antarctic waters in the Pacific, Indian, Atlantic and Southern Oceans.	Low	Potential to fly over only. No suitable habitat.
<i>Ardenna carneipes</i>	Flesh-footed Shearwater	V	J,K	Ranges throughout the Pacific and Indian Oceans. There are two main breeding areas in the world: one in the South West Pacific includes Lord Howe Island and New Zealand; the other along the coast of Western Australia.	Low	Potential to fly over only. No suitable habitat.
<i>Ardenna pacificus</i>	Wedge-tailed Shearwater		J	The Wedge-tailed Shearwater is a pelagic, marine bird known from tropical and subtropical waters. The species tolerates a range of surface-temperatures and salinities, but is most abundant where temperatures are greater than 21 °C and salinity is greater than 34.6 ‰. In tropical zones the species may feed over cool nutrient-rich waters. The species has been recorded in offshore waters of eastern Victoria and southern NSW, mostly over continental slope.	Low	Potential to fly over only. No suitable habitat.
<i>Botaurus poiciloptilus</i>	Australasian Bittern	E	E	Australasian Bitterns are widespread but uncommon over south-eastern Australia. In NSW they may be found over most of the state except for the far north-west. Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (<i>Typha</i> spp.) and spike rushes (<i>Eleocharis</i> spp.). Hides during the day amongst dense reeds or rushes and feed mainly at night on frogs, fish, yabbies, spiders, insects and snails	Negligible	No suitable habitat.

Scientific Name	Common Name	NSW status	Commonwealth status	Habitat Description	Likely Occurrence in subject Site	Rationale for Likelihood Ranking
<i>Erythroriorchis radiatus</i>	Red Goshawk	E	V	Red Goshawks inhabit open woodland and forest, preferring a mosaic of vegetation types, a large population of birds as a source of food, and permanent water, and are often found in riparian habitats along or near watercourses or wetlands. In NSW, preferred habitats include mixed subtropical rainforest, Melaleuca swamp forest and riparian Eucalyptus forest of coastal rivers. Distributed sparsely through northern and eastern Australia, from the western Kimberley Division of northern Western Australia to north-eastern Queensland and south to far north-eastern NSW, and with scattered records in central Australia.	Negligible	Extinct in NSW
<i>Hieraaetus morphnoides</i>	Little Eagle	V		Occupies open eucalypt forest, woodland or open woodland. She-oak or Acacia woodlands and riparian woodlands of interior NSW are also used. Nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter.	Low	No suitable habitat.
<i>Haematopus fuliginosus</i>	Sooty Oystercatcher	V		Favours rocky headlands, rocky shelves, exposed reefs with rock pools, beaches and muddy estuaries. Forages on exposed rock or coral at low tide for foods such as limpets and mussels.	Low	Potential to fly over only. No suitable habitat.
<i>Haematopus longirostris</i>	Pied Oystercatcher	E		In NSW the species is thinly scattered along the entire coast, with fewer than 200 breeding pairs estimated to occur in the State. Favours intertidal flats of inlets and bays, open beaches and sandbanks. Forages on exposed sand, mud and rock at low tide, for molluscs, worms, crabs and small fish. The chisel-like bill is used to pry open or break into shells of oysters and other shellfish.	Low	Potential to fly over only. No suitable habitat.

Scientific Name	Common Name	NSW status	Commonwealth status	Habitat Description	Likely Occurrence in subject Site	Rationale for Likelihood Ranking
<i>Pluvialis squatarola</i>	Grey Plover		C,J,K	In non-breeding grounds in Australia, Grey Plovers occur almost entirely in coastal areas, where they usually inhabit sheltered embayment's, estuaries and lagoons with mudflats and sandflats, and occasionally on rocky coasts with wave-cut platforms or reef-flats, or on reefs within muddy lagoons. They also occur around terrestrial wetlands such as near-coastal lakes and swamps, or salt-lakes.	Low	Potential to fly over only. No suitable habitat..
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper		C,J,K	In Australasia, the Sharp-tailed Sandpiper prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation. This includes lagoons, swamps, lakes and pools near the coast, and dams, waterholes, soaks, bore drains and bore swamps, salt pans and hypersaline salt lakes inland.	Low	Potential to fly over only. No suitable habitat.
<i>Calidris melanotos</i>	Pectoral Sandpiper		J,K	In Australasia, the Pectoral Sandpiper prefers shallow fresh to saline wetlands. The species is found at coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands.	Low	Potential to fly over only. No suitable habitat.
<i>Gallinago hardwickii</i>	Latham's Snipe		C,J,K	In Australia, Latham's Snipe occurs in permanent and ephemeral wetlands up to 2000 m above sea-level. They usually inhabit open, freshwater wetlands with low, dense vegetation (e.g. swamps, flooded grasslands or heathlands, around bogs and other water bodies). However, they can also occur in habitats with saline or brackish water, in modified or artificial habitats, and in habitats located close to humans or human activity	Low	Insufficient habitat. Known only from limited historic records within a 10km radius
<i>Limosa lapponica</i>	Bar-tailed Godwit		C,J,K	The Bar-tailed Godwit is found mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. It is found often around beds of seagrass and, sometimes, in nearby saltmarsh. It has been sighted in coastal sewage farms and saltworks, salt lakes and brackish wetlands near coasts, sandy ocean beaches, rock platforms, and coral reef-flats.	Low	Potential to fly over only. No suitable habitat.

Scientific Name	Common Name	NSW status	Commonwealth status	Habitat Description	Likely Occurrence in subject Site	Rationale for Likelihood Ranking
<i>Numenius minutus</i>	Little Curlew		C,J,K	The Little Curlew is most often found feeding in short, dry grassland and sedgeland, including dry floodplains and blacksoil plains, which have scattered, shallow freshwater pools or areas seasonally inundated. Open woodlands with a grassy or burnt understorey, dry saltmarshes, coastal swamps, mudflats or sandflats of estuaries or beaches on sheltered coasts, mown lawns, gardens, recreational areas, ovals, racecourses and verges of roads and airstrips are also used. When resting during the heat of day, the Little Curlew congregates around pools, river beds and water-filled tidal channels, and shallow water at edges of billabongs. The species prefers pools with bare dry mud (including mudbanks in shallow water) and they do not use pools if they are totally dry, flooded or heavily vegetated.	Low	Insufficient habitat. Known only from historic records within a 10km radius. Vagrant.
<i>Tringa nebularia</i>	Common Greenshank		C,J,K	The species is known to forage at edges of wetlands, in soft mud on mudflats, in channels, or in shallows around the edges of water often among pneumatophores of mangroves or other sparse, emergent or fringing vegetation, such as sedges or saltmarsh. It will occasionally feed on exposed seagrass bed. It roosts and loafes round wetlands, in shallow pools and puddles, or slightly elevated on rocks, sandbanks or small muddy islets. Occasionally the species will perch and roost on stakes	Low	Potential to fly over only. No suitable habitat.
<i>Tringa stagnatilis</i>	Marsh Sandpiper		C,J,K	The Marsh Sandpiper usually forages in shallow water at the edge of wetlands. They probe wet mud of mudflats or feed among marshy vegetation. he Marsh Sandpiper has been recorded roosting or loafing on tidal mudflats, near low saltmarsh, and around inland swamps.	Low	Potential to fly over only. No suitable habitat.

Scientific Name	Common Name	NSW status	Commonwealth status	Habitat Description	Likely Occurrence in subject Site	Rationale for Likelihood Ranking
<i>Stercorarius pomarinus</i>	Pomarine Jaeger		C,J	Insufficient data	Low	Potential to fly over only. No suitable habitat.
<i>Onychoprion fuscata</i>	Sooty Tern	V		The Sooty Tern is found over tropical and sub-tropical seas and on associated islands and cays around Northern Australia. In NSW only known to breed at Lord Howe Island. Occasionally seen along coastal NSW, especially after cyclones.	Low	Potential to fly over only. No suitable habitat.
<i>Sterna hirundo</i>	Common Tern		C,J,K	Common Terns are marine, pelagic and coastal. In Australia, they are recorded in all marine zones, but are commonly observed in near-coastal waters, both on ocean beaches, platforms and headlands and in sheltered waters, such as bays, harbours and estuaries with muddy, sandy or rocky shores.	Low	Potential to fly over only. No suitable habitat.
<i>Sternula albifrons</i>	Little Tern	E	C,J,K	In NSW, it arrives from September to November, occurring mainly north of Sydney. Nests in small, scattered colonies in low dunes or on sandy beaches just above high tide mark near estuary mouths or adjacent to coastal lakes and islands. Often seen feeding in flocks, foraging for small fish, crustaceans, insects, worms and molluscs by plunging in the shallow water of channels and estuaries, and in the surf on beaches, or skipping over the water surface with a swallow-like flight.	Low	Potential to fly over only. No suitable habitat.

Scientific Name	Common Name	NSW status	Commonwealth status	Habitat Description	Likely Occurrence in subject Site	Rationale for Likelihood Ranking
<i>Calyptrorhynchus lathamii</i>	Glossy Black-Cockatoo	V		Inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of she-oak occur. Black She-oak (<i>Allocasuarina littoralis</i>) and Forest She-oak (<i>A. torulosa</i>) are important foods. Feeds almost exclusively on the seeds of several species of she-oak (<i>Casuarina</i> and <i>Allocasuarina</i> species), shredding the cones with the massive bill. Dependent on large hollow-bearing eucalypts for nest sites	Low	Less than ideal habitat, though some potential foraging sites may occur in surrounding area. No recent proximal records. Likely extinct in this part of Sydney.
<i>Lathamus discolor</i>	Swift Parrot	E	E	Migrates to the Australian south-east mainland between March and October. On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Favoured feed trees include winter flowering species such as Swamp Mahogany <i>Eucalyptus robusta</i> , Spotted Gum <i>Corymbia maculata</i> , Red Bloodwood <i>C. gummifera</i> , Mugga Ironbark <i>E. sideroxylon</i> , and White Box <i>E. albens</i> .	Low-Moderate	Potential to fly over only. No suitable habitat.

Scientific Name	Common Name	NSW status	Commonwealth status	Habitat Description	Likely Occurrence in subject Site	Rationale for Likelihood Ranking
<i>Ninox strenua</i>	Powerful Owl	V		The Powerful Owl requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. It roosts by day in dense vegetation comprising species such as Turpentine Syncarpia glomulifera, Black She-oak Allocasuarina littoralis, Blackwood Acacia melanoxylon, Rough-barked Apple Angophora floribunda, Cherry Ballart Exocarpus cupressiformis and a number of eucalypt species. The main prey items are medium-sized arboreal marsupials, particularly the Greater Glider, Common Ringtail Possum and Sugar Glider. There may be marked regional differences in the prey taken by Powerful Owls.	Moderate	Potential to fly over or temporarily perch only. No suitable foraging, roosting or breeding habitat.
<i>Epthianura albifrons</i>	White-fronted Chat	V		Found mostly in temperate to arid climates and very rarely sub-tropical areas, it occupies foothills and lowlands up to 1000 m above sea level. In NSW, it occurs mostly in the southern half of the state, in damp open habitats along the coast, and near waterways in the western part of the state. Along the coastline, it is found predominantly in saltmarsh vegetation but also in open grasslands and sometimes in low shrubs bordering wetland areas.	Low	No suitable habitat.

Scientific Name	Common Name	NSW status	Commonwealth status	Habitat Description	Likely Occurrence in subject Site	Rationale for Likelihood Ranking
<i>Epthianura albifrons</i>	White-fronted Chat population in the Sydney Metropolitan Catchment Management Area	E		Two isolated sub-populations of White-fronted Chats are currently known from the Sydney Metropolitan Catchment Management Authority (CMA) area; one at Newington Nature Reserve on the Parramatta River and one at Towra Point Nature Reserve in Botany Bay.	Low	No suitable habitat.
<i>Petroica boodang</i>	Scarlet Robin	V		The Scarlet Robin lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs. This species lives in both mature and regrowth vegetation. It occasionally occurs in mallee or wet forest communities, or in wetlands and tea-tree swamps. Scarlet Robin habitat usually contains abundant logs and fallen timber: these are important components of its habitat.	Low	No suitable habitat.
<i>Stagonopleura guttata</i>	Diamond Firetail	V		Not commonly found in coastal districts, though there are records from near Sydney, the Hunter Valley and the Bega Valley. This species has a scattered distribution over the rest of NSW. Found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum Eucalyptus pauciflora Woodlands. Also occurs in open forest, mallee, Natural Temperate Grassland, and in secondary grassland derived from other communities. Often found in riparian areas (rivers and creeks), and sometimes in lightly wooded farmland.	Negligible	No suitable habitat.. Extinct in this part of Sydney.
Mammals						

Scientific Name	Common Name	NSW status	Commonwealth status	Habitat Description	Likely Occurrence in subject Site	Rationale for Likelihood Ranking
<i>Dasyurus maculatus</i>	Spotted-tailed Quoll	V	E	Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline.	Low-moderate	Only a single record within a 10km radius of the Subject Site. The size of the subject site is likely to be insufficient to support required foraging and breeding habitat as the site is isolated and lacking in habitat structure.
<i>Dasyurus viverrinus</i>	Eastern Quoll	E	CE	Highly flexible habitat selection, occurring in dry sclerophyll forest, scrub, heathland, pastures and even cultivated land. Opportunistic carnivore with insects as it's most important prey. Capable of taking prey nearly as large as itself. Home ranges vary between sexes and are dependent on habitat quality. In fertile habitats females restrict their movements to a few hundred metres surrounding their dens because prey are plentiful. Males often travel over a kilometre in a night, familiarising themselves with local mates	Negligible	No verified sightings of this species have occurred in NSW since 1963. Presumed extinct.
<i>Aepyprymnus rufescens</i>	Rufous Bettong	V		The original range from Coen in north Queensland to central Victoria has been reduced to a patchy distribution from Cooktown, Queensland, to north-eastern NSW as far south as Mt Royal National Park. In NSW it has largely vanished from inland areas but there are sporadic, unconfirmed records from the Pilliga and Torrington districts.	Negligible	Subject site is well outside of known or predicted range.
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V	V	Grey-headed Flying-foxes are generally found within 200 km of the eastern coast of Australia. Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy.	High	Known to frequent the surrounding area for foraging purposes. Known from recent observation records. No suitable habitat within proposed walking track impact area.

Scientific Name	Common Name	NSW status	Commonwealth status	Habitat Description	Likely Occurrence in subject Site	Rationale for Likelihood Ranking
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing-bat	V		Eastern Bentwing-bats occur along the east and north-west coasts of Australia. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. Form discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young.	Moderate	No previous records within a 5km radius to the subject site. No suitable habitat within proposed impact area.
<i>Myotis macropus</i>	Southern Myotis	V		The Southern Myotis is found in the coastal band from the north-west of Australia, across the top-end and south to western Victoria. Generally roost in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage. Forage over streams and pools catching insects and small fish by raking their feet across the water surface.	Moderate	No previous records within a 5km radius to the subject site. No suitable habitat within proposed impact area.
<i>Dugong dugon</i>	Dugong	E		Major concentrations of Dugongs occur in wide shallow protected bays, wide shallow mangrove channels and in the lee of large inshore islands. Will also occupy deeper waters if their sea grass food is available.	Negligible	No suitable habitat.
<i>Arctocephalus forsteri</i>	New Zealand Fur-seal	V		Occurs in Australia and New Zealand. Reports of non-breeding animals along southern NSW coast particularly on Montague Island, but also at other isolated locations to north of Sydney.	Negligible	No suitable habitat.
<i>Arctocephalus pusillus doriferus</i>	Australian Fur-seal	V		Reported to have bred at Seal Rocks, near Port Stephens and Montague Island in southern NSW. Haul outs are observed at isolated places along the NSW coast. Prefers rocky parts of islands with flat, open terrain	Negligible	No suitable habitat.

Scientific Name	Common Name	NSW status	Commonwealth status	Habitat Description	Likely Occurrence in subject Site	Rationale for Likelihood Ranking
<i>Eubalaena australis</i>	Southern Right Whale	E	E	Temperate and subpolar waters of the Southern Hemisphere, with a circumpolar distribution between about 20°S and 55°S with some records further south to 63°S.	Negligible	No suitable habitat.
<i>Megaptera novaeangliae</i>	Humpback Whale	V	V	Oceanic and coastal waters worldwide	Negligible	No suitable habitat.

Threatened Flora Occurrence Likelihood Table. List Generated through Bionet Search of records within a 10km radius centred on subject site.

Scientific Name	Common Name	NSW status	Commonwealth status	Likely Occurrence in subject Site	Rationale for Likelihood Ranking	Habitat Description
<i>Allocasuarina portuensis</i>	Nielsen Park She-oak	E	E	Low	Potential habitat found locally. Not known from subject site.	The original habitat is tall closed woodland. Known original distribution is restricted to Nielsen Park, in Woollahra local government area. The original habitat occurs above a sandstone shelf approximately 20 m above the harbour. The shallow sandy soils are highly siliceous, coarsely textured and devoid of a soil profile. The plantings have occurred on similar soils. There are no plants left at the original site where it was discovered.
<i>Hibbertia puberula</i>		E		Low	Known from a historical record in an area adjacent to subject site. No recent records.	Habitats are typically dry sclerophyll woodland communities, although heaths are also occupied. It favours low heath on sandy soils or rarely in clay, with or without rocks underneath. Early records of this species are from the Hawkesbury River area and Frenchs Forest in northern Sydney, South Coogee in eastern Sydney, the Hacking River area in southern Sydney, and the Blue Mountains. Recent work on this species have shown it to be widespread, but never common.
<i>Amperea xiphoclada</i> var. <i>pedicellata</i>		E	X	Negligible	Presumed extinct	<i>Amperea xiphoclada</i> var. <i>pedicellata</i> is known only from the type specimen collected in 1892 from Sydney, NSW. The species has not been observed since and is presumed to be extinct. previously widespread in heath, woodland and forest in low-fertility, sandy soils
<i>Acacia terminalis</i> subsp. <i>terminalis</i>	Sunshine Wattle	E	E	Moderate	Recent records within the area surrounding subject site. Not present during the survey period but may occur on site in future.	Very limited distribution, mainly in near-coastal areas from the northern shores of Sydney Harbour south to Botany Bay, with most records from the Port Jackson area and the eastern suburbs of Sydney. Coastal scrub and dry sclerophyll woodland on sandy soils. Habitat is generally sparse and scattered. Most areas of habitat or potential habitat are small and isolated.

Scientific Name	Common Name	NSW status	Commonwealth status	Likely Occurrence in subject Site	Rationale for Likelihood Ranking	Habitat Description
<i>Callistemon linearifolius</i>	Netted Bottlebrush	V		Low	Targeted survey was undertaken with no evidence of the species found within the subject site or surrounding area.	The specie is known from only a few populations which are found in the Northern Beaches LGA, however it is known to grow in dry sclerophyll forest on the coast and adjacent ranges.
<i>Prostanthera marifolia</i>	Seaforth Mintbush	E	CE	Negligible	Subject Site is outside of known or predicted range.	Currently only known from the northern Sydney suburb of Seaforth and has a very highly restricted distribution within the Sydney Basin Bioregion. Occurs in localised patches in or in close proximity to the endangered Duffys Forest ecological community. Located on deeply weathered clay-loam soils associated with ironstone and scattered shale lenses, a soil type which only occurs on ridge tops and has been extensively urbanised.
<i>Eucalyptus nicholii</i>	Narrow-leaved Black Peppermint	V	V	Planted - out of range only ornamentals only.	Subject Site is outside of known or predicted range.	This species is sparsely distributed but widespread on the New England Tablelands from Nundle to north of Tenterfield. Typically grows in dry grassy woodland, on shallow soils of slopes and ridges. Found primarily on infertile soils derived from granite or metasedimentary rock
<i>Eucalyptus scoparia</i>	Wallangarra White Gum	E	V	Planted - out of range only ornamentals only.	No suitable habitat. Subject Site is outside of known or predicted range.	Found in open eucalypt forest, woodland and heaths on well-drained granite/rhyolite hilltops, slopes and rocky outcrops, typically at high altitudes.
<i>Melaleuca deanei</i>	Deane's Paperbark	V	V	Low	Little suitable habitat. No proximal records..	The species occurs mostly in ridgetop woodland, with only 5% of sites in heath on sandstone.
<i>Syzygium paniculatum</i>	Magenta Lilly Pilly	E	V	Moderate	Recent records within the area surrounding subject site. Not present during the survey period but may	Found only in NSW, in a narrow, linear coastal strip from Upper Lansdowne to Conjola State Forest. On the south coast the Magenta Lilly Pilly occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforest. On the central coast Magenta Lilly Pilly occurs on

Scientific Name	Common Name	NSW status	Commonwealth status	Likely Occurrence in subject Site	Rationale for Likelihood Ranking	Habitat Description
					occur on site in future.	gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities.
<i>Diuris arenaria</i>	Sand Double-tail	E		Negligible	No suitable habitat. Subject Site is outside of known or predicted range.	This species occurs in coastal heath and dry grassy eucalypt forest on sandy flats. Grows in gently undulating country in eucalypt forest with a grassy understorey on clay soil. Known to occur only north of Newcastle
<i>Dichanthium setosum</i>	Bluegrass	V	V	Negligible	No suitable habitat. Subject Site is outside of known range.	Associated with heavy basaltic black soils and red-brown loams with clay subsoil. Known to occur in the New England Tablelands, North West Slopes and Plains and the Central Western Slopes of NSW, extending to northern Queensland.
<i>Persoonia hirsuta</i>	Hairy Geebung	E	E	Moderate	Recent records within the area surrounding subject site. Not present during the survey period but may occur on site in future.	Scattered distribution around Sydney. The species is distributed from Singleton in the north, along the east coast to Bargo in the south and the Blue Mountains to the west. Despite a large area of occurrence, this species occurs in small populations, or as isolated individuals increasing the species' fragmentation in the landscape. It can be found in sandy soils in dry sclerophyll open forest, woodland and heath on sandstone.

Appendix 4 – Biodiversity credit report

Biodiversity credit report



This report identifies the number and type of biodiversity credits required for a major project.

Date of report: 1/03/2017

Time: 10:36:22AM

Calculator version: v4.0

Major Project details

Proposal ID:	224/2017/4217MP
Proposal name:	UNSW Cliffbrook Campus Redevelopment
Proposal address:	45-51 Beach Street Coogee NSW 2034
Proponent name:	University of NSW
Proponent address:	45-51 Beach Street Coogee NSW 2034
Proponent phone:	(02) 9385 2172
Assessor name:	Kurtis Lindsay
Assessor address:	PO Box 406 Mona Vale NSW 2103
Assessor phone:	9986 1295
Assessor accreditation:	224

Summary of ecosystem credits required

Plant Community type	Area (ha)	Credits created
Heath-leaved Banksia - Scrub She-oak heath on sandstone headlands in the Sydney basin	0.03	0.42
Total	0.03	0

Credit profiles

1. Heath-leaved Banksia - Scrub She-oak heath on sandstone headlands in the Sydney basin, (ME101)

Number of ecosystem credits created

0

IBRA sub-region

Pittwater (Part B)

Offset options - Plant Community types	Offset options - IBRA sub-regions
Heath-leaved Banksia - Scrub She-oak heath on sandstone headlands in the Sydney basin, (ME101)	Pittwater (Part B) and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

Summary of species credits required



NARLA
environmental

Biodiversity Management Plan

Redevelopment of UNSW Cliffbrook Campus

45-51 Beach Street, Coogee

State Significant Development Application (SSD 8126)

Revision B

Date: 16/08/17



NARLA

environmental

Prepared for: University of New South Wales

Prepared by: Narla Environmental Pty Ltd

Project no: unsw2

Date: 16/08/2017

Version: Final Revision B

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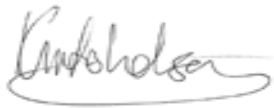
Report Certification

Works for this report were undertaken by:

Name	Company / Position	Role
Kurtis Lindsay BSc (Hons)	Narla Environmental – Principal Ecologist	Project Management, Co-author, Document Review
Emily Strautins BSc (Hons)	Narla Environmental – Ecologist	Field Ecologist, Co-author

As Principal of Narla Environmental Pty Ltd I, Kurtis Lindsay, certify that:

- This report has been prepared in accordance with the brief provided by the client.
- The information presented in this report is a true and accurate record of the study findings in the opinion of the authors.



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Glossary and abbreviations

ACRONYM	DESCRIPTION
BAR	Biodiversity Assessment Report
BioMetric	Refers to the State Government devised methodology for vegetation assessment
BMP	Biodiversity Management Plan
BCC	Bio-banking Credit Calculator
DPE	NSW Department of Planning and Environment
Subject site	UNSW Cliffbrook Campus, 45-51 Beach Street, Coogee, 2034
EEC	Endangered Ecological Community
EPBC Act	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
ESBS	Eastern Suburbs Banksia Scrub
FBA	Framework for Biodiversity Assessment
IBRA	Interim Bio-regionalisation of Australia
LGA	Local Government Area
LPI	Land and Property Information
OEH	NSW Office of Environment and Heritage
PCT	Plant Community Type
SEARs	Secretary's Environmental Assessment Requirements
SSD	State Significant Development
m	Metres
km	Kilometres
ha	Hectares
TSC Act	NSW <i>Threatened Species Conservation Act 1995</i>
UNSW	The University of New South Wales

1.Introduction

1.1 Background and Project Proposal

Narla Environmental Pty Ltd was engaged by The University of New South Wales (UNSW) Planning and Development Facilities Management, to prepare this Biodiversity Management Plan (BMP) for the Cliffbrook Campus, 45-51 Beach Street Clovelly (the 'subject site'). The BMP has been developed as a guide for the mitigation of impacts associated with the redevelopment of the campus and installation of a walkway within the subject site. This BMP provides site specific requirements and recommendations to maintain and enhance biodiversity on the Cliffbrook Campus and the surrounding locality.

The primary objective of this BMP is the restoration of native vegetation and habitat enhancement for native fauna. Works described in this report address the entire subject site; however, focus is given to the eastern half of the Campus, the 'bushland areas', which include existing native vegetation and surrounding exotic lawn that is proposed for revegetation. The BMP also provide recommendations for protecting and enhancing biodiversity values within the western half of the subject site (the 'built' areas) which prior to development encompassed ornamental gardens (The Ents 2016, FJMT 2016) .

This BMP is intended to operate in conjunction with and inform the Landscape Plan designed by FMJT Studio (2016).

1.2 Aims and Objectives

The primary objective of this BMP is to enhance the onsite biodiversity at the Cliffbrook Campus. Specific aims will be to mitigate the impact on native vegetation and its value as habitat for fauna associated with the proposed development. This is to be achieved through:

- Mitigating the impact associated with the construction of a walkway through native bushland.
- Enhancing or retaining the same habitat value for native wildlife across the entire subject site.
- Management and removal of exotic plants, including noxious and environmental weeds.
- Facilitating an increase in the extent of locally indigenous native vegetation on the Cliffbrook Campus.
- Restoring elements of Eastern Suburbs Banksia Scrub to areas where it is considered to have formerly occurred (north of the existing vegetation remnant)



Figure 1. The Subject Site, demonstrating proposed development footprint and mapped vegetation distribution

2. Site Description

2.1 Existing Vegetation Communities

Site surveys by Narla Ecologists conducted on the 7th and 9th of February 2017 determined the vegetation which made up the bushland patch on the subject site was dominated by native flora, interspersed with weed infestations (Narla 2017). The flora assemblage was influenced by a history of disturbance, including clearing, urbanisation and introduction of exotic species. Bushcare groups had also influenced the site through historic and ongoing weed removal and revegetation works (RCC 2015).

The native vegetation in the subject site displayed floristic and structural variation across its extent. The variations in soil and local geology suggest that the northern (developed) portion of the subject site and adjoining residential area may once have supported a transitional zone between the two closely related vegetation communities: Eastern suburbs Banksia Scrub (ESBS) and Coastal Headland Heath, however the site was confirmed to now only support the latter. A band of deep, podsolised soil occurs where the lawn area meets the remnant vegetation patch. Tall Coastal Banksia grow in this area; however, the disturbed nature of the site has significantly altered the floristic assemblage making it non-reflective of ESBS. This area is narrow and interrupted by an abrupt, exposed outcrop of Hawkesbury Sandstone. The majority of the native vegetation on the subject site was growing in shallow, sandy soils, perched on Hawkesbury Sandstone. Sandstone was exposed over much of the patch, including the northern most limits. Dominance of 'maritime shrubs' such as Coastal Rosemary (*Westringia fruticosa*), White Correa (*Correa alba*) and Heath Myrtle (*Baeckea imbricata*) indicated a characteristic Coastal Headland Heath vegetation community throughout the patch (OEH 2013; OEH 2011).

Further analysis of the vegetation plots revealed the vegetation of the subject site correlated more strongly with Coastal Headland Banksia Heath, a non-threatened vegetation community that shares floristic elements with ESBS. The Coastal Headland Banksia Heath vegetation supported low-lying maritime shrubs including Coastal Rosemary (*Westringia fruticosa*), White Correa (*Correa alba*) and Heath Myrtle (*Baeckea imbricata*), which are key distinguishing features between ESBS and coastal heathland communities (OEH 2013; OEH 2011). The presence of skeletal soils and exposed Hawkesbury sandstone provided further evidence to support the identification of this vegetation community.

Exotic vine and woody weed cover was found across the subject site in varying density. The extensive urban interface has promoted 'edge effects' on across the subject site. Garden escapees and herbaceous exotics were observed to have colonised both the ornamental gardens and of the native vegetation patch.

Table 1. Nomenclature of the single vegetation community within the subject site

Common Name	Total Extent on Subject Site	Sydney Metropolitan Vegetation Type	NSW Plant Community Type	BioMetric Vegetation Type
Coastal Headland Banksia Heath	0.40 ha	H_L06 Coastal Headland Banksia Scrub	PCT 1822: Heath-leaved Banksia - Scrub She-oak heath on sandstone headlands in the Sydney basin	ME101

2.2 Threatened Species

Targeted threatened flora searches were performed for species with likelihood to occur within the subject site:

- Magenta Lilly Pilly (*Syzygium paniculatum*)
- Sunshine Wattle (*Acacia terminalis* subsp. *terminalis*)
- Netted Bottle Brush (*Callistemon linearifolius*)

Each of these species is suited to the habitat conditions found within the subject site, however active targeted surveys were undertaken for each of these three species by an experienced Narla Ecologist (Emily Strautins) on 20th of June 2016 and 9th of February 2017.

Further survey for threatened flora were undertaken during the assessment of the four vegetation plots that were spread across the vegetation patch by both Emily Strautins and experienced local Restoration Ecologist Dean Sugden on the 7th and 9th of February 2017.

Despite thorough in-field searches, no flora species of conservation significance listed under either "Rare or Threatened Australian Plants" (RoTAP) (Briggs and Leigh 1996), TSC Act or EPBC Act were confirmed on or immediately adjacent the subject site.

2.3 Environmental and Noxious Weeds

Field survey identified sixty-five environmental weeds and four noxious weeds within the Cliffbrook Campus (**Table 2**). Additionally, seven species of these species were listed as undesirable within the LGA in the Randwick DCP.

Of particular concern were exotic vine infestations which were abundant and evidently posing a risk of smothering a number of native shrubs. Cape Ivy (*Delairea odorata*) was particularly dominant, though significant environmental weed species Turkey Rhubarb (*Acetosa sagittata*) and Madeira vine (*Anredera cordifolia*) were also prevalent.

Dense, though isolated patches of woody weed species were also observed, including noxious species Lantana (*Lantana camara*), Bitou Bush (*Chrysanthemoides monilifera rotundata*) and Green Cestrum (*Cestrum parqui*). Mirror Bush (*Coprosma repens*) was also present near the eastern boundary, associated with localised erosion issues.

Ground Asparagus (*Asparagus aethiopicus*) was the third noxious weed identified within the subject site. This species was rarely observed, with specimens mainly immature.

Table 2. Noxious and environmental weeds identified within the subject site

Scientific Name	Common Name	Non-local natives	Exotic Species	WM Act Noxious	Randwick DCP
<i>Acetosa sagittata</i>	Turkey Rhubarb		x		
<i>Ageratina adenophora</i>	Crofton Weed		x		
<i>Anagallis arvensis</i>	Scarlet Pimpernel		x		
<i>Anredera cordifolia</i>	Madeira Vine		x		
<i>Araucaria heterophylla</i>	Norfolk Island Pine	x			
Asparagus aethiopicus	Ground Asparagus		x	4	
<i>Asteraceae sp.</i>			x		
<i>Bidens pilosa</i>	Cobblers Pegs		x		
<i>Bromus catharticus</i>	Prairie Grass		x		
<i>Celtis occidentalis</i>	Hackberry		x		Undesirable
Cestrum parqui	Green Cestrum		x	3	
<i>Chlorophytum comosum</i>					
Chrysanthemoides monilifera rotundata	Bitou Bush			3	
<i>Cinnamomum camphora</i>	Camphor Laurel		x		Undesirable
<i>Conyza bonaerensis</i>	Conyza		x		
<i>Coprosma repens</i>	Mirror Bush		x		
<i>Crocosmia x crocosmiiflora</i>			x		
<i>Cynadon dactylon</i>	Common Couch	x			
<i>Cyperus eragrostis</i>	Umbrella Sedge		x		
<i>Cyperus involucratus</i>	Umbrella Sedge		x		
<i>Cyrtomium falcatum</i>	Holly Fern		x		
<i>Delairea odorata</i>	Cape Ivy		x		
<i>Digitaria sanguinalis</i>	Summer Grass				
<i>Dypsis decaryi</i>	Triangle Palm		x		
<i>Ehrharta erecta</i>	Bird Seed Grass		x		
<i>Eleusine indica</i>	Crow's Foot Grass		x		
<i>Eragrostis curvula</i>	African Lovegrass		x		
<i>Euphorbia peplus</i>	Petty Spurge		x		
<i>Ficus lyrata</i>	Fiddle Leaf Fig		x		
<i>Fraxinus raywoodii</i>	Claret Ash		x		
<i>Galinsoga parviflora</i>	Potato Weed		x		
<i>Gamochaeta calviceps</i>	Cudweed		x		
<i>Howea forsteriana</i>	Kentia Palm	x			
<i>Hymenosporum flavum</i>	Native Frangipani	x			
<i>Hypochaeris glabra</i>	Cat's Ear		x		
<i>Lagunaria patersonii</i>	Norfolk Island Hibiscus	x			Undesirable
Lantana camara	Lantana		x	4	

Scientific Name	Common Name	Non-local natives	Exotic Species	WM Act Noxious	Randwick DCP
<i>Lonicera japonica</i>	Japanese Honeysuckle		x		
<i>Magnolia grandiflora</i>	Bull magnolia		x		Undesirable
<i>Modiola caroliniana</i>	Red Flowered Mallow		x		
<i>Morus sp.</i>	Mulberry		x		Undesirable
<i>Nephrolepis cordiflora</i>	Fishbone Fern	x	x		
<i>Nerium oleander</i>	Oleander		x		Undesirable
<i>Northoscordum borbonicum</i>	False Onion Weed		x		
<i>Ochna serrulata</i>	Mickey Mouse Plant		x		
<i>Olea europaea subsp. cuspidata</i>	African Olive		x		
<i>Parietaria judaica</i>	Asthma Weed		x		
<i>Phoenix canariensis</i>	Canary Island Date Palm	x			
<i>Phyllanthus tenellus</i>	Hen and chicken		x		
<i>Polygala myrtifolia</i>	Myrtle-leaf Milkwort		x		
<i>Portulaca oleracea</i>	Pigweed				
<i>Schefflera actinophylla</i>	Umbrella Tree	x	x		Undesirable
<i>Setaria parviflora</i>	Pigeon Grass		x		
<i>Sida rhombifolia</i>	Paddy's Lucerne		x		
<i>Solanum nigrum</i>	Black Nightshade		x		
<i>Solanum seaforthianum</i>	Brazilian Nightshade		x		
<i>Sonchus oleraceus</i>	Sonchus				
<i>Stenotaphrum secundatum</i>	St. Augustine Grass				
<i>Strelitzia reginae</i>	Bird of Paradise		x		
<i>Syagrus romanzoffiana</i>	Cocos palm		x		
<i>Tradescantia fluminensis</i>	Trad		x		
<i>Ulmus parvifolia</i>	Chinese Elm		x		
<i>Zantedeschia aethiopica</i>	Arum Lily		x		
<i>Zelkova serrata</i>	Japanese Elm		x		

2.4 Environmental Management Issues

- The shallow, sandy soils are easily subject to erosion from water and wind movement if exposed.
- Unauthorised thoroughfare through bushland (off track).
- Unauthorised poisoning, trimming and felling of trees and shrubs from the bushland patch.
- Unauthorised planting of garden plants within the Cliffbrook Campus.
- Unauthorised dumping of green waste, allowing the introduction of weed propagules and damage to native vegetation.
- Colonisation of 'escaped garden plants' in bushland patch.
- Phytophthora, Myrtle rust and Chytrid fungus are environmental pathogens which are not yet evident within the subject site. These pathogens have been listed as 'Key Threatening Processes' (KTP) under the TSC Act, and are easily spread through infected soil.

Matters not requiring Additional Attention

- No acid sulphate soils (ASS) were identified within the subject site or within any directly adjacent areas.
- The subject site is not mapped as bushfire prone land.
- The subject site does not contain any waterways or riparian zones.

2.5 Management Zones

Work zones to which this BMP applies represent three regions, each with distinct requirements and objectives, as summarised in **Table 3**. Zones and vegetation referred to within this table are illustrated in **Figure 2**.

Table 3. Biodiversity Management Zones across the subject site

Work Zone	Description	Objectives	Management Issues
<u>Zone 1</u> Bushland	Intact bushland east of the dividing fence line which extends to lot boundaries to the east, north and south incl. adjacent lawn and Coastal Headland Heath	Extend area of native of vegetation through revegetation works. Enhance biodiversity incl. increasing species richness and fauna habitat potential	▪ Weed infestation/ infiltration ▪ Erosion and stormwater washout ▪ Establishment of low impact walkway
<u>Zone 2</u> Garden Bed and Recreational Lawn	Green space which contains a mix of native and exotic vegetation situated within 'built' areas	Maintain (or increase) existing potential for fauna habitat Allow for redevelopment works	▪ Located in close vicinity to redevelopment works
<u>Zone 3</u> Coastal Banksia/ Tick Bush Patch	Isolated patch of indigenous vegetation, contiguous with Coastal Headland Banksia Heath, found on the northern boundary within the built region of the subject site	Protect and enhance native vegetation during and post construction works	▪ Located in close vicinity to major elements of redevelopment works ▪ Existing exotic vegetation



Figure 2. Management zones

3. Recommended Management Actions

3.1 Pre-construction Phase

Any trees not scheduled for removal must be protected by suitable Tree Protection Zones (TPZ) established prior to the commencement of any other works (The Ents 2016). A guide for appropriate size of TPZ must be supplied by a qualified arborist.

Prior to any vegetation clearing or construction works it is recommended that best practice erosion and sedimentation mitigation measures are installed as per the provisions of 'The Blue Book' (Landcom 2004). Maintain erosion and sedimentation measures, and monitor for signs of any erosion/sedimentation throughout construction phase.

If topsoil stripping is required, ensure any topsoil stripped from bushland areas is stockpiled following best practice methodology to retain topsoil biota and seedbank. Areas of topsoil stripped from non-bushland areas will not require the same level of care when stockpiling.

Select storage, stockpiling and laydown sites away from native vegetation. Preferably locate these sites in areas that are cleared or paved.

Zone 1

A combined pre-clearing and micro-sighting survey is recommended to minimise ecological impact of the proposed walkway. This must be undertaken by a qualified Ecologist, no more than one week prior to any proposed vegetation clearing or removal works.

The pre-clearing assessment will allow identification of any habitat containing fauna which may be harmed during the clearing process, such as cavernous rock outcrops, soaks, culverts (possible microbat roosts) and birds' nests. Prevention of harm to native fauna is a requirement of the *Prevention of Cruelty to Animals Act 1979* and the *NSW National Parks and Wildlife Act 1974*. Avoidance of ecological features may involve shifting the walkway within the assessed corridor; however alterations should not exceed 1m. Where works are predicted to directly impact or occur within close vicinity of sandstone outcropping or native vegetation an Ecologist must be contacted and may be required to return to site to supervise works.

Micro-siting the finalised route of the pathway will further ensure that the integrity of the bushland is retained. Of specific importance is the need to retain mature stands of native trees, specifically Heath-leaved Banksia, Coastal Banksia, Sydney Red Gum, any *Eucalyptus spp.* and large specimens of Coastal Teatree. These trees take long time to mature and provide among the more significant fauna habitat values in the bushland patch. If deemed necessary during micro-siting the route of walkway may be altered by a maximum of 1m. The finalised location of walkway should be clearly delineated from surrounding vegetation with TPZ and erosion control measures established.

Zone 2

Any trees not scheduled for removal must be protected by suitable Tree Protection Zones (TPZ) established prior to the commencement of any other works (The Ents 2016). A guide for appropriate size of TPZ must be supplied by a qualified arborist.

Fauna may inhabit tree hollows, buttresses, bark crevices and nests in the canopy of trees as well as culverts within the built region of the subject site. Therefore prior to the removal of any trees or demolition works a Qualified Ecologist is required to inspect potential habitat no more than one week prior to clearing for signs of inhabitant fauna. Any tree felling or lopping works must be undertaken by a qualified arborist with an Ecologist present to capture and relocate any displaced fauna. If any injured or sensitive fauna is found the Ecologist must be contacted to safely capture and transport the fauna to a registered wildlife carer.

Zone 3

Vegetation within this zone has been scheduled for retention and protection. As such prior to commencement of development works, this region must be clearly delineated and TPZ erected. Protected areas should encompass sandstone retaining walls, to ensure subsidence of the supporting garden bed does not undermine the viability of the zone.

3.2 Construction Phase

A basic hygiene protocol should be established to prevent the spread of weed propagules and environmental pathogens inadvertently to the site. Basic principles include avoiding transport of soil onto and off site by cleaning all work clothing, gloves, tools and machinery. In some cases, a solution of 70% ethanol or methylated spirits in 30% water may be sufficient to disinfect equipment prior to use.

The report, 'Arrive Clean, Leave Clean' (Commonwealth of Australia 2015) provides detailed information on best practice methods to reduce spread of these pathogens between work sites.

Zone 1

A fence is proposed mid-way through the site and will provide a clear boundary between the campus and the revegetation / coastal foreshore zone. Fences must not impede fauna movement and no barbed wire or similar material is to be used. The Landscape Schematic Design provides detail of proposed fencing that is to be retained, replaced or established across the subject site (FJMT 2016a).

In some areas establishment of dense native plantings around the boundaries of lawn and bushland may also provide suitable barriers for human traffic to maintain the integrity of these areas. Suitable plantings for screens include, locally indigenous, dense fast growing, impenetrable shrubs such as *Lomandra longifolia* and *Hakea teretifolia*.

Any construction, machinery operation, excavation, vehicle movement and other works that occur within the bushland area of the subject site should (as much as practicable) avoid impact to sandstone outcropping.

Particular consideration of soil and site stability is recommended within bushland regions as the soil layer is shallow and highly prone to erosion. For this reason, it is advised that clearing should be undertaken by manual means only and no excavation equipment or other plant should be used on the slope. Furthermore, it is recommended that works is carried out progressively from the upper to lower slope. This will help to stabilise soil and will prevent reinfestation of exotics via downslope seed migration. In areas containing existing erosion problem areas, staging of works to manage high erosion areas should proceed as follows:

- primary removal of exotic weed species cover;
- installation of erosion-control coir-log terracing where required;
- thorough secondary control of remerging exotic weed species;
- installation of a deep mulch layer to prepared site;
- revegetation of prepared and mulched area with provenance native plant stock;
- establishment and maintenance of installed plants;
- ongoing weed maintenance.

Zone 2 and 3

Work zones must be maintained away from vegetation or identified habitat features which have been scheduled for retention.

In the event that any injured or sensitive fauna is observed, the Ecologist must be immediately contacted for advice. When required the Ecologist will be also attend site to safely capture and transport wildlife to a registered wildlife carer.

3.3 Post-Construction

This BMP identifies and details selected areas for native bush regeneration within Zone 1. Replacement plantings may also occur anywhere on campus, as determined within the Landscape Plans (FJMT 2016).

New plantings, particularly those located within close proximity to existing native vegetation are recommended to only contain locally indigenous species, sympathetic to the indigenous vegetation type that originally occurred at the location, both:

- Eastern Suburbs Banksia Scrub (higher elevations/northern end of subject site) or
- Coastal Headland Banksia Heath (lower elevations/southern end of subject site)

All plants must be sourced from known provenance stock collected from within a maximum distance of 20 kilometres from the subject site. This document contains detailed lists of appropriate species suggested for use within the subject site (**Table 8**). Planting of medium sized shrubs is recommended as an important element to provide soil stabilisation and privacy screening for adjoining houses. However, no trees or shrub species likely to exceed a height of 2.5m or above are to be used in 'screening zone' as tall plants may impede outlooks of residents and campus users.

Habitat may be further enhanced through the installation of nest boxes of sizes relevant for locally occurring, native fauna including microbats and Ring-tailed Possum.

Zone 1

It is recommended that all noxious weeds on site are continually removed and suppressed, with the aim of eventual eradication across the subject site. This is a requirement of the landholder (UNSW) under the *Noxious Weeds Act 1993* (NW Act). All Noxious weeds and Randwick council declared 'undesirable' weeds on the subject site should be removed. Some weeds including Privet (*Ligustrum sp.*) may currently provide, prey, nectar, fruit or shelter for fauna such as birds and intermittently by Grey-headed Flying Fox.

Progressive weed removal should take place in tandem with replacement with an ecological equivalent indigenous native flora species. This is especially important since the vegetation patch at the subject site is believed to have low restoration resilience with minimal, natural seedbank. Revegetation works are recommended to focus along the northern boundary of Zone 1, to increase extent of native vegetation into areas previously occupied by exotic turf (FJMT 2016). The installation of native vegetation within this area will provide an opportunity to increase local biodiversity whilst mitigating the loss of vegetation from the footprint of the proposed walkway.

Qualified Bush Regeneration specialists should support natural regeneration of native vegetation through scalping and direct seeding; reducing the cost of planting tube stock (DECC2009). If plantings are to take place within remnant vegetation, effort must be made to ensure species chosen are known to occur naturally within the respective vegetation community.

Council-funded / volunteer Bushcare teams should be encouraged to continue working in and around the Cliffbrook Campus bushland areas. The proponent and their contracted professional Qualified Bush Regeneration specialists may choose to assist with work by Council-funded / volunteer Bushcare teams.

Zone 2

In order to maintain landscape amenity, shade, and fauna habitat value (nectar, fruit or shelter) on the campus, where possible it is recommended that any tree removed from the western portion of the campus (in association with campus re-construction) should be replaced with a locally indigenous, native tree that provide comparable habitat value elsewhere on the campus. Narla have compiled a list of suitable replacement trees (**Table 10**). These tree species are recommended as they are locally indigenous and provide fauna foraging habitat and aesthetic values.

Replacement trees can be planted anywhere on the campus where suitable space is available, this includes within the bushland area and adjoining space. This action will assist in achieving no long-term net loss of ecological values from the subject site.

Any tree hollows removed through lopping or felling should be replaced with at least two similarly sized, all-weather, fauna nest boxes. These should be attached to the same or proximal tree to provide fauna shelter values.

3.4 Ongoing Management Requirements

Erosion Management across All Zones

In the event erosion or sedimentation is observed, the Project Coordinator should be notified immediately and they will implement appropriate response.

Areas of isolated erosion are already present within the subject site. It is apparent that erosion and sedimentation controls may have been previously established in these areas, though measures have since deteriorated and more work is required to address this issue.

Erosion caused by high velocity stormwater flushing events within the gully associated with the stormwater outlet should also be continually monitored. Sections of sandstone have already been exposed here from past gully erosion. This has in part led to the heavy disturbance of local plant communities. These disturbed plant communities are more subject to future weed invasion, as can be seen currently with the intense vine infestation in the surrounding area. Dissemination of water outlets may be a simple solution to reduce impact.

An additional area with existing erosion issues should be addressed along the eastern boundary of the site. It is recommended that the proponent removes all Mirror Bush currently occurring in the area and installs the appropriate erosion mitigation measures such as jute matting, installation of coil logs or a similar method. This area should then be covered in a layer of topsoil and be planted with native ground covers to assist in stabilisation.

Zone 1

It is recommended that removal and control of existing vine and woody weeds is the primary focus for bushland management works in initial stages of the project. Control of re-emerging weeds has the potential to impose high ongoing maintenance costs if initial control effort or techniques are insufficient. To minimise ongoing weed maintenance costs from the control of re-emerging noxious and environmental weed species, well planned and executed weed control works will be critical. Specific issues may arise when dealing with exotic species which possess regenerative underground structures such as rhizomes (e.g. Cape Ivy) or stolons (e.g. Lantana). Wherever viable, weed control techniques that remove the capacity for weed species to re-emerge from underground rhizomes or stolons following removal of above-ground vegetation, without negatively impacting upon native vegetation outcomes at a site would be favoured.

Substantial efforts have been made by local volunteers and council-funded / volunteer Bushcare teams to aid bush regeneration through weed control and supplementary native plantings. These efforts should be encouraged to continue. It is important to note however that the control of vine infestations, which are a significant issue on the subject site, will require more regular and intensive management than can be offered by sporadic volunteer hours. Therefore, it is recommended that weed removal work is undertaken by professional bush regenerators to assist/supplement the work of local Bushcare groups in and immediately around the subject site.

In order to achieve best possible outcomes, where possible, UNSW and Randwick Council should undertake active weed management in their adjoining bushland patches, in a

coordinated manner. This will increase likelihood of controlling local noxious weed problems in the locality and in the long term will save resources spent on managing recurring weed infestations that spread from Cliffbrook Campus to council land and vice versa.

Environmental pathogens Phytophthora, Myrtle rust and Chytrid fungus which can be spread through infected soil will remain a risk to the viability of the subject site. Continued efforts must be maintained to avoid their introduction. Basic principles include avoiding transport of soil onto and off site by cleaning all work clothing, gloves, tools and machinery. In some cases, a solution of 70% ethanol or methylated spirits in 30% water may be sufficient to disinfect equipment prior to use.

Zone 2

Continued maintenance of ornamental gardens, to be undertaken as prescribed by landscaping contractors.

Zone 3

Removal and ongoing suppression of all exotic flora within this area is recommended to reduce competition for native species. To decrease the likelihood of reinfestation by exotic species, supplementary native plantings may be considered. In the case that revegetation is adopted, this should aim to increase the species diversity of the patch by introducing a range of Coastal Headland Banksia Heath ground cover species (**Table 8**).

3.5 Plant Supply and Revegetation

Revegetation works will aim to establish a diverse native plant species assemblage and habitat mosaic across the subject site. This revegetation outcome is intended to create as wide a range of habitat and food resources for local native fauna as possible. Suitable species may be selected from the list provided in **Table 8**. This table identified species which are already present within the site and therefore recommended to be utilised sparingly within novel plantings.

All plant propagation is to be undertaken by a specialist native plant nursery which is qualified and experienced in provenance plant propagation. Any plants to be introduced to the subject site, especially into bushland areas must reflect appropriate provenance, preferably with plant stock collected from within a 20-kilometre distance of the subject site. It is understood this is not always possible, however local provenance is encouraged.

Upon supply, all plants will be in the following condition:

- appropriately hardened-off;
- fully developed root system;
- not root bound;
- in a healthy and robust condition;
- free of pests, disease and weed infestation;
- free of malformations and other defects.

Planting of all native revegetation areas will take place using locally indigenous tubestock planted to a density of:

- 4 groundcover plants 1 m²
- 2 shrub plants per 1 m²
- one tree/tall shrub per 20 m² (only in areas outside of 10m from a private residence)

3.6 Works Specifications

Work stages in relation to management zones are outlined below in **Table 4**. The commencement of certain works will be dependent on the completion of other work actions.

Table 4. Staging of biodiversity management works

Action	Objectives	Specifications	Location	Activities/ Materials Involved	Responsibility	Frequency
Pre-Construction Phase						
Zone 1 - Bushland						
Micro-siting and pre-clearing ecological assessment	Minimise impacts on native fauna and flora	Mark ecological features to avoid and shift walkway within assessed corridor if required	Length of proposed walkway through bushland	Flagging tape, Global Positioning System (GPS)	Ecologist and Surveyor	Once prior to any vegetation clearing activity.
Zone 2 – Garden and lawn						
Pre-clearing ecological assessment	Minimise impacts on native fauna and flora	Mark ecological features to avoid	All areas of vegetation to be cleared within garden	Flagging tape, GPS	Ecologist	Once prior to each tree lopping/removal activity.
All zones						
Erosion and sedimentation mitigation	Prevent soil movement during vegetation clearing construction works	Install best practice erosion and sedimentation mitigation measures as per 'The Blue Book' (Landcom 2004)	Surrounding proposed vegetation clearing and construction areas	Sediment fences etc. as required	Construction Contractor	Prior to any soil disturbance, vegetation removal or construction works
	Prevent soil movement allowing native vegetation to take root	Address existing specific problem areas including on the eastern boundary of bushland area and associated with stormwater outlets	Length of eastern boundary and in the vicinity of stormwater outlets on southern boundary	Steps: 1.Installation of coir logs 2.Mulch 3.Installation of deep rooting native vegetation and extensive ground covers	Professional Bush Regenerators	
Construction Phase						

Action	Objectives	Specifications	Location	Activities/ Materials Involved	Responsibility	Frequency
Zone 1 – Bushland						
Construction of proposed walkway	Avoid disturbance to native vegetation	Maintain 'buffer zone' of vegetation that is intensively weed-controlled and infill-planted with locally indigenous plants.	Surrounding proposed vegetation clearing and construction areas	See Landscape Plan (FJMT 2016)	Landscaper/ Construction Contractor/ Professional Bush Regenerators	Maintain and manage buffer immediately post construction, then six-times per year for duration of VMP.
Installation of fencing	Avoid impacts on fauna	Fencing to allow movement of fauna within and between bushland and garden vegetation	According to FJMT fencing strategy	See Landscape Plan (FJMT 2016)	Construction Contractor/ Landscape	Once during construction phase
All zones						
Ecological clearing supervision	Avoid impacts on fauna through disturbance to fauna habitat including protected vegetation, sandstone cropping, and culverts	Check vegetation to be cleared for any active fauna nests to be avoided or relocated. Check culverts/crevices for presence of sheltering fauna, especially threatened microbats. Supervise the clearing and felling of vegetation to capture and relocate any displaced native fauna.	All areas where trees or shrubs are to be removed or where works adjoin native vegetation or of sandstone cropping and culverts	Ecologist to be present on site prior to any tree or vegetation removal or works around outcropping or culverts. Ecologist to inform vegetation clearing or construction contractors of appropriate techniques for minimising impact to fauna and habitat. Ecologist will have fauna capture and handling	Ecologist	During any tree/shrub removal, vegetation clearing works or construction, excavation or demolition around culverts or rock outcrops

Action	Objectives	Specifications	Location	Activities/ Materials Involved	Responsibility	Frequency
Mature tree removal	Minimise impacts on fauna	Limit the removal of large, mature native trees, particular nectar and fruit bearing species (e.g. Coastal Banksia)	All vegetation clearing areas	equipment on hand. See Arborist Report for removal techniques.	Construction Contractors/ Arborist/	
		Supervise any felling or lopping of mature trees	All locations where trees or shrubs are lopped, felled or cleared across the subject site	Ecologist will advise tree loppers of best method to minimise impacts to fauna and habitat. Ecologist will have fauna capture and handling equipment on hand.	Ecologist	During any tree/shrub removal, vegetation clearing works
Storage and stockpiling	Minimise impacts on native vegetation and soils	Locate stockpile sites in historically cleared areas	Storage sites		Construction Contractor	Prior to any construction, demolition or landscaping works
		Stockpile topsoil from bushland areas using best practice methodology to retain topsoil biota and seedbank	Proposed walkway through bushland		Construction Contractor	Prior to any construction, demolition or landscaping works

Action	Objectives	Specifications	Location	Activities/ Materials Involved	Responsibility	Frequency
Post-Construction Phase						
Zone 1 – Bushland						
Weed management and bush regeneration	Encourage regeneration of native vegetation by removing problematic weeds. Control and suppress Noxious Weeds	Focus on suppression of Cape Ivy (<i>Delairea odorata</i>), Mirror Bush (<i>Coprosma repens</i>), and Noxious weeds and to allow expansion of native flora	Focus on high weed infestations, moving progressively to lower level infestations	To be achieved through a combination of manual removal, cut/scrape and paint, and careful spot spraying as appropriate. Planting of native tubestock to replace weeds removed and increase soil stability.	Professional Bush Regenerators	<u>Year 1 and 2:</u> One site visit per month for a team of four qualified, professional Bush Regenerators including a supervisor. This equates to 24 site visits over 24 months. <u>Years 3-5:</u> Six visits (every two months) per year by a team of four qualified, professional Bush Regenerators including a supervisor. This equates to 18 site visits over 36 months.
Revegetation	Expansion of bushland areas	Installing and establishing of propagated plants (e.g. tubestock) with species that reflect indigenous vegetation communities	Grassed areas to north of bushland remnant	Refer to Section 3.8	Professional Bush Regenerators	To be conducted as required during the weed control site visits.
	Restoration of understorey below	Installing and establishment of propagated plants (e.g. tubestock) with species that	Patch of trees to south of campus buildings	Refer to Section 3.8	Professional Bush Regenerators	To be conducted as required during the

Action	Objectives	Specifications	Location	Activities/ Materials Involved	Responsibility	Frequency
	trees to improve fauna habitat	reflecting indigenous existing vegetation communities				weed control site visits.
	Increase the likelihood and number of plants that survive to maturity	Close monitoring of new plantings and weather conditions to ensure appropriate care is taken	All revegetation areas	Watering and fine detail weeding, twice weekly during first weeks after installation and decreasing as required	Ecologist	Undertaken four times per year by Ecologist and as required by Professional Bush Regenerators.
Tree replacement	Replacement of some of the trees removed in association with campus re-construction	Planting of replacement trees from species list anywhere on campus where suitable space is available	Western portion of campus		Landscapers	As required
All zones						
Sewerage and stormwater	Prevent nutrient enrichment of bushland	Monitor site for signs of seepage from stormwater or sewerage	Throughout the site		Landscapers / Professional Bush Regenerators	As required

3.7 Appointment of Bushland Restoration Contractors

All bushland management works within bushland areas are to be implemented by a qualified and experienced Bushland Restoration Company.

To ensure no unnecessary legal ramifications or suboptimal quality of work, the Bush Regeneration Company selected to complete the project works must:

- Provide a statutory declaration stating their compliance with provisions of the National Gardening & Landscaping Services Award 2010;
- Provide completed and signed Subcontractor Statement regarding payment of worker's compensations, payroll tax and remuneration;
- Provide established Workplace Health & Safety and Environmental Management Systems. Preferably the company has third-party accredited systems in place;
- Demonstrate implementation of safe workplace and appropriate environmental management practices and procedures (e.g. appropriate transport and management of herbicides);
- Provide Public Liability (min \$10M) and Workers Compensation Insurance;
- Have previous experience undertaking bushland restoration works within Western Sydney. Contractor references are to be contacted;
- Provide supervisor with minimum qualifications and experience including Certificate III Conservation & Land Management and two years full-time equivalent experience as a trained bush regenerator;
- Provide a minimum of one trained bush regenerator per team of four (minimum qualifications and experience including Certificate III Conservation & Land Management and one year full -time equivalent experience as a bush regenerator.
- Provide a minimum of two trained bush regenerators per team with minimum qualifications and experience including Certificate III Conservation & Land Management and one year full – time equivalent experience as a trained bush regenerator
- Schedule appropriately resourced regular site visits for the duration of the contract period;
- All herbicide usage, including storage and transport, to be in accordance with the *NSW Pesticides Act 1999*, *WorkCover NSW (2006)* and all other relevant legislation;
- All bush regeneration crew members undertaking herbicide spray applications must hold a current chemicals application training certificate to AQF level III.

3.8 Appointment of Project Ecologist

A Project Ecologist must be appointed prior to any tree/shrub removal or construction works taking place.

The Project Ecologist must (as a minimum) have:

- Five years' experience as an Ecologist Consultant
- Experience in bushland restoration practices in coastal environments
- Experience supervising the clearing of trees and vegetation

- A full and current NSW Scientific License under Section 132c of the National parks and Wildlife Act 1974
- A current Animal Ethics Permit from the NSW Department of Primary Industries

3.9 Construction Environmental Management Plan

Prior to any construction works, a detailed Construction Environmental Management Plan (CEMP) should be produced the details the implementation of all recommendations in the Landscape Plan (FJMT 2016) Arborist Report (reference) and this BMP.

This must detail precise erosion control and mitigation measures and procedures for when to call Arborist or Ecologist to supervise works.

The CEMP and this BMP must be available on hand during all construction works.

4. Monitoring

In order to ensure the proposed landscape management works are meeting their aims, it is recommended that the Project Ecologist is appointed to monitor the works over the five year lifespan of this BMP. Monitoring of the management actions undertaken within each zone should be carried-out on an annual basis. Each monitoring visit should be followed by an annual biodiversity monitoring report.

Annual independent monitoring will ensure that the project objectives are being fulfilled. These included reducing impacts associated with the proposed development and noxious weed issues on the subject site, and working towards achieving a net gain in biodiversity for the subject property.

The Project Ecologist will undertake quarterly vegetation monitoring (4 times per year) and produce a concise summary report detailing the findings of each monitoring bout.

At the end of each year an annual monitoring report will be produced. This report will detail all the biodiversity management works that have been undertaken on the site to date. This report must assess adherence to the following key performance criteria.

4.1 Key Performance Criteria

Year 0 – Prior to Construction

- The Ecologist must establish four, permanent 20m x 20m across the bushland patch (outside of the proposed track construction)
- Each plot must be surveyed of all native and exotic flora species with a percentage cover applied to each species.
- A photo must be taken from each end of the plot, looking in
- Two pickets must be erected to indicate the northern and southern edges of the plot. Each picket will be positioned at 10m (the centre) of each plot edge.
- Photograph areas of erosion that require soil stabilisation and planting

Year 1 – One year Post VMP Implementation

- Reduction in total weed cover by 30% from baseline across the Subject Site
 - Reduction in Noxious Weed cover by 50% from baseline across the Subject Site
 - Ensure all revegetation areas (refer to Landscape Plan by FJMT 2016) solely contain locally indigenous plants to a density of :
 - o 4 groundcover 1 m²
 - o 2 shrub plants per 1 m²
 - o 1 tree/tall shrub per 10 m²
- Or other density as determined by the Landscape Plan.
- Erosion remediation areas are not continuing to erode and soil stabilisation measures are still in place

Year 2 – Two years Post VMP Implementation

- Reduction in total weed cover by 70% from baseline across the Subject Site
- Reduction in Noxious Weed cover by 80% from baseline across the Subject Site
- Ensure all revegetation areas (refer to Landscape Plan by FJMT 2016) solely contain locally indigenous plants to a density of :
 - o 4 groundcover 1 m²
 - o 2 shrub plants per 1 m²
 - o 1 tree/tall shrub per 10 m²

Or other density as determined by the Landscape Plan.

- Erosion remediation areas are not continuing to erode and soil stabilisation measures are still in place

Year 3 – Three years Post VMP Implementation

- Reduction in total weed cover by 85% from baseline across the Subject Site
- Reduction in Noxious Weed cover by 95% from baseline across the Subject Site
- Ensure all revegetation areas (refer to Landscape Plan by FJMT 2016) solely contain locally indigenous plants to a density of :
 - o 4 groundcover 1 m²
 - o 2 shrub plants per 1 m²
 - o 1 tree/tall shrub per 10 m²

or other density as determined by the Landscape Plan.

- Erosion remediation areas are not continuing to erode and soil stabilisation measures are still in place

Year 4 – Four years Post BMP Implementation

- Reduction in total weed cover by 85% from baseline across the Subject Site
- Reduction in Noxious Weed cover by 95% from baseline across the Subject Site
- Ensure all revegetation areas (refer to Landscape Plan by FJMT 2016) solely contain locally indigenous plants to a density of :
 - o 4 groundcover 1 m²
 - o 2 shrub plants per 1 m²
 - o 1 tree/tall shrub per 10 m²

or other density as determined by the Landscape Plan.

- Erosion remediation areas are not continuing to erode and soil stabilisation measures are still in place

4.2 Review of Vegetation Management Plan

After five years from initial implementation of this BMP, this entire document should be reviewed by a qualified Ecologist to ensure that it remains relevant and appropriate for the on-going biodiversity management of the subject site.

References

- Chapman and Murphy (1989) Soil Landscapes of the Sydney 1:100 000 Sheet, Soil Conservation Service of NSW, Sydney.
- Commonwealth of Australia Threatened Species Scientific Committee (TSSC) (2015) Conservation Advice for Eastern Suburbs Banksia Scrub of the Sydney Region, s266B of the Environment Protection and Biodiversity Conservation Act 1999, approved by the Delegate of the Minister on 01 October 2015.
- Department of Environment and Climate Change NSW (2009a) Best Practice Guidelines Eastern Suburbs Banksia Scrub [February 2017]
<http://www.environment.nsw.gov.au/resources/threatenedspecies/0942eastsubsbanksiascrubpg.pdf>
- Department of Environment and Climate Change NSW (2009b) Protecting and restoring Eastern Suburbs Banksia Scrub
<http://www.environment.nsw.gov.au/resources/threatenedspecies/0968tsdsesbanksiascrub.pdf>
- Francis-Jones Morehen Thorp Studio (FJMT) (2016) Cliffbrook Campus Redevelopment: Schematic Design Report- Landscape, UNSW Australia, 19 August 2016 – UNSWCCR – Rev 1
- Francis-Jones Morehen Thorp Studio (FJMT) (2016a) SK-5.02 Tree Management Plan – UNSW Cliffbrook Campus (Preliminary Plans)
- Francis-Jones Morehen Thorp Studio (FJMT) (2016b) SK-5.03-4 Landscape Plans: East and West– UNSW Cliffbrook Campus (Preliminary Plans)
- Herbert, C. (1983) Geology of the 1:100 000 Sheet 9130. Geological Survey of NSW, Sydney.
- Landcom (2004) Managing urban stormwater: harvesting and reuse 'The Blue Book'
- Narla Environmental Pty Ltd (2017) Biodiversity Assessment Report: UNSW Cliffbrook Campus. Commissioned by the University of New South Wales. March 2017
- NSW Department of Primary Industries (DPI) (2016) Weeds declared in the Local Control Authority area of Randwick City Council, Weeds Wise, [February 2017],
<http://weeds.dpi.nsw.gov.au/WeedDeclarations?RegionId=95>
- NSW Office of Environment and Heritage (OEH) (2011) NSW Scientific Committee - final determination: Eastern Suburbs banksia scrub in the Sydney Basin Bioregion - endangered ecological community listing
<http://www.environment.nsw.gov.au/determinations/EasternSuburbsBanksiaScrubEndComListing.htm>

NSW Office of Environment and Heritage (OEH) (2013) The Native Vegetation of the Sydney Metropolitan Area, Volume 2: Vegetation Community Profiles, Version 2.0, NSW Office of Environment and Heritage, Sydney.

NSW Office of Environment and Heritage (OEH) (2016a) NSW soil and land information, eSPADE Online Database, <http://www.environment.nsw.gov.au/eSpadeWebapp/>

PlantNET (The NSW Plant Information Network System) (2016) NSW Flora Online: Plant Species Profiles, Royal Botanic Gardens and Domain Trust, Sydney. Accessed June16
<http://plantnet.rbgsyd.nsw.gov.au>

The Ents Tree Consultancy (2016) Arboriculture Impact Assessment, Location: UNSW Coogee Campus, Commissioned by University of NSW, 20th May 2017

Ralph, M. (2003) Growing Australian Native Plants from Seed – For Revegetation Tree Planting and Direct Seeding, Second Edition, Bushland Horticulture Publications

Richardson, F, Ricardson, R., Shepard, R. (2011) Weeds of the South-East – An Identification Guide for Australia, Second Edition, R.G. and F.J Richardson

Robinson, L. (2003) Field Guide to the Native Plants of Sydney, Third Edition, Kangaroo Press

Appendix

- Table 5. Locally relevant species suitable for use in revegetation works (selected from Coastal Headland Banksia Heath and ESBS community descriptions)
- Table 6. Native flora species recorded in the subject site by Narla Environmental
- Table 7. Tree replacement guide for use within the 'built' region of the subject site

Table 8. Locally relevant species suitable for use in revegetation works (selected from Coastal Headland Banksia Heath and ESBS community descriptions)

Species	Common Name	Abundant on Site	Height	Habit	Niche	Notes
<u>Understorey</u>						
<i>Actinotus helianthi</i>	Flannel Flower		<0.5m	slender / upright	dry	flowering herb
<i>Actinotus minor</i>	Lesser Flannel Flower		<0.5m	low / spreading	dry	flowering herb
<i>Cyathochaeta diandra</i>	Sheath Rush		<1m	tufted	dry	sedge
<i>Dampiera stricta</i>			<0.5m	slender / decumbent	dry	flowering herb
<i>Dianella caerulea</i>	Blue Flax-lily		<1m	tufted	dry	flowering herb
<i>Entolasia marginata</i>	Bordered Panic	x	<0.5m	slender +/- upright	dry/damp	grass
<i>Entolasia stricta</i>	Wiry Panic		<0.5m	slender	dry	grass
<i>Gonocarpus teucroides</i>	Raspwort		<0.5m	low / spreading	dry	herb
<i>Hypolaena fastigiata</i>	Tassel Rope-rush		<1m	upright / creeping	damp	sedge
<i>Lepyrodia scariosa</i>			<1m	tufted	damp/ wet	sedge
<i>Lomandra glauca</i>	Pale Mat-rush		<0.5m	tufted	dry	flowering sedge
<i>Lomandra longifolia</i>	Spiny-headed Mat-rush	x	<1m	tufted	dry/damp	flowering sedge
<i>Xanthosia pilosa</i>	Woolly Xanthosia		<0.5m	low / scrambler	dry	herb
<i>Xanthosia pilosa</i>	Woolly Xanthosia		<0.5m	low / scrambler	dry	herb
<u>Vine</u>						
<i>Billardiera scandens</i>	Hairy Apple Berry		-	climber / creeper	dry	diversity enhancement
<i>Cassytha pubescens</i>	Bindweed		-	climber / twining	dry	diversity enhancement
<u>Sub-Shrub</u>						
<i>Epacris longiflora</i>	Fuchsia Heath		<1m	+/- slender	dry	flowering / diversity
<i>Lasiopetalum ferrugineum</i>	Rusty Velvet-bush		<1m	+/- slender		diversity
<i>Leucopogon ericoides</i>	Pink Beard-heath		<1m	dense	dry	flowering / diversity
<i>Philotheca buxifolia</i>	Box-leaf Waxflower		<0.5m	low +/- slender	dry	flowering / diversity
<i>Pimelea linifolia</i>	Slender Rice Flower		<1m	slender +/- upright	dry	flowering / diversity
<i>Xanthorrhoea resinosa</i>	Grass Tree		<1m	low / spreading	dry	diversity enhancement
<u>Shrub</u>						

Species	Common Name	Abundant on Site	Height	Habit	Niche	Notes
<i>Acacia suaveolens</i>	Sweet Scented Wattle		1-2m	upright / slender	dry	structural/ fragrant
<i>Darwinia fascicularis</i>			1-2m	dense	dry	primary structural species
<i>Kunzea ambigua</i>	Tick Bush		1-2m	+/- dense	dry	primary structural species
<i>Lambertia formosa</i>	Mountain Devil		1-2m	upright +/- dense	dry	nectar producing
<i>Persoonia lanceolata</i>	Lance Leaf Geebung		1-2m	upright +/- dense	dry	fruit producing
<i>Philotheca salsolifolia</i>			0.5-2m	upright +/- dense	dry	structural/ flowering
<i>Woolfsia pungens</i>	Snow Wreath		0.5-2m	upright +/- dense	dry	flowering/ fragrant
<i>Ricinocarpus pinifolius</i>	Wedding Bush		1-3	upright +/- dense		abundantly flowering
<u>Medium Shrub</u>						
<i>Acacia longifolia</i>	Sydney Golden Wattle	x	<3m	+/- dense	dry	primary structural species
<i>Allocasuarina distyla</i>	Scrub She-oak		<3m	upright	dry	primary structural species
<i>Banksia ericifolia</i> subsp. <i>ericifolia</i>	Heath-leaved Banksia		<3m	dense	dry/damp	structural/ nectar producing
<i>Dillwynia retorta</i>	Egg and Bacon Pea		<3m	+/- dense	dry	flowering / diversity
<i>Hakea dactyloides</i>	Needlebush		<3m	upright/slender	damp	primary structural species
<i>Hakea teretifolia</i>	Needlebush	x	<3m	upright/slender	damp	primary structural species
<i>Melaleuca nodosa</i>	Prickly-leaved Paperbark	x	<3m	dense	dry	structural/ flowering
<i>Monotoca elliptica</i>	Tree Broom-heath		<3m	+/- dense	dry	primary structural species
<u>Small Tree</u>						
<i>Leptospermum laevigatum</i>	Coast Tea-tree	x	3m	dense	dry	primary structural species
<i>Melaleuca armillaris</i> subsp. <i>armillaris</i>	Cream Paperbark	x	3m	dense	dry	structural/ flowering
<i>Banksia aemula</i>	Wallum Banksia		3m	dense	dry	nectar producing
<i>Kunzea ambigua</i>	Tickbush		3m	dense	dry	primary structural species

Table 9. Native flora species recorded in the subject site by Narla Environmental

Scientific Name	Common Name
<i>Acacia longifolia sophorae</i>	Coastal Wattle
<i>Acacia myrtifolia</i>	Red-stemmed Wattle
<i>Acmena smithii</i>	Common Lilly Pilly
<i>Adiantum aethiopicum</i>	Maidenhair Fern
<i>Allocasuarina distyla</i>	Black She-oak
<i>Corymbia maculata</i>	Spotted Gum
<i>Asplenium australasicum</i>	Birds Nest Fern
<i>Baeckea imbricata</i>	Heath Myrtle
<i>Banksia ericifolia</i>	Heath-leaved Banksia
<i>Banksia integrifolia</i>	Coastal Banksia
<i>Bauera rubioides</i>	Dog Rose
<i>Breynia oblongifolia</i>	Coffee Bush
<i>Callistemon citrinus</i>	Crimson Bottlebrush
<i>Calochlaena dubia</i>	Common Ground Fern
<i>Carpobrotus glaucescens</i>	Pigface
<i>Casuarina glauca</i>	Swamp She-Oak
<i>Christella dentata</i>	Binung Fern
<i>Commelina cyanea</i>	Scurvy Weed
<i>Correa alba</i>	White Correa
<i>Crinum pendeculatum</i>	Swamp Lily
<i>Cupaniopsis anacardioides</i>	Tuckeroo
<i>Cyperus brevifolius</i>	Globe Kyllinga
<i>Cyrtomium falcatum</i>	Holly Fern
<i>Dianella caerulea</i>	Blue Flax Lily
<i>Dianella revoluta</i>	Blue Flax Lily
<i>Dichelachne crinita</i>	Longhair Plume Grass
<i>Dicksonia antarctica</i>	Soft Tree Fern
<i>Dodonaea triquetra</i>	Common Hopbush
<i>Eleaocarpus reticulatus</i>	Blueberry Ash
<i>Eragrostis brownii</i>	Browns Love Grass
<i>Eucalyptus botryoideis</i>	Southern Mahogany

Scientific Name	Common Name
<i>Ficinia nodosa</i>	Knotted Club-rush
<i>Ficus rubiginosa</i>	Port Jackson Fig
<i>Gahnia sp</i>	
<i>Glochidion ferdinandi</i>	Cheese Tree
<i>Grevilea hookeriana</i>	Hookers Grevillea
<i>Hakea gibbosa</i>	Needlebush
<i>Hakea teretifolia</i>	Dagger Hakea
<i>Hardenbergia violacea</i>	Purple Coral Pea
<i>Hibbertia scandens</i>	Snake Vine
<i>Histiopteris incisa</i>	Bats Wing Fern
<i>Hymenosporum flavum</i>	Native Frangipani
<i>Imperata cylindrica</i>	Blady Grass
<i>Juncus continuus</i>	Juncus
<i>Kunzea ambigua</i>	Tick Bush
<i>Leptospermum laevigatum</i>	Coastal Teatree
<i>Livistona australis</i>	Cabbage Palm
<i>Lobelia ancepslata</i>	Angled lobelia
<i>Lomandra longifolia</i>	Spiny Mat Rush
<i>Melaleuca armillaris</i>	Bracelet Honey-myrtle
<i>Melaleuca nodosa</i>	Ball Honey myrtle
<i>Microlaena stipoides</i>	Weeping Grass
<i>Opercularia aspera</i>	Course Stinkweed
<i>Oplismenus imbecillis</i>	Basket Grass
<i>Oxalis rubens</i>	Coastal Oxalis
<i>Pittosporum undulatum</i>	Sweet Pittosporum
<i>Portulaca oleracea</i>	Pigweed
<i>Pteridium esculentum</i>	Bracken Fern
<i>Sigesbeckia orientalis</i>	Common St. Paul's Wort
<i>Stephania japonica</i>	Tape Vine
<i>Tetragonia tetragonoides</i>	New Zealand Spinach
<i>Viola hederacea</i>	Native Violet
<i>Westringia fruticosa</i>	Coastal Rosemary



Table 10. Tree replacement guide for use within the 'built' region of the subject site

Tree Habitat Features	Status	Species within ornamental gardens	Replacement Suggestions
Fruit-bearing	Local native	<i>Pittosporum undulatum</i> <i>Ficus rubiginosa</i> <i>Elaeocarpus reticulatus</i> <i>Cupaniopsis anacardioides</i> <i>Livistonia australis</i> <i>Olea europea subsp. cuspidata</i> <i>Cinnamomum camphora</i> <i>Nerium oleander</i> <i>Howea forsteriana</i>	<i>Syzigium paniculatum</i> <i>Ficus rubiginosa</i> <i>Elaeocarpus reticulatus</i> <i>Acmena smithii</i> <i>Persoonia lanceolata</i>
	Noxious/Undesirable Weed	<i>Dyopsis decaryi</i> <i>Murraya paniculata</i> <i>Phoenix canariensis</i> <i>Cinnamomum camphora</i>	
	Ornamental	<i>Ficus lyrata</i> <i>Celtis occidentalis</i> <i>Syagrus romanzoffiana</i> <i>Morus sp.</i> <i>Phoenix dactylifera</i>	
Nectar-bearing	Local native	<i>Banksia integrifolia</i> <i>Banksia ericifolia</i>	<i>Angophora costata</i> <i>Corymbia gummifera</i> <i>Banksia ericifolia</i> <i>Banksia integrifolia</i> <i>Banksia serrata</i> <i>Melaleuca nodosa</i> <i>Melaleuca squamea</i> <i>Kunzea ambigua</i>
	Ornamental	<i>Corymbia citriodora</i> <i>Corymbia citriodora</i> <i>Corymbia ficifolia</i> <i>Corymbia ficifolia</i> <i>Eucalyptus botryoides</i> <i>Eucalyptus botryoides</i> <i>Eucalyptus saligna</i> <i>Eucalyptus saligna</i> <i>Grevillea hookeriana</i> <i>Grevillea hookeriana</i> <i>Lagunaria pattersonii</i> <i>Lagunaria pattersonii</i> <i>Melaleuca quinquinervia</i> <i>Melaleuca quinquinervia</i>	
Ornamental	Ornamental	<i>Ulmus parvifolia</i> <i>Araucaria heterophylla</i> <i>Zelkova serrata</i> <i>Magnolia gandiflora</i> <i>Hymenosporum flavum</i> <i>Fraxinus raywoodi</i>	<i>Angophora costata</i> <i>Corymbia gummifera</i> <i>Syzigium paniculatum</i> <i>Ficus rubiginosa</i> <i>Elaeocarpus reticulatus</i> <i>Banksia integrifolia</i>



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Plot 1- Native			GF	CA	
Common Name	Botanical Name	Label on Data Sheet			
Coastal Wattle	<i>Acacia longifolia sophorae</i>	identified correctly in field	s	6	planted
Bird's Nest Fern	<i>Asplenium australasicum</i>	identified correctly in field	h	1	
Heath-leaved Banksia	<i>Banksia ericifolia</i>	identified correctly in field	s	3	
Coffee Bush	<i>Breynia oblongifolia</i>	identified correctly in field	s	1	
Pigface	<i>Carpobrotus glaucescens</i>	identified correctly in field	h	2	
Binung Fern	<i>Christella dentata</i>	identified in office	H	3	**
Scurvy Weed	<i>Commelina cyanea</i>	identified correctly in field	h	5	
White Correa	<i>Correa alba</i>	identified correctly in field	s	4b	
Tuckeroo	<i>Cupaniopsis anacardioides</i>	identified correctly in field	t	3	
Blue Flax Lily	<i>Dianella caerulea</i>	identified correctly in field	g	4a	
Longhair Plumegrass	<i>Dichelachne crinita</i>	identified correctly in field	g	2	
Club Rush	<i>Ficinia nodosa</i>	identified correctly in field	g	3	
Cheese Tree	<i>Glochidion ferdinandi</i>	identified correctly in field	t	2	
Needlebush	<i>Hakea gibbosa</i>	identified correctly in field	s	5	
Dagger Hakea	<i>Hakea teretifolia</i>	identified correctly in field	s	3	
Snake Vine	<i>Hibbertia scandens</i>	identified correctly in field	v	3	TBC
Bats Wing Fern	<i>Histiopteris incisa</i>	Field label 'soft bracken' correctly identified in office	h	2	
Spikey Matrush	<i>Lomandra longifolia</i>	identified correctly in field	g	5	
Bracelet Honey-myrtle	<i>Melaleuca armillaris</i>	Field label 'Melaleuca ericifolia' correctly identified in office	s	4b	
Prickly-leaved Paperbark	<i>Melaleuca nodosa</i>	identified correctly in field	s	3	
Weeping Grass	<i>Microlaena stipoides</i>	identified correctly in field	g	1	
Basket Grass	<i>Oplismenus imbecillis</i>	identified correctly in field	g	4a	
Sweet Pittosporum	<i>Pittosporum undulatum</i>	identified correctly in field	t	2	
Common St. Paul's Wort	<i>Sigesbeckia orientalis</i>	Field label 'Chileanfireweed?' in exotics, correctly identified in office	h	4a	
New Zealand Spinach	<i>Tetragonia tetragonoides</i>	identified correctly in field	h	1	
Coastal Rosemary	<i>Westringia fruticosa</i>	identified correctly in field	s	5	
Juncus	<i>Juncus continnus</i>	identified in office	g	1	

Plot Species richness 27

h-herb
g- graminoid
v- vine
t-tree

Plot 2- Native	
Common Name	Botanical Name
Coastal Wattle	<i>Acacia longifolia</i>
Spotted Gum	<i>Corymbia maculata</i>
Bird's Nest Fern	<i>Asplenium platyneuron</i>
Heath Myrtle	<i>Baekea ericifolia</i>
Coast Banksia	<i>Banksia integrifolia</i>
Dog Rose	<i>Bauera rubiginosa</i>
Coffee Bush	<i>Breynia oblongifolia</i>
Crimson Bottlebrush	<i>Callistemon rigidus</i>
Scurvy Weed	<i>Commelina cyanea</i>
Swamp Lily	<i>Crinum peruvianum</i>
Tuckeroo	<i>Cupaniopsis anacardioides</i>
Blue Flax Lily	<i>Dianella caerulea</i>
Soft Tree Fern	<i>Dicksonia bartramia</i>
Cheese Tree	<i>Glochidion ferdinandi</i>
Dagger Hakea	<i>Hakea teretifolia</i>
Bats Wing Fern	<i>Histiopteris incisa</i>
Coastal Teatree	<i>Leptospermum laevis</i>
Angled lobelia	<i>Lobelia angustifolia</i>
Spikey Matrush	<i>Lomandra longifolia</i>
Tape Vine	<i>Stephania laevis</i>
Native Violet	<i>Viola hederifolia</i>
Coastal Rosemary	<i>Westringia fruticosa</i>

Plot Species richness 22

Label on Data Sheet	GF	CA
identified correctly in field	s	2
not written in to field data sheet but correctly identified from photo	t	1
not written in to field data sheet but correctly identified from specimen brought to office	h	1
identified correctly in field	s	2
identified correctly in field (only on on the transect page)	t	1
identified correctly in field	s	2
identified correctly in field	s	3
Misidentified in to field data sheet but correctly identified from photo	s	1
identified correctly in field	h	3
identified correctly in field	h	2
identified correctly in field	t	3
identified correctly in field	g	3
Misidentified in to field data sheet as 'Pteridium esculentum' but correctly identified from specimen as Dicksonia	h	1
identified correctly in field	t	4a
identified correctly in field	s	2
not written on field data sheet but correctly identified from specimen	h	1
not written in to field data sheet but correctly identified from photo	t	2
Misidentified in to field data sheet as 'Lobelia elata' but correctly identified from specimen as L.anceps	h	2
not written in to field data sheet but correctly identified from photo	g	3
not written in to field data sheet but correctly identified from specimen brought to office	v	2
not written in to field data sheet but correctly identified from specimen brought to office	h	1
identified correctly in field	s	2

Plot 3- Native	
Common Name	Botanical Name
Coastal Wattle	<i>Acacia longifolia sophorae</i>
Coast Banksia	<i>Banksia integrifolia</i>
Coffee Bush	<i>Breynia oblongifolia</i>
White Correa	<i>Correa alba</i>
Tuckeroo	<i>Cupaniopsis anacardioides</i>
Blue Flax Lily	<i>Dianella caerulea</i>
Common Hopbush	<i>Dodonaea triquetra</i>
Dagger Hakea	<i>Hakea teretifolia</i>
Purple Coral Pea	<i>Hardenbergia violacea</i>
Snake Vine	<i>Hibbertia scandens</i>
Blady Grass	<i>Imperata cylindrica</i>
Spikey Matrush	<i>Lomandra longifolia</i>
Prickly-leaved Paperbark	<i>Melaleuca nodosa</i>
Coastal Oxalis	<i>Oxalis rubens</i>
Sweet Pittosporum	<i>Pittosporum undulatum</i>
Pigweed	<i>Portulaca oleracea</i>
New Zealand Spinach	<i>Tetragonia tetragonoides</i>
Coastal Rosemary	<i>Westringia fruticosa</i>

Plot Species richness

18

Label on Data Sheet	GF	CA
identified correctly in field	s	5
identified correctly in field	t	2
identified correctly in field	s	5
identified correctly in field	s	2
identified correctly in field (except written in 'exotics')	t	4a
identified correctly in field	g	3
identified correctly in field	s	1
identified correctly in field	s	3
identified correctly in field	v	1
identified correctly in field	v	2
identified correctly in field	g	3
identified correctly in field	g	4b
identified correctly in field	s	1
identified correctly in office (originally written in 'exotics')	h	3
identified correctly in field	t	4b
identified correctly in office (originally written in 'exotics')	h	3
identified correctly in field	h	2
identified correctly in field	s	3

Plot 4- Native				
Common Name	Botanical Name	Label on Data Sheet	GF	CA
Coastal Wattle	<i>Acacia longifolia sophorae</i>	identified correctly in field	s	4b
Common Lilly Pilly	<i>Acmena smithii</i>	identified correctly in field	s	1
Heath Myrtle	<i>Baeckea imbricata</i>	identified correctly in field	s	1
Heath-leaved Banksia	<i>Banksia ericifolia</i>	identified correctly in field	s	1
Coast Banksia	<i>Banksia integrifolia</i>	identified correctly in field	t	3
Coffee Bush	<i>Breynia oblongifolia</i>	identified correctly in field	s	4b
Swamp She-oak	<i>Casuarina glauca</i>	identified correctly in field	t	3
Scurvy Weed	<i>Commelina cyanea</i>	identified correctly in field	h	3
Tuckeroo	<i>Cupaniopsis anacardioides</i>	identified correctly in field	t	3
Blue Flax Lily	<i>Dianella caerulea</i>	identified correctly in field	g	3
Dagger Hakea	<i>Hakea teretifolia</i>	identified correctly in field	s	1
Snake Vine	<i>Hibbertia scandens</i>	identified correctly in field	v	2
Bats Wing Fern	<i>Histiopteris incisa</i>	identified correctly in field	h	2
Blady Grass	<i>Imperata cylindrica</i>	identified correctly in field	g	3
Coastal Teatree	<i>Leptospermum laevigatum</i>	identified correctly in field	t	2
Spikey Matrush	<i>Lomandra longifolia</i>	identified correctly in field	g	5
Prickly-leaved Paperbark	<i>Melaleuca nodosa</i>	identified correctly in field	s	2
Basket Grass	<i>Oplismenus imbecillis</i>	identified correctly in field	g	3
Coastal Oxalis	<i>Oxalis rubens</i>	identified correctly in field	h	3
Sweet Pittosporum	<i>Pittosporum undulatum</i>	identified correctly in field	t	2
Tape Vine	<i>Stephania japonica</i>	identified correctly in field	v	2
Coastal Rosemary	<i>Westringia fruticosa</i>	identified correctly in field	s	2

Plot Information		Recorders	Date
Site Name/Code		DS / ES	9/2/17
Start Easting	- 33.914357°	20m Easting	50m Easting
Start Northing	151.262450°	20m Northing	50m Northing
Orientation of transect plot (direction and degrees)	West NW 300°	Photo No. start	Slope (degrees)
		Photo No. end of 50m transect	
		✓	35° → S

* Record Easting and Northing of each stake, from the start, 20m mark and end of 50m transect

Vegetation Zone Identification	
Location	PI
Vegetation Community	Coastal Heath
Condition (Low or Mod-Good)	Mod-Good
Habitat Features (rocks etc.)	small rock shelf & outcrops
Comments	Some erosion evident

		5	10	15	20	25	30	35	40	45	50		
Native 50m transect – 10 points (at 5m spaces)	Native overstorey cover (%)	0	0	0	0	0	0	0	0	0	20	Sum /10	%
	Native midstorey cover (%)	60	15	30	65	65	5	10	0	5	75	Sum /10	%
Native 50m transect – 50 Points (at 1m spaces)	Native ground cover (tally hits/50 points) - shrubs	= 28										Sum x 2	%
	Native ground cover (tally hits/50 pts) - grasses	= 35										Sum x 2	%
	- cryptogam											Sum x 2	%
	Leaf litter (tally/ 50 pts)	= 31										62	1.24
	Leaf litter (tally/50 pts) other	= 10										20	0.4
Exotic: 50m transect – 50 points	Ground cover (tally hits/50 points) - grasses or shrubs	= 10										Sum x 2	%
Exotic: 50m transect – 10 points (at 5m spaces)	Exotic overstorey cover (%)	X	0	0	0	0	0	0	0	0	0	Sum/10	%
	Exotic midstorey cover (%)	X	0	70	0	0	0	0	0	0	0	Sum/10	%
20m x 50m Quadrat	Number of individual trees with hollows (only hollow ≥5cm diameter):						Total length fallen logs in metres (only logs >10cm width)						
	0						0						
Whole Veg. Zone	Over-storey regeneration	Over-storey Species					Regenerating (<5cm)					Comments	
		n/a					n/a					—	

Cover: <1, 1,2,3,4,5, 15,20,25,30,35 etc foliage cover %

+ lantana

Cover: <1, 1,2,3,4,5, 15,20,25,30,35 etc foliage cover %

Monitoring Plot Data Sheet (Biometric)	Site Sheet No.
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Plot Information		Recorders	Date	
Site Name/Code	UNSW2			
Start Easting		20m Easting		50m Easting
Start Northing		20m Northing		50m Northing
Orientation of transect plot (direction and degrees)	ESE	Photo No. start	✓	Slope (degrees)
		Photo No. end of 50m transect	✓	
				15° → S

* Record Easting and Northing of each stake, from the start, 20m mark and end of 50m transect

Vegetation Zone Identification	
Location	P3
Vegetation Community	
Condition (Low or Mod-Good)	Mod-Good (leading to low?)
Habitat Features (rocks etc.)	
Comments	edge close to lawn, active regeneration / planting bed

		5	10	15	20	25	30	35	40	45	50		
Native 50m transect – 10 points (at 5m spaces)	Native overstorey cover (%)	0	0	0	55	0	5	0	0	0	0	Sum /10	%
	Native midstorey cover (%)	10	45	0	65	0	0	2	15	0	55	Sum /10	%
Native 50m transect – 50 Points (at 1m spaces)	Native ground cover (tally hits/50 points)											Sum x 2	%
	- shrubs	= 15										32/	0.64
	Native ground cover (tally hits/50 pts)											Sum x2	%
	- grasses	= 25										50/	1
	- cryptogam	0										Sum x2	%
	Leaf litter (tally/ 50 pts)											Sum	%
	Leaf litter (tally/50 pts) other											Sum	%
Exotic: 50m transect – 50 points	Ground cover (tally hits/50 points)											Sum x2	%
	- grasses or shrubs	= 60										120	120
Exotic: 50m transect – 10 points (at 5m spaces)	Exotic overstorey cover (%)	0	0	0	0	0	0	0	0	0	0	Sum/10	%
	Exotic midstorey cover (%)	0	0	0	0	0	0	0	100	85	20	Sum/10	%
20m x 50m Quadrat		Number of individual trees with hollows (only hollow ≥5cm diameter):										Total length fallen logs in metres (only logs >10cm width)	
		0										10 + 4 + 11 + 2 + 4 = 31	
Whole Veg. Zone	Over-storey regeneration	Over-storey Species					Regenerating (<5cm)					Comments	
		Little evidence											
		except planted											

Cover: <1, 1,2,3,4,5, 15,20,25,30,35 etc foliage cover %

Monitoring Plot Data Sheet (Biometric)	Site Sheet No.
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Plot Information		Recorders	Date	
Site Name/Code	UNSW2	ES	9/2/17	
Start Easting		20m Easting	50m Easting	151.26062
Start Northing		20m Northing	50m Northing	33.91587
Orientation of transect plot (direction and degrees)	WSW	Photo No. start	✓	Slope (degrees) 12° → S
		Photo No. end of 50m transect		

* Record Easting and Northing of each stake, from the start, 20m mark and end of 50m transect

Vegetation Zone Identification	
Location	P4
Vegetation Community	
Condition (Low or Mod-Good)	Mod - Good
Habitat Features (rocks etc.)	
Comments	close / intersecting lawn edge

		5	10	15	20	25	30	35	40	45	50		
Native 50m transect – 10 points (at 5m spaces)	Native overstorey cover (%)	5	20	10	0	0	0	0	0	0	0	Sum /10	%
	Native midstorey cover (%)	0	85	5	20	70	5	60	5	20	75	Sum /10	%
Native 50m transect – 50 Points (at 1m spaces)	Native ground cover (tally hits/50 points) - shrubs	= 15										Sum x 2	%
	Native ground cover (tally hits/50 pts) - grasses	= 35										Sum x 2	%
	- cryptogam	0										Sum x 2	%
	Leaf litter (tally/ 50 pts)	= 14										Sum	%
	Leaf litter (tally/50 pts) other	= 6										Sum	%
Exotic: 50m transect – 50 points	Ground cover (tally hits/50 points) - grasses or shrubs											Sum x 2	%
Exotic: 50m transect – 10 points (at 5m spaces)	Exotic overstorey cover (%)	0	0	0	0	0	0	0	0	0	0	Sum/10	%
	Exotic midstorey cover (%)	0	0	0	0	5	0	0	0	5	0	Sum/10	%
20m x 50m Quadrat	Number of individual trees with hollows (only hollow ≥ 5cm diameter):						Total length fallen logs in metres (only logs > 10cm width)						
	0						0						
Whole Veg. Zone	Over-storey regeneration	Over-storey Species					Regenerating (<5cm)					Comments	
		Banksia integrifolia					2						
		Casuarina glauca					suckering						

Cover: <1, 1,2,3,4,5, 15,20,25,30,35 etc foliage cover %

Sample

entered

Site No: P1		Date:		Recorders: (2)		
Species Native	CA	GF	Species Exotic	CA	GF	
1 Tetragenia tetragonoides	H	1	Acetosa sagittata	V	4b	
2 Commelina cyanea	H	5	Achanta erecta	G	5	
3 Lamandra longifolia	G	5	Solanum nigrum	H	4a	
4 Hibbertia scandens	V	3	Conyza bonariensis	H	4a	
5 Westringia fruticosa	S	5	Galingoga parvifolia	H	3	
6 Banksia ericifolia	S	3	Corysanthoides monilifera	S	3	Bitou
7 Acacia longifolia saphoreae	S	4b	Anredera sarifera cordifolia	V	2	
6 Correa alba	S	4b	Cape Ivy	V	2	
9 Ficus nodosa	G	3	Tradescantia flumensis	H	3	
10 Dianella caerulea caerulea	G	4a	Mulberry (alba)	T	1	
11 Siagasbechia orientalis	H	4a	Sonchus oleraceus	H	3	
12 Hakea teretifolia	S	3	Gal Onion weed Northoscordum berchonicum	G	1	
13 Melaleuca nodosa	S	3	Cyperus eragrostis (false papyrus)	G	1	#
14 Melaleuca ericifolia #	S	4b	Digitaria sanguinalis	G	3	#
15 Hakea gibbosa	S	5	Euphorbia pelopis	H	1	
16 Breynia oblongifolia	S	1	Arum lily/Zantedeschia	H	1	
17 Microleuca stipoides	G	2	Aetheopicus (Ground asparagus)	H	2	
18 Dicalachne erectum crenata	H	2	Ghamocheta (photo)	H	1	
19 Oplismis imbecillis	G	4a	Hypochaeris	H	2	
20 Glochidion ferdinades	T	2	Hypochaeris	H		
21 Tuckeria	T	3	Anagallis arvensis	H	2	
22 Carpobrotus glaucescens	H	2	Cestrum p (Green)	S	2	
23 Pittosporum undulatum	T	2				
24						
25 Birds nest fern - Asplenium australasicum	H	1				
26						
27						
28						
29						
30						
31						
32 # Christella dentata ✓			#			
33 Fern 1/P1 → Chetli	H	2	Brassicaceae P1	2		
34			Chilean fireweed ? CF/P1	1	X	
35 Juncus P1 - 'Juncus continus'	G	1				
36 Acacia longifolia (?) juv X	H	1				
37 Soft Bracken?	H	2				
38						
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Total			Total			

GA (Growth form): T = tree, S = shrub, G = grass, V = vine, H = Herb, E = exotic

CA (Cover Abundance Braun-Blanquet scale): 1: <5% - rare/<3 individuals, 2: <5% - uncommon, >3 individuals, 3: <5% - common, scattered or locally common, 4a: <5% - very abundant, 4b: 5-25%, 5: 25-50%, 6: 50-75%, 7: 75-100%

Plot 3 UNSW 7/4/17

entered

Site No:		Date:		Recorders:		
Species Native	CA	GF	Species Exotic	CA	GF	
1 <i>Aracia saphea</i>	5		<i>Conyza</i> sp.	4a		
2 <i>Hardenbergia violacea</i>	1		<i>Bromus</i>	3		
3 <i>Breynia oblongifolia</i>	5		<i>Bidens</i>	2		
4 <i>Pittosporum undulatum</i>	4b		<i>Oxalis</i>	2		
5 <i>Imperata cylindrica</i>	3		<i>Digitaria sangu</i>	3		
6 <i>Wristingia fruticosa</i>	3		<i>Cynodon dactylon</i>	3		
7 <i>Correa alba</i>	2		<i>Acetosa</i>	4b		
6 <i>Hibertia scandens</i>	2		<i>Callisaya parviflora</i>	2		
9 <i>Dodonea triquetra</i>	1		<i>Cestrum</i>	4a		
10 <i>Lomandra longifolia</i>	4b		<i>Solanum nigrum</i>	3		
11 <i>Dianella caerulea</i>	3		<i>Modeola</i>	3		
12 <i>Banksia integrifolia</i>	2		<i>Priasteria judacia</i>	3		
13 <i>Melaleuca nodosa</i>	1		<i>Cape Ivy</i>	4b		
14 <i>Tetragonia tetragonioides</i>	2		<i>Portulacca</i>	3		
15 <i>Hakea teritifolia</i>	3		<i>Anredera cordifolia</i>	4a		
16			<i>Erhata erecta</i>	5		
17			<i>Tuckersoo</i>	4a		
18	Note: Check a few plantings next visit					
19						
20						
21						
22						
23						
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25 <i>Crinum pedunculatum</i> /Swamp Lily	2		<i>Cyperus</i>	1		
26 <i>Breynia oblongifolia</i>	3		<i>Crocasmia x crocosmiiflora</i>	2		
27 <i>Actaea longifolia</i> saphereae	2		<i>Erhata erecta</i>	4b		
28 <i>Wristingia fruticosa</i>	4b		<i>Phyllanthus</i>	2		
29 <i>Tuckersoo</i>	3		<i>Solanum nigrum</i>	3		
30 <i>Commelina cyanea</i>	3		<i>Umbrella / Schefflera actinophylla</i>	1		
31 <i>Labellia elata</i>	2		<i>Acetosa sagittata</i>	4b		
32 <i>Glochidion ferdinadii</i> (cheese)	4a		<i>Conyza bonariensis</i>	4a		
33 <i>Hakea teritifolia</i>	2		<i>Cestrum</i> (green)	3		
34 <i>Pittosporum undulatum</i>	2		<i>Olea europaea</i>	1		
35 <i>Pteridium esculatum</i>	1		<i>Celtis</i>	1		
36 <i>Baurea rubiodes</i>	2		<i>Asparagus eathopius</i> (grated)	1		
37 <i>Bechea imbricata</i>	2		<i>Setaria parviflora</i>	1		
38 <i>Dianella caureli</i>	3					
39 <i>Callistemon citrinus</i>	1					
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Entered

Site No:	P4	Date:	9/2/17	Recorders:	ES
Species Native	CA	GF	Species Exotic	CA	GF
1 Acacia sphorae	S	4b	Buffalo Grass.	G	2
2 Commelina cyanea	h	3	Cynodon dactolyn	G	3
3 Tuckeroo	T	3	Achanta erecta	G	5
4 Lemnandra longifolia	E	5	Cestrum parqui	S	3
5 Breynia	S	4b	bredera	V	3
6 Banksia integrifolia	T	3	Bidens	h	2
7 Dianella caerulea ca	E	3	Portulacaea	h	2
6 Melaleuca nodosa	S	2	Conyza	h	2
9 Oplismenis imbecillis	G	3	hypochaeris	h	2
10 Imperata cylindrica	G	3	Acetosa	V	3
11 Hakea tetrafolia	S	1	Parietaria judaea	h	2
12 Westringia fruticosa	S	2	Solanum nigrum	h	2
13 Stephania (japonica?)	V	2	Acetosa Sagittata	V	3
14 Beakhea	E	1	Asparagus atropicus	h	3
15 Banksia ericifolia	S	1	Brazilian Solanum	V	1
16 Catisuarina glauca	T	3	Lantana	S	3
17 Hibbertia scandens	V	2	Oxalis Cape Ivy	V	3
18 Pitta undulatum	T	2	Ochna	S	2
19 Bats wing	H	2			
20 Acemena O smithii	S	1			
21 Lepto laevigata	S	2			
22 Oxalis rubens	h	3			
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