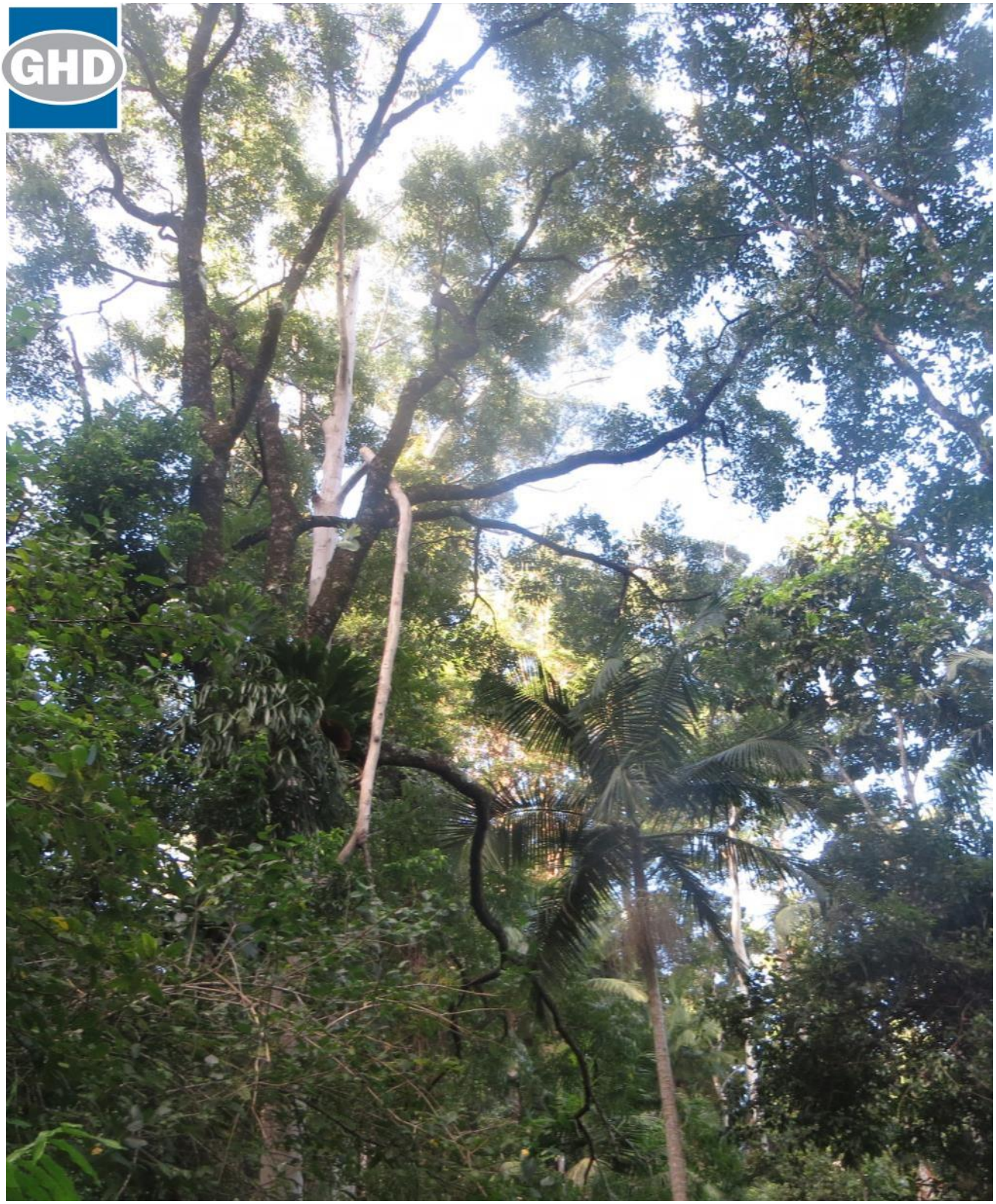

Roads and Maritime Services

Pacific Highway Upgrade, Warrell Creek to Nambucca Heads
Biodiversity Offset Package

November 2016

Executive summary

Roads and Maritime Services (Roads and Maritime) are upgrading a section of the Pacific Highway between Warrell Creek and Nambucca Heads (WC2NH) as part of the Pacific Highway upgrade program funded by the Commonwealth and NSW Governments (the Project).

The Project will result in impacts on the following threatened biota, listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999 (*EPBC Act): Clear Milkvine also known as Slender Marsdenia (*Marsdenia longiloba*) and the Cryptic Forest Twiner also known as Woolls' Tylophora (*Tylophora woollsii*), the Koala (*Phascolarctos cinereus*), Grey-headed Flying-fox (*Pteropus poliocephalus*), Spotted-tailed Quoll (*Dasyurus maculatus*), and Giant Barred Frog (*Mixophyes iteratus*). These two threatened flora species and four threatened fauna species are hereafter referred to collectively as 'the affected threatened species'. The Project was referred to the Commonwealth and assessed in accordance with the requirements of the EPBC Act.

The Minister's approval was received on 11 December 2014 subject to a number of conditions being met. The EPBC Approval for the Project (EPBC 2013/7101) requires biodiversity offsets for affected threatened species calculated with reference to the *Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy* (DSEWPaC, 2012).

GHD have prepared this 'Pacific Highway Upgrade, Warrell Creek to Nambucca Heads Biodiversity Offset Package' report (offset package) to assist Roads and Maritime deliver the biodiversity offsets required for the affected threatened species. The offset package outlines the approach to the delivery of biodiversity offsets for the Project by conservation and management of the Norton, Boambee State Forest (SF) and xxxxx offset sites, comprising:

- Background information about the affected threatened species to inform appropriate management actions.
- A detailed description of the quality of the offset with reference to the ecology and habitat requirements of the affected threatened species and based on targeted field surveys of the sites.
- Description of the titling and management framework that will be adopted at the offset sites and how maintenance and enhancement of habitat will contribute to the conservation of the affected threatened species.
- Details of a monitoring program for determining the effectiveness of management actions.

The conservation and management of the Norton, Boambee SF and xxxxx offset sites will meet the Project's direct offset requirements (as determined by the Department in accordance with the Offsets assessment guide) and enhance the conservation of the affected threatened species.

This offset package report is subject to, and must be read in conjunction with, the limitations set out in Section 1.7 and the assumptions and qualifications contained throughout the report.

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1. Introduction

1.1 Background

Roads and Maritime Services (Roads and Maritime) are upgrading a section of the Pacific Highway between Warrell Creek and Nambucca Heads (WC2NH) as part of the Pacific Highway upgrade program funded by the Federal and NSW Governments (the Project).

The Project will result in significant residual impacts on the following threatened biota, listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act): Clear Milkvine also known as Slender Marsdenia (*Marsdenia longiloba*) and the Cryptic Forest Twiner also known as Woolls' Tylophora (*Tylophora woollsii*); the Koala (*Phascolarctos cinereus*), Grey-headed Flying-fox (*Pteropus poliocephalus*); Spotted-tailed Quoll (*Dasyurus maculatus*) and Giant Barred Frog (*Mixophyes iteratus*). These two threatened flora species and four threatened fauna species are hereafter referred to collectively as 'the affected threatened species'.

The Project was referred to the Commonwealth in accordance with the requirements of the EPBC Act. The Minister's approval was received on 11 December 2014 subject to a number of conditions being met. The EPBC Approval for the Project (EPBC 2013/7101) requires biodiversity offsets for significant residual impacts on the affected threatened species calculated with reference to the *Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy* (DSEWPaC, 2012) (the policy).

GHD have prepared this 'Biodiversity Offset Package' report (offset package) to assist Roads and Maritime deliver the biodiversity offsets required for the affected threatened species. The offset package has been prepared with reference to the EPBC Act Approval for the project and the policy and to specifically to comply with Condition 12:

"*To compensate for the loss of threatened species habitat, within 12 months of the approval of the action, the approval holder must submit to the Minister for approval a Biodiversity Offset Package*".

The offset package provides for the conservation of appropriate offset sites containing populations and habitat for the affected threatened species of appropriate condition and size. A desktop assessment was undertaken to identify potential offset sites with the necessary attributes and field surveys of candidate offset sites were undertaken to identify offset sites containing populations of the affected threatened species. Roads and Maritime have selected the most suitable of these candidate offset sites to offset the impacts of the Project:

- a 185 hectare site (the 'WC2NH Norton offset area') that occurs within a 496 hectare property (the 'Norton offset site'). Roads and Maritime currently owns the Norton site and are developing an in-perpetuity conservation covenant on the title via a BioBanking agreement to facilitate the long-term management and conservation of the property. Roads and Maritime will purchase and retire all of the biodiversity credits generated at the Norton biobank to ensure that it is securely titled, that funds are available for its management and that it cannot be used to offset the impacts of another project.
- a 49.5 hectare site (the 'WC2NH Boambee offset area') that occurs within a 121 hectare parcel of land in the Boambee State Forest (the 'Boambee SF offset site'). Roads and Maritime have in-principle agreement from the Forestry Corporation of NSW (FCNSW) that the site can be legally secured in perpetuity as a Flora Reserve to conserve populations of *Marsdenia longiloba* and *Tylophora woollsii* and their habitat as well as habitat for the other threatened species.

- a five hectare site (the 'WC2NH xxxxx offset area') that occurs within a 97.4 hectare parcel of privately owned land (the 'xxxxx offset site'). Roads and Maritime have in-principle agreement from the owners of the property that the site can be legally secured in perpetuity under BioBanking agreements to facilitate the long-term management and conservation of the property. Roads and Maritime will purchase and retire the biodiversity credits that are linked to the WC2NH xxxxx offset area to ensure that it is securely titled, that funds are available for its management and that it cannot be used to offset the impacts of another project. Roads and Maritime are also intending to purchase and retire credits from the remainder of the xxxxx offset site to offset the impacts of other projects.

The offset package will conserve known habitat at the Norton, Boambee SF and xxxxx offset sites to compensate for the significant residual impacts of the Project on the affected threatened species and meet the requirements of the the EPBC Act offset policy.

The Project and the Norton, Boambee SF and xxxxx offset sites are shown on Figure 1.

1.2 Summary of impacts

The Project represents the southern section of the Upgrade of the Pacific Highway between Warrell Creek and Urunga (WC2U) on the mid north coast of NSW. The WC2U upgrade has been approved under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and the EPBC Act is being implemented in two stages: the northern (Nambucca Heads to Urunga) section and the southern (Warrell Creek to Nambucca Heads) section. The two stages are considered separate projects and are referred to as the Warrell Creek to Nambucca Heads (WC2NH) Upgrade and the Nambucca Heads to Urunga (NH2U) Upgrade.

The Project (WC2NH) comprises a 19.5 kilometre section of the Pacific Highway extending from the northern end of the Allgomera deviation south of Warrell Creek to Old Coast Road west of Nambucca Heads. It includes a motorway style dual carriageway and will include a number of significant structures, including seven bridges, crossing of the Nambucca River and Warrell Creek floodplain and underpasses for both traffic and fauna (BEM, 2014).

The Project included measures to avoid or mitigate impacts on biodiversity values but resulted in significant residual impacts on threatened species listed under the EPBC Act. The EPBC Approval for the Project (EPBC 2013/7101) includes the following limitations on the removal of **habitat** for the project:

- 17.8 hectares of known habitat for *Marsdenia longiloba* and *Tylophora woollsii.* The area approved to be removed has a site quality score of 6/10 (BEM, 2014) for the purposes of offset assessment guide calculations.
- 106.6 hectares of known habitat for the Koala, including 86.5 hectares of habitat that is critical to the survival of the species. The area approved to be removed has a site quality score of 7/10 (BEM, 2014).
- 106.6 hectares of habitat for the Grey-headed Flying-fox, comprising 103.5 hectares of foraging habitat and 3.1 hectares of roosting habitat critical to the survival of the species. The area approved to be removed has a site quality score of 7/10 (BEM, 2014).
- 114.1 hectares of habitat for the Spotted-tailed Quoll (comprising 113.3 hectares that was included in the referral for the Project and a further 0.8 hectares of impact associated with a Project variation dated 11 May 2015). The area approved to be removed has a site quality score of 5/10 (BEM, 2014).
- 0.7 hectares of known habitat for the Giant Barred Frog. RMS committed to increase the offset area to 0.88 ha of Giant Barred Frog habitat, as a result of an unexpected find process in October 2015 (email from M. Samarakoon, 30 October 2015). It was later

determined the find was of Great Barred Frog (*Mixophyes fasciolatus*) tadpoles, however, RMS will still offset the increased area as a precautionary measure. The area approved to be removed has a site quality score of 6/10 (BEM, 2014).

Direct offsets for these impacts will be delivered through conservation of appropriate areas of habitat in the WC2NH Norton, Boambee SF and xxxxx offset areas. Offset assessment guide calculations that demonstrate how these direct offsets will comply with the EPBC Act offset policy are included in Section 10.4.

A preliminary set of Offset assessment guide calculations was included in the offset strategy for the Project based on known impacts and potential conservation and management of candidate offset sites (BEM, 2014). The Project impact inputs to the final Offset assessment guide calculations included in Section 10.4 have been taken from the offset strategy. The area of offset varies from the estimates presented in the offset strategy because of differences in the quality of habitat at the offset sites and factors such as the mitigated risk of loss of the offset area.

1.3 Purpose of report

This offset package outlines the approach to the delivery of biodiversity offsets for threatened fauna impacted by the Project through conservation and management of the Norton, Boambee SF and xxxxx offset sites, comprising:

- Background information about *Tylophora woollsii* and *Marsdenia longiloba* and the Koala, Grey-headed Flying-fox, Spotted-tailed Quoll, and Giant Barred Frog (in relation to ecology, biology and conservation status) to inform appropriate management actions.
- A detailed description of the quality of the offset with reference to the affected threatened species, comprising:
  - map(s) and shapefiles that clearly define the location and boundaries of the offset sites.
  - the results of targeted field surveys within the offset sites to assess habitat suitability and presence / absence of individuals in relation to the affected threatened species.
  - an assessment of the baseline population of affected threatened biota detected within the offset area during field surveys.
  - maps and data illustrating the extent and quality of habitat for the affected threatened species.
- Description of the titling and management framework that will be adopted at the offset sites.
- A description of performance objectives and management actions that will enable maintenance and enhancement of habitat within the offset area, as well as contribute to the better protection of individuals and/or populations of affected threatened biota onsite, including:
  - Identification of management actions that will improve the quality of habitat or viability of fauna populations.
  - Demonstration that any management actions to be undertaken will not adversely impact the affected threatened species.
  - A description of funding arrangements or agreements, including work programs and responsible entities.
- Details of a monitoring program for determining the effectiveness of management actions.

- Concluding statements demonstrating that conservation and management of the Norton, Boambee SF and xxxxx offset sites will meet the Project's direct offset requirements (as determined by the Department in accordance with the Offsets assessment guide), comply with the conditions of approval for the Project and enhance the conservation of the affected threatened species.

1.4 Terms and definitions

Biodiversity values	The composition, structure and function of ecosystems, including native species, populations and ecological communities, and their habitats.
DotE	The Commonwealth Department of the Environment.
DSEWPaC	The former Department of Sustainability Environment Water Populations and Communities, the Commonwealth Department of the Environment at the time of approval of the Project.
EPBC Act	The *Environment Protection and Biodiversity Conservation Act 1999.*
FCNSW	Forestry Corporation of New South Wales.
Flora reserve	An area that is set aside for the preservation of native flora under the Forestry Act 2012.
Food tree	A tree species that is recognised as being of significant value as a foraging resource for a given fauna species.
Forestry Act	The *New South Wales Forestry Act 2012.*
Habitat critical to the survival of the Koala	Koala habitat that is considered to be important for the species' long-term survival and recovery. Specifically an area that scores five or more, using the habitat assessment tool in the DotE (2013) *Draft EPBC Act referral guidelines for the vulnerable Koala.*
NPW Act	The *National Parks and Wildlife Act 1974.*
NPWS	The NSW National Parks and Wildlife Service
Offset package	The Warrell Creek to Nambucca Heads Biodiversity Offset Package (this report).
PMST	Protected Matters Search Tool, a database administered by the Department that contains known and predicted records of matters of national environmental significance listed under the EPBC Act.
Roads and Maritime	Roads and Maritime Services
The affected threatened species	The two threatened plants and four threatened fauna species that are the subject of this offset package: Clear Milkvine also known as Slender Marsdenia (*Marsdenia longiloba*) and the Cryptic Forest Twiner also known as Woolls' Tylophora (*Tylophora woollsii*); the Koala (*Phascolarctos cinereus*), Grey-headed Flying-fox (*Pteropus poliocephalus*); Spotted-tailed Quoll (*Dasyurus maculatus*), and Giant Barred Frog (*Mixophyes iteratus*).
The Boambee State Forest (SF) offset site	The 121 hectare parcel of land within the Boambee SF that will be set aside and managed as a Flora Reserve to function as a biodiversity offset as part of this offset package and offset packages for other Roads and Maritime projects.
The Department	The Commonwealth Department of the Environment and Energy.

The locality	The area within a 10 kilometre radius of a site.
The Norton offset site	The 496 hectare parcel of land at South Kempsey that will be set aside and managed under a BioBanking agreement as a biodiversity offset as part of this offset package and offset packages for other Roads and Maritime projects.
The Offset assessment guide	The spreadsheet offset calculator that accompanies the DSEWPaC (2012) *Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy*.
The policy	The *Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy* (DSEWPaC 2012).
The Project	The Proposed upgrade of a section of the Pacific Highway between Warrell Creek and Nambucca Heads that is the subject of EPBC Act approval EPBC 2013/7101 and this offset package. Also known as 'WC2NH'.
The region	The NSW north coast, which is equivalent to the Northern Rivers Catchment Management Authority region.
The xxxxx offset site	The 97.4 hectare parcel of land at Upper Corindi that will be set aside and managed under three BioBanking agreements as a biodiversity offset as part of this offset package and offset packages for other Roads and Maritime projects.
The WC2NH Boambee SF offset area	A 49 hectare area contained within the broader Boambee SF offset site that will be specifically set aside as an offset for impacts of the WC2NH Project on the affected threatened species.
The WC2NH Norton offset area	A 185 hectare area contained within the broader Norton offset site that will be specifically set aside as an offset for impacts of the WC2NH Project on the affected threatened species.
The WC2NH xxxxx offset area	A five hectare area contained within the broader xxxxx offset site that will be specifically set aside as an offset for impacts of the WC2NH Project on the affected threatened species.
WC2NH	The Proposed upgrade of a section of the Pacific Highway between Warrell Creek and Nambucca Heads that is the subject of EPBC Act approval EPBC 2013/7101 and this offset package. Also known as 'the Project'

1.5 Methods

1.5.1 Desktop assessment

This offset package draws upon information in specialist reports which have described the biodiversity values of the offset sites for other projects, including the following:

- *Pacific Highway Upgrade, Nambucca Heads to Urunga Threatened Flora Offset Management Plan* (GHD, 2016a) which describes the vegetation and especially *Marsdenia longiloba* and *Tylophora woollsii* populations at the Boambee SF offset site.

- *Pacific Highway Upgrade, Nambucca Heads to Urunga Norton and Griffin Offset Management Plan* (GHD, 2016a) which describes the vegetation and quality of habitat for the Grey-headed Flying Fox, Koala and Spotted-tail Quoll at the Norton offset site.
- *Warrell Creek to Nambucca Heads Pacific Highway upgrade Compensatory Habitat Assessment Multiple Properties* (BEM, 2014) which describes the amount and quality of habitat for the affected threatened species in the WC2NH impact area.

A broader desktop assessment was undertaken to help describe the ecology of the affected threatened species, the existing environment of the offset sites and to describe the presence and characteristics of local and regional populations of the affected threatened species. The following resources were reviewed:

- The OEH Threatened Species, Populations and Communities Database (OEH, 2015a) and the Department's Species Profiles and Threats Database for general information about the ecology and biology of the affected threatened species (DotE, 2015a).
- The NSW Office of Environment and Heritage (OEH) Atlas of NSW Wildlife (OEH, 2015b) for records of the affected threatened species in the locality of the offset sites and the Departments Protected Matters Search Tool (PMST) for known or predicted records of the affected threatened species in the locality (DotE, 2015b).
- The *Kempsey to Eungai: Compensatory Habitat package* (Lewis and James, 2010) which includes an ecological assessment of the Norton offset site.
- Recovery plans and threat abatement plans for of the affected threatened species and scientific journal articles that have informed these plans, for specific information about the ecology and biology of the species, threats, conservation objectives and recovery actions.
- Other resources describing the existing environment of the offset sites, including regional vegetation, soil landscapes and geology mapping.

1.5.2 Consultation

Development of offset package

Consultation was undertaken with Roads and Maritime and other relevant stakeholders in developing this offset package, with particular focus on the titling and management framework that will be adopted at each site.

The main stakeholders involved were:

- Roads and Maritime Property Services, to confirm the future owners of each property, arrangements for the changes in tenure and titling and provision of funds for management.
- The Forestry Corporation of NSW (FCNSW) who will be responsible for managing the Boambee SF offset site as a Flora Reserve.
- Dr Andrew Benwell who is a recognised specialist on the distribution and ecology of *Marsdenia longiloba* and *Tylophora woollsii* in the region.

Finalisation of offset package

This offset package has been finalised in accordance with Condition 12 of the approval (EPBC 2013/7101) and with reference to comments received from the Department based on their review of the final draft offset package which was submitted on 11 December 2015.

A table summarising Roads and Maritime's response to the Department's comments on the final draft offset package (received on 11 February 2016) is presented in Appendix E. The main

issues raised in the Department's review and addressed in this final offset package report comprise:

- Updated project impact areas.
- Confirmation that a BioBanking agreement will be the conservation covenant that is applied at the Norton site and inclusion of the management actions plan for the biobank as Appendix D.
- Additional justification for attribute scores entered in offset assessment guide calculations including habitat quality, averted risk of loss and confidence scores.
- Additional detail about field survey methodology and which of the affected threatened biota were targeted by each survey technique.
- Additional detail confirming the consistency of management actions proposed at offset sites with threat abatement plans for the affected threatened biota.
- Additional detail regarding management actions proposed at offset sites including timing, measureable performance indicators, triggers and corrective actions.
- A risk assessment.
- Details of the various parties responsible for implementing the offset package.
- Various editorial changes, corrections to formatting, clarification of references etc.

Other inputs to this final offset package due to factors beyond the Department's review include:

- Inclusion of the 'WC2NH xxxxx offset area' as an offset for impacts on the Giant Barred Frog because an appropriate area of habitat could not be confirmed at the Boambee SF offset site.
- Changes to the boundary of the Norton offset site and the location of the WC2NH Norton offset area because of recent land acquisitions and construction of the 'Pacific Highway Upgrade, Kundabung to Kempsey' project adjacent to the site.
- Inclusion of additional field survey results for the Norton offset site from the BioBanking assessment that was conducted at the site in April 2016, including plant species richness results from 39 BioBanking plot/transects and fine scale vegetation mapping.

1.5.3 Field surveys

Norton offset site

The Norton offset site was initially surveyed and assessed as part of the offset strategy for the broader Pacific Highway upgrade program. The Norton offset site was surveyed by a specialist zoologist and a specialist botanist as documented in Lewis and James (2010). The flora survey of the Norton offset site and an adjoining 100 hectare site was undertaken over five days in May 2010 with a total survey effort of around 50 person-hours (Lewis and James, 2010).

Each property was systematically traversed on foot to obtain data on the following (Lewis and James, 2010):

- Type and extent of vegetation communities.
- Species composition/inventory.
- Condition of vegetation with reference to BioBanking condition thresholds and benchmark values.
- The presence and extent of noxious weeds.

- The presence or likelihood of occurrence of threatened species and ecological communities.

Targeted field surveys were undertaken by GHD and Omvi ecologists within the Norton offset site in September 2014 to assess habitat suitability and the status of local populations of the affected threatened species. The purpose of these supplementary surveys was to more accurately map the extent and quality of habitat for the affected threatened species to inform offset calculations and the development of management actions.

An additional of targeted surveys was conducted by GHD and Idyll Spaces ecologists in April 2016 to help complete the BioBanking assessment for the Norton site. The 2016 surveys included full floristic survey of 39 BioBanking plot/transects and fine scale vegetation mapping.

Field survey methods comprised:

- Ground-truthing of the existing vegetation mapping.
- Habitat assessments, focussing on identifying the extent and quality of specific habitat resources of relevance to the affected threatened species, including:
  - Food tree species for the Koala as specified in the Comprehensive Koala Plan of Management for the Eastern portion of Kempsey Shire LGA, Vol. 1 (KSC, 2011).
  - Vegetation type and structure, presence and quality of woody debris, caves rock outcrops and other potential den sites for the Spotted-tailed Quoll.
  - Critical foraging habitat for the Grey-headed Flying-fox as defined in Eby and Law (2008) and the recovery plan for the species (DECC, 2009).
- BioBanking plot/transect surveys to collect data on vegetation structure, species richness, regeneration and presence of habitat resources such as fallen logs and hollow bearing trees (see DECC, 2009) (note that some of these plot/transects are located outside of the WC2NH offset area that is the subject of this offset package. The results have been included in the general assessment of vegetation condition and habitat quality at the site).
- Sampling of 'Canopy plots' nested in BioBanking plot/transects, comprising counts of every tree in the 50 m x 20 m plot along with its height, species, canopy cover and any evidence of fauna activity. Each tree species was then cross referenced to lists of food tree species for the Koala and Grey-headed Flying-fox to calculate the cover of food tree species.
- Koala 'Spot Assessment Technique' (SAT) searches for scats and evidence of Koala activity with reference to Phillips and Callaghan (2011), comprising:
  - Location and flagging of a centre tree that was located in a plot/transect and that was a Koala primary food tree species;
  - Identification and marking of the 29 trees closest to the centre tree; and
  - Searches for Koala scats within 100cm of the trunk of each of the 30 trees.
- Nocturnal surveys targeting the Koala, Spotted-tailed Quoll, Grey-headed Flying-fox and Giant Barred Frog over two sets of four person-hour survey rounds on two separate nights, including walked spotlighting transects, quiet listening periods, call playback and streamside searches.
- Four motion sensing camera-traps targeting the Koala and Spotted-tailed Quoll, placed for five days and five nights, split between the main habitat types and targeting potential fauna movement corridors such as fire trails and drainage lines.

The site was stratified into fauna habitat types following an assessment of floristic composition, structure, topography, hydrological features, soil characteristics and disturbance history.

Throughout all stages of the GHD surveys and the previous surveys, specific attention was given to detecting scats and other characteristic signs of fauna as well as areas of suitable habitat for affected threatened biota, including the presence of food trees for the Koala, den or latrine sites for the Spotted-tailed Quoll and roost sites for the Grey-headed Flying Fox.

Field survey results are provided in Appendix A.

Boambee SF offset site

The Boambee SF offset site was initially surveyed and assessed as part of the offset strategy for the Nambucca Heads to Urunga Pacific Highway upgrade project. The Boambee SF offset site was surveyed by a specialist zoologist and up to two specialist botanists. The flora survey of the Boambee SF offset site was undertaken over a total of 8 days in April and May 2015 with a total survey effort of around 140 person-hours.

An initial two-day survey of the Boambee SF and adjoining land in the Tuckers Nob SF was undertaken by Dr Andrew Benwell in April 2015. The purpose of this initial survey was to identify occupied habitat for the affected threatened plants and to help define a suitable offset site.

A subsequent detailed survey of the entire Boambee SF offset site was undertaken over six days in May 2015 by the suitably qualified ecologists summarised in Table 2. The detailed survey was the basis of the threatened plant counts and habitat mapping included in this offset package. Targeted surveys of the offset site comprised the following methodology:

- Ground-truthing of existing regional vegetation mapping (OEH, 2012).
- Targeted searches for threatened plants along closely-spaced meander traverses (i.e. parallel traverses approximately 20 metres apart) through appropriate habitat. Survey intensity was increased at the locations of clusters/individuals of threatened plants identified in the preliminary survey and/or whenever threatened plants were located in order to obtain accurate counts of the numbers of stems at the site.
    - Capture of GIS locations of individual threatened plants or clumps of closely spaced stems (i.e. <five metres apart) along with: a unique identifier for each point; species; number of stems; height; and plant health data where relevant.
    - Sampling of five biometric plot/transects to describe the species composition, structure and condition of vegetation within the site with plot/transects placed within patches of occupied threatened plant habitat.
    - Collection of Braun-Blanquett cover-abundance data within the 20 m x 20 m species richness plot component of the biometric plot/transects.
    - Habitat assessment and general description of the existing environment of the offset site and condition of native vegetation.
    - Mapping and assessment of weed infestations, cleared or modified native vegetation and any other areas that will require management at the offset site.
    - Mapping of management features and attributes such as the location of proposed or existing fences and gates, signs, trails etc.

Additional targeted field surveys were undertaken within the Boambee SF in November 2015, mainly targeting the affected threatened fauna species within the WC2NH offset area. Surveys were undertaken by a specialist botanist and two zoologists over five days and four nights. The purpose of these supplementary surveys was to confirm the presence of local populations of the Koala, Grey-headed Flying Fox and Giant Barred Frog as required by the conditions of approval and to quantify the extent and quality of habitat for the affected threatened fauna species to inform offset calculations and the development of management actions.

The survey effort was stratified across fauna habitat types based on an assessment of floristic composition, structure, topography, hydrological features, soil characteristics and disturbance history.

Field survey methods comprised:

- Habitat assessments, focussing on the extent and quality of specific habitat resources of relevance to the affected threatened species, including:
  - Food tree species for the Koala as specified in the Coffs Harbour City Koala plan of management (Lunney et. al., 1999).
  - Vegetation type and structure, presence and quality of woody debris, caves rock outcrops and other potential den sites for the Spotted-tailed Quoll.
  - Critical foraging habitat for the Grey-headed Flying-fox as defined in Eby and Law (2008) and the recovery plan for the species (DECC, 2009).
  - Breeding habitat for the Giant Barred Frog as defined in its species profile (OEH, 2015a; DotE, 2015a) and associated literature.
- Sampling of a further seven BioBanking plot/transects, stratified between vegetation types in the WC2NH offset area portion of the site.
- Sampling of 'Canopy plots' nested in BioBanking plot/transects.
- Koala SAT searches (as described above).
- Nocturnal surveys targeting the Koala, Spotted-tailed Quoll and Grey-headed Flying-fox over four sets of four person-hour survey rounds on four separate nights, including walked spotlighting transects and quiet listening periods for fauna calls.
- Targeted frog surveys over four person-hour survey rounds on four separate nights, including streamside searches, call playback, dip netting for tadpoles and quiet listening periods.
- Five motion sensing camera-traps targeting the Koala and Spotted-tailed Quoll, placed for five days and four nights split between the main habitat types and targeting potential fauna movement corridors or habitat features.

Throughout all stages of the GHD surveys specific attention was given to detecting scats and other characteristic signs of fauna as well as areas of suitable habitat for the affected threatened biota.

Daily weather observations for the Coffs Harbour Airport weather station during the targeted fauna surveys at the Boambee SF offset site (3-7 November) and for the preceding seven days are presented in Table 1.

Weather conditions during the survey period were generally suitable for detecting the Giant Barred Frog and other fauna species, with moderate rain in the week preceding surveys, frequent heavy rain during the survey period and warm nights. Despite these generally favourable conditions no adult Giant Barred Frogs were detected, potentially because adults were seeking shelter and avoiding the flooding of breeding habitat during heavy downpours (a week after heavy rain events is identified as the optimum time for surveys in the *Survey guidelines for Australia's threatened frogs: Guidelines for detecting frogs listed as threatened under the EPBC Act* (DEWHA, 2010) rather than during heavy rainfall or stream flow).

Table 1 Weather conditions for targeted frog surveys at the xxxxx and Boambee SF offset sites

Date	Day	Temps		Rain
		Min	Max	
		°C	°C	mm
27 Oct.	Tuesday	16.3	25.0	1.6
28 Oct.	Wednesday	14.8	20.7	0.2
29 Oct.	Thursday	15.6	20.5	
30 Oct.	Friday	14.4	24.0	2.6
31 Oct.	Saturday	16.4	24.4	0
1 Nov.	Sunday	18.0	27.0	0
2 Nov.	Monday	19.6	29.1	0
3 Nov. (Boambee night 1)	Tuesday	19.3	25.6	0.6
4 Nov. (Boambee night 2)	Wednesday	17.1	24.1	13.8
5 Nov. (Boambee night 3)	Thursday	19.6	23.7	20.0
6 Nov. (Boambee night 4)	Friday	20.1	28.3	6.4
7 Nov.	Saturday	17.7	27.3	0
24 March	Thursday	14.9	26.5	0
25 March	Friday	16.1	28.2	0.4
26 March	Saturday	18.7	27.1	3.4
27 March	Sunday	20.2	25.7	0
28 March	Monday	17.6	27.6	0
29 March	Tuesday	21.4	30.7	4.6
30 March	Wednesday	20.0	24.7	0.2
31 March (xxxxx night 1)	Thursday	14.4	26.8	0
1 April (xxxxx night 2)	Friday	14.2	27.3	0

xxxxx offset site

The xxxxx offset site was surveyed by a specialist zoologist, a specialist botanist and a recognised Giant Barred Frog specialist. The survey of the xxxxx offset site was undertaken over two days in April 2016 with a total survey effort of around 30 person-hours. The main purpose of the survey was to identify occupied Giant Barred Frog habitat as required by the conditions of approval and to quantify the extent and quality of habitat to inform offset calculations and the development of management actions for this species.

The targeted surveys of the xxxxx offset site comprised the following methodology:

- Ground-truthing of existing regional vegetation mapping (OEH, 2012).
- Sampling of five biometric plot/transects to describe the species composition, structure and condition of vegetation within the site with two plot/transects placed within occupied

Giant Barred Frog habitat in the WC2NH xxxxx offset area to help define site quality and baseline condition.

- Collection of cover and abundance data within the 20 m x 20 m species richness plot component of the biometric plot/transects.
- Habitat assessment with particular focus on breeding habitat for the Giant Barred Frog as defined in its species profile (OEH, 2015a; DotE, 2015a) and associated literature as well as a general assessment of the existing environment of the offset site and condition of native vegetation.
- Targeted frog surveys over four person-hour survey rounds on two separate nights, including streamside searches, call playback and quiet listening periods.
- Mapping and assessment of weed infestations, cleared or modified native vegetation and any other areas that will require management at the offset site.
- Mapping of management features and attributes such as the location of proposed or existing fences and gates, signs, trails etc.

Daily weather observations for the Coffs Harbour Airport weather station during the targeted fauna surveys at the xxxxx offset site (31 March, 1 April) and for the preceding seven days are presented in Table 1.

Weather conditions during the survey period were generally suitable for detecting the Giant Barred Frog and other fauna species, with 8.6 millimetres of rain in the week preceding surveys, warm, humid weather during the survey period and warm nights. Multiple adult Giant Barred Frogs, including some calling adult males were detected (see Section 5.5).

1.6 Staff qualifications

Qualifications of ecologists and environmental management specialists that undertook field surveys and helped prepared this biodiversity offset package are provided in Table 2. Flora and fauna surveys were conducted under a Section 132C scientific licence (SL100146) issued under the NSW *National Parks and Wildlife Act 1974* and complied with GHD's animal ethics Research Authority.

Ben Harrington, a Senior Ecologist at GHD, is the suitably qualified ecologist responsible for preparing the biodiversity offset package as required by the conditions of approval. Ben is a Senior Ecologist with over 13 years' experience conducting ecological surveys and assessments in NSW, including over 11 years' experience in environmental consulting. Ben has extensive field survey and project experience on the NSW North Coast and throughout regional NSW. Ben is the technical lead of GHD's BioBanking and biodiversity offset group. He has extensive experience preparing biodiversity offset assessments and offset site management plans for major projects using the EPBC Act Offset Policy and guide as well as the NSW BioBanking and Framework for Biodiversity Assessment methodologies.

Dr Andrew Benwell is an additional suitably qualified ecologist who was engaged by Roads and Maritime to assist with botanical surveys, vegetation assessment and especially assessment and management of the affect threatened plants *Marsdenia longiloba* and *Tylophora woollsii* in the preparation of this offset package. Dr Benwell is a highly experienced botanist with specialist technical experience in the identification, assessment and management of the affected threatened plants. Dr Benwell has overseen field surveys, including targeted surveys for the affected threatened plants in the project site, Boambee SF offset site and other candidate offset sites for WC2NH and similar projects. He has also overseen ongoing studies of the life history and population dynamics of the regional population of the affected threatened plants through

translocation and monitoring programs completed for the Pacific Highway upgrade (Benwell and Watson, 2011; Benwell, 2013).

Jayne Tipping, a Principal Ecologist at GHD, is the independent expert responsible for overseeing the preparation and implementation of the biodiversity offset package and for technical review as required by the conditions of approval. Jayne is a principal ecologist with over 23 years' experience and a proven track record of working closely with clients and stakeholders to gain project approvals and comply with relevant legislation and policy at the State and Federal levels. She has a strong understanding of the ecological assessment and approval processes, backed by a sound technical knowledge of all aspects of ecological assessment.

Table 2 Qualifications of staff

Name	Company	Position/Role	Qualifications	Years' Experience
Ben Harrington	GHD	Senior Ecologist / lead author of offset package. Desktop assessment, site surveys, offset calculations, preparation of offset package and management plan.	BSc, MSc (Physical Geography) NSW BioBanking Assessor Accreditation (number 0073)	13+
Dr Andrew Benwell	ECOS Environmental	Principal Botanist / lead botanist. Site surveys, vegetation assessment, specialist technical inputs regarding ecology of threatened plants.	Dip. Hort., Ba. Hons. (Biogeography). Phd (Plant ecology)	20+
Jayne Tipping	GHD	Principal Ecologist / technical reviewer. Independent expert technical review of the offset package.	BSc (Ecology), MEnvLaw	23+
Dan Williams	GHD	Principal Environmental Scientist / management specialist. Specialist technical inputs to management actions and planning.	BAppSc (Conservation Technology)	15+
Lui Weber	Sole trader	Senior Botanist / field botanist. Site surveys, vegetation assessment.	BSc. Hons. (Botany),	8+
Rob Price	Wanungara	Senior Botanist / field botanist. Site surveys.	BSc (Botany). Cert II Land conservation and Restoration.	12+
Brendan Ryan	Omvi Ecological	Senior Ecologist / field zoologist. Site surveys.	BSc, MSc (Environmental Science)	19+

Name	Company	Position/Role	Qualifications	Years' Experience
Malith Weerakoon	GHD	Graduate Ecologist / field zoologist. Site surveys.	BSc, MPhil. (Zoology)	2+
Jess Sharp	GHD	Graduate Ecologist / field zoologist. Site surveys.	BEnvs	2+
Greg Elks	Idyll Spaces	Senior Botanist / site surveys	BSc, MLitt	20+

1.7 Scope and limitations

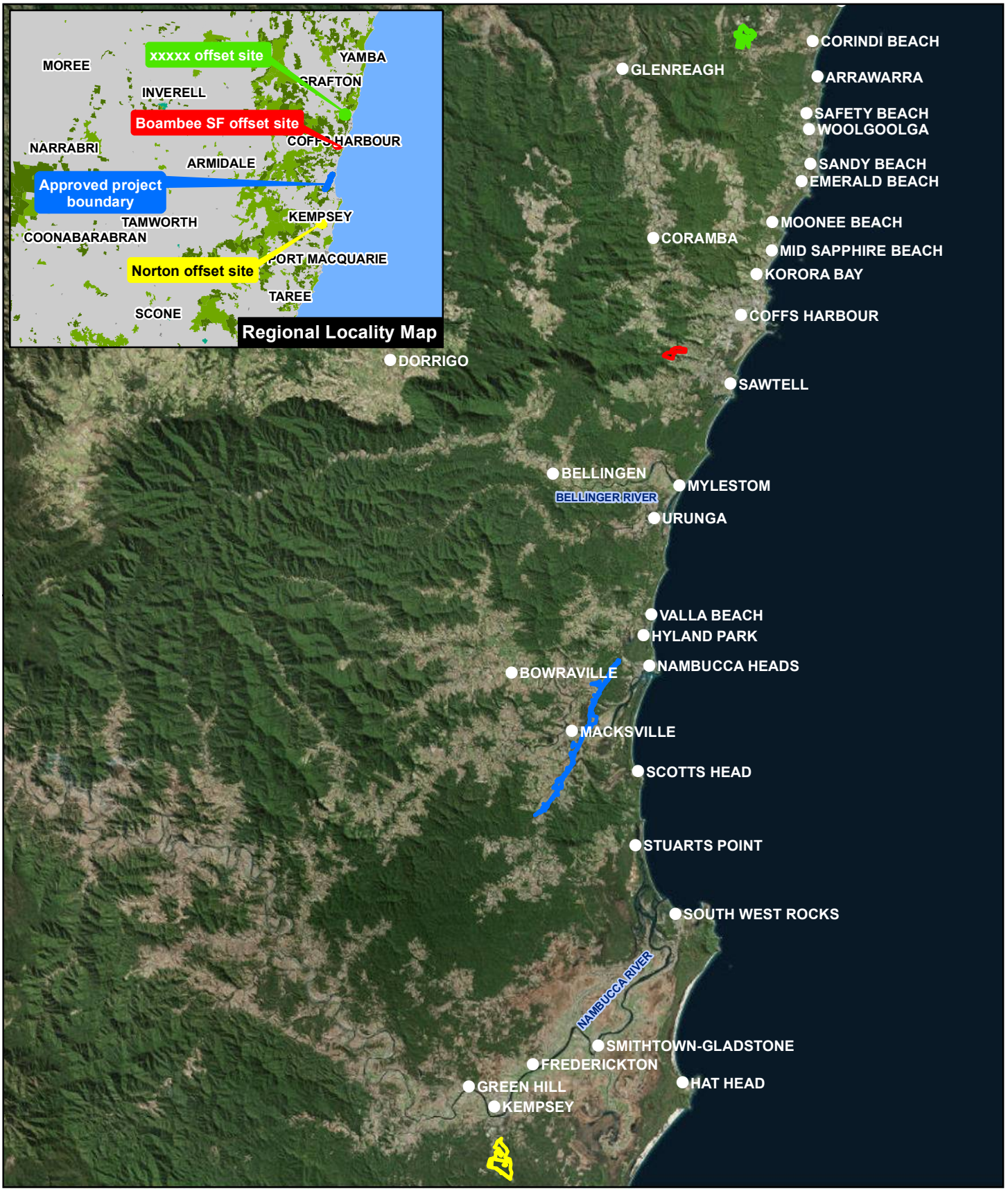
This report has been prepared by GHD for Roads and Maritime Services to assist Roads and Maritime Services to meet the conditions of approval relating to biodiversity offsets for the project (specifically EPBC2013/7101: Condition 12). This report may only be used and relied on by Roads and Maritime Services for the purpose agreed between GHD and the Roads and Maritime Services as set out in Section 1.3 of this report. GHD otherwise disclaims responsibility to any person other than Roads and Maritime Services arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report in Sections 2 to 4 and GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Roads and Maritime Services and others who provided information to GHD, which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which may have been included in the information provided by Roads and Maritime Services.



LEGEND

- xxxxx offset site
- Boambee SF offset site
- Norton offset site
- Approved project boundary

Paper Size A4

0 5 10 20

Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

Roads and Maritime Services
Pacific Highway Upgrade
Warrell Creek to Nambucca Heads
Biodiversity Offset Package

Job Number 21-24927
Revision A
Date 02 Sep 2016

The Project and offset sites

Figure 1

N:\AU\Sydney\Projects\21\24927\GIS\Maps\Deliverables\21_24927_Z001_ProjectSite.mxd

Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data Source: General topo - NSW LPI DTDB 2012, Geoscience Australia: 250k Data - Jan 2011; Aerial Imagery - ESRI 2016.jrichardson

2. Ecology of the affected threatened species

2.1 Overview

The following section provides information about *Marsdenia longiloba*, *Tylophora woollsii*, the Koala, Grey-headed Flying-fox, Spotted-tailed Quoll and Giant Barred Frog, in relation to the ecology, biology and conservation status of these threatened species, to inform the development of appropriate management actions.

The information presented below has been used to compile this offset package for the affected threatened species as follows:

- To describe the existing environment of the offset sites, including the extent and quality of habitat resources and status of local populations (see Section 3 and 4).
- To identify management actions appropriate to the life cycle, habitat requirements and threats to the persistence of these species (see Sections 6 and 7).
- To determine the quality of the biodiversity offset that will be delivered by conservation of the Norton, Boambee SF and xxxxx sites (see Section 9).

2.2 *Marsdenia longiloba*

Marsdenia longiloba is a slender, rhizomatous (i.e. growing with multiple stems from a shared root system), perennial climber of the 'milk vine' group. This group comprise the Family Apocynaceae, previously placed in the Asclepediaceae. *Marsdenia longiloba* has opposite pairs of very finely pointed leaves which are an elongated heart-shape with a thin texture and 5-6 tiny glands at the base of the leaves. The stems of *Marsdenia longiloba* exude clear, watery sap when cut, unlike most of the milk vines which have milky sap. Clusters of small white star-shaped flowers are produced in Summer and are followed by long, narrow seed-capsules that split to release many seeds with tufts of long silky hair (DECC, 2005a) which suggests that seed spread is via wind.

2.2.1 Conservation status

Marsdenia longiloba is listed as a vulnerable species under the EPBC Act. *Marsdenia longiloba* is also listed as an endangered species under the NSW *Threatened Species Conservation Act 1995* (TSC Act) and as a vulnerable species under the Queensland *Nature Conservation (Wildlife) Regulation 2006*.

Marsdenia longiloba has been assigned to the 'Keep-watch' species management stream under the NSW Saving our Species program because relatively large populations of this species occur within reserves (e.g. up to 1000 individuals estimated to occur in Bongil and New England National Parks and over 1000 in Yabbra NP) where it is assumed that current management will be sufficient to secure the conservation of the species in NSW (OEH, 2015a).

2.2.2 Distribution and habitat

Marsdenia longiloba occurs as scattered populations from the coast to the Great Dividing Range, from the Hastings River north through the north coast of NSW and into south-east Queensland. Within this range it is conserved within the Lamington National Park (NP), Main Range NP, Mt Barney NP, and Toonumbar NP (Threatened Species Scientific Committee, 2008a) as well as Bongil Bongil NP, New England NP and Yabbra NP (OEH, 2015a).

It occurs in wet sclerophyll forest, on sheltered south-facing slopes or narrow gullies in hilly terrain (Benwell, pers. comm. 2014). *Marsdenia longiloba* is most frequently associated with forest dominated by Grey Gum (*Eucalyptus propinqua*), Tallowwood (*E. microcorys),* Narrow-leaved Ironbark (*E. crebra)* and White Mahogany (*E. acmenoides*). In the study area for the project, this species also occurred in forest dominated by Brushbox (*Lophostemon confertus)* Flooded Gum (*E. grandis*) or Blackbutt (*E. pilularis*) but much less frequently (Benwell, pers. comm. 2014).

Specific characteristics of the *Marsdenia longiloba* habitat recorded at the project site and the surrounding Nambucca - Coffs Harbour region included:

- Moderate to gentle, well drained slopes, often with a southerly aspect.
- A yellow to red clay podzol soil type formed on Permian metasediments.
- Topsoil that was slightly acidic (pH >6), 15-30cm deep, dark brown and rich in organic matter.
- Wet sclerophyll forest vegetation with an open to mid dense rainforest understorey.
- Understorey vegetation that was moderately well lit and open, not dense or heavily shaded (Benwell, 2013).

The fine scale vegetation mapping of Coffs Harbour LGA (OEH 2012) identifies *Marsdenia longiloba* as a component species in two vegetation types:

- Coast and Hinterland Riparian Flooded Gum Bangalow Wet Forest (CH_WSF01)
- Northern Escarpment Blackbutt - Apple Wet Ferny Forest (CH_WSF09) (OEH, 2012).

Both of these vegetation types are present at the Boambee SF offset site and contained extensive areas of occupied *Marsdenia longiloba* habitat. *Marsdenia longiloba* was also recorded in other wet sclerophyll forest vegetation communities (see Sections 4.3 to 4.5).

2.2.3 Life history and population dynamics

The life history and population dynamics of the regional population of *Marsdenia longiloba* surrounding the project site and offset site have been studied in detail during translocation and monitoring programs completed for the Pacific Highway upgrade (Benwell and Watson 2011; Benwell,2013). Specific attributes include:

- Discrete sub-populations and patches generally comprising several single-stemmed ramets (i.e. genetically identical stems) growing from a single branching underground rhizome (i.e. fibrous root system).
- Sub-populations may originate vegetatively from the same parent plant and spread over a considerable area (e.g. 0.04 hectares).
- Above ground stems are comparatively short-lived (1-10 years), while the rhizomes are probably more long-lived.
- The rhizomes are relatively thin, 10-30cm long and generally grow horizontally within the topsoil before budding off and separating from the parent rhizome to form separate plants.
- Plants may die back to the rhizome and remain stem-less and dormant for at least two years.
- Most stems never grow more than 30 cm tall before dying back.
- Only large stems (i.e. >one metre tall) produce flowers and production of pods and seed is extremely rare; one pod was recorded during several years of monitoring at several

locations and a single pod was observed at the Boambee SF offset site during the current surveys.

- *Marsdenia longiloba* appears to rely on vegetative reproduction for population persistence with flowering and seed dispersal playing a minor role.

Marsdenia longiloba stems are conspicuously absent from recently logged or burnt forest, although monitoring of translocation areas has shown that dormant rhizomes may be present in the soil. This suggests that conditions during early post-disturbance succession are not favourable for growth of *Marsdenia longiloba*, and stem growth may occur mainly during mid to late stages of succession (Benwell and Watson 2011; Benwell,2013).

The specific response of *Marsdenia longiloba* to fire has never been monitored (Benwell and Watson 2011; Benwell, 2013) but it is generally assumed to be sensitive to fire (DECC, 2005a; Threatened Species Scientific Committee, 2008a).

2.2.4 Threats and recovery actions

No Threat Abatement Plan has been provided for this species and the DotE has determined that a recovery plan is not required (DotE, 2015).

The main identified threats to *Marsdenia longiloba* include localised extinction due to small population size; loss and fragmentation of habitat through land clearing for agriculture and urban development; invasion by introduced weeds, such as Lantana (*Lantana camara*); grazing and trampling by cattle; inappropriate fire regimes; and herbicide usage (DECC, 2005a; Threatened Species Scientific Committee, 2008a).

Additional threats that are not explicitly recognised in any conservation advice for *Marsdenia longiloba* but which may potentially have an impact on the species or its habitat include:

- Root rot caused by the fungus *Phytophthora cinnamomi,* which is recognised as a threat to the closely related *Tylophora woollsii* (DECC, 2005b; Threatened Species Scientific Committee, 2008b).
- Grazing, trampling and habitat degradation by feral herbivores.
- Prolonged drought or other severe weather events.

The approved conservation advice for *Marsdenia longiloba* identifies the following priority recovery and threat abatement actions that can be undertaken to support the recovery of the species and which are relevant to the management of the species in the offset site:

- Avert habitat loss, disturbance and modification by:
  - Monitoring known populations to identify key threats.
  - Monitoring the progress of recovery, including the effectiveness of management actions and the need to adapt them if necessary.
  - Marking all populations on roadsides, and ensuring road widening and maintenance activities (or other infrastructure or development activities) involving substrate or vegetation disturbance in areas where *Marsdenia longiloba* occurs do not adversely affect known populations.
  - Controlling access routes to suitably constrain public access to known sites on public land.
  - Minimising adverse impacts from land use at known sites.
  - Investigating formal inclusion of crown land in reserve tenure if possible.
- Avoid damaging wildfires or inappropriate fire regimes by:

  - Developing and implementing a suitable fire management strategy for *Marsdenia longiloba*.
  - Providing maps of known occurrences to local and state Rural Fire Services and seeking inclusion of mitigation measures in bush fire risk management plan(s), risk register and/or operation maps.
- Avoiding livestock impacts such as trampling, browsing or grazing by managing total grazing pressure at important/significant sites through exclusion fencing or other barriers.
- Manage invasive weeds.
- Implement the threat abatement strategies for the control of Lantana in the region.
- Identify, remove, and prevent introduction of weeds in the local area, which could become a threat to the *Marsdenia longiloba* using appropriate methods.
- Ensure chemicals or other mechanisms used to eradicate weeds do not have a significant adverse impact on the species (DECC, 2005a; Threatened Species Scientific Committee, 2008a).

Managing feral herbivores will also benefit the recovery of the species.

Marsdenia longiloba has been transplanted successfully from disturbance footprints as part of translocation programs and has been propagated successfully from rhizome pieces (Benwell and Watson 2011; Benwell, in. prep.).

2.3 *Tylophora woollsii*

Tylophora woollsii is a slender woody climber with a thin twining stalk that grows to three metres long. It is in the 'milk vine' group (Family Apocynaceae) along with the closely related *Marsdenia longiloba* described above. It has opposite, paired leaves on stalks 7 - 20 mm long, which are an elongated heart-shape with a firm texture. There are two to four tiny glands at the base of each leaf-blade and the stems exude a clear, watery sap if cut. The purple to red flowers are 5 - 6 mm in size, and are produced in late summer to autumn on zigzagging branched stalks growing from the leaf junctions. They are followed by narrow seed-capsules 5 - 8 cm long, which split to release many seeds, each of which has a tuft of silky hair (DECC, 2005b) which suggests that seed spread is via wind.

2.3.1 Conservation status

Tylophora woollsii is listed as an endangered species under the EPBC Act. *Tylophora woollsii* is also listed as an endangered species under the TSC Act and an endangered species under the Queensland *Nature Conservation Act 1992*.

Tylophora woollsii has been assigned to the 'Site-managed species' management stream under the Saving our Species program because it requires site-based management in order to secure it from extinction in NSW for 100 years (OEH, 2015b)(see Section 2.3.4 below).

2.3.2 Distribution and habitat

Tylophora woollsii occurs in northern NSW and the Darling Downs in south-east Queensland. NSW records are from the Coffs Harbour–Dorrigo area, the upper reaches of Taylors Arm near Nambucca Heads, and along the Queensland border near Tenterfield. It is known to occur in Bald Rock NP and Gibraltar Range NP (Threatened Species Scientific Committee, 2008b).

Tylophora woollsii occurs in wet sclerophyll forest or rainforest, on mid to upper slopes on sheltered south-facing slopes in hilly terrain (Benwell, pers. comm. 2014). This habitat has been described as brown clay over metasediments in wet sclerophyll forest at elevations between 10 and 750 metres (Quinn et al. 1995 quoted in Threatened Species Scientific Committee, 2008b).

Targeted surveys conducted for translocation and monitoring programs suggest that the specific characteristics of the *Tylophora woollsii* habitat in the Nambucca - Coffs Harbour region are equivalent to that described for *Marsdenia longiloba* in Section 2.2.3 above (Benwell, 2013).

The fine scale vegetation mapping of Coffs Harbour LGA (OEH 2012) does not identify *Tylophora woollsii* as a component species in any vegetation communities (OEH, 2012) presumably because of the low abundance and cryptic character of the species.

2.3.3 Life history and population dynamics

Little is definitively known about the life history and population dynamics of *Tylophora woollsii* (Benwell, 2013).

As described above, the life history and population dynamics of the regional population of *Marsdenia longiloba* have been studied in detail during translocation and monitoring programs (Benwell and Watson 2011; Benwell,2013). The two threatened plant species are physically similar, closely related, occupy the same areas of habitat and observation of flowering in translocated individuals has confirmed that some plants previously thought to be *Marsdenia longiloba* are in fact *Tylophora woollsii* (Benwell, pers. comm. 2014). Therefore, it is probably safe to infer the following life history attributes for *Tylophora woollsii*:

- Discrete sub-populations may originate vegetatively from the same parent plant and spread over a considerable area.
- Sub-populations are likely to comprise several single-stemmed ramets growing from a branching underground rhizome.
- Plants may die back to the rhizome and remain stem-less and dormant.
- It is likely to rely on vegetative reproduction for population persistence with flowering and seed dispersal playing a minor role since no flowers or pods have been recorded during several years of monitoring at several locations. Flowering has been recorded in translocated stems under nursery conditions (Benwell, pers. comm. 2014).

The specific response of *Tylophora woollsii* to fire has never been monitored (Benwell and Watson 2011; Benwell, 2013) but it is generally assumed to be sensitive to fire (DECC, 2005b; Threatened Species Scientific Committee, 2008b). The species should not be burnt more frequently than once every 25 years (NSW RFS, 2004, quoted in Threatened Species Scientific Committee, 2008b).

2.3.4 Threats and recovery actions

No Threat Abatement Plan has been provided for this species and the DotE has determined that a recovery plan is required and it has been included on the commenced list (DotE, 2015).

The main identified threats to *Tylophora woollsii* include timber harvesting operations, clearing for agriculture, cattle grazing, competition with weeds; physical damage, particularly to roadside populations due to vehicles and associated roadwork, root rot caused by the fungus *Phytophthora cinnamomi* (DECC, 2005b; Threatened Species Scientific Committee, 2008b) and inappropriate fire regimes (Forster, 2001, pers. comm. quoted in Threatened Species Scientific Committee, 2008b).

Additional threats that are not explicitly recognised in any conservation advice for *Tylophora woollsii* but which may potentially have an impact on the species or its habitat include:

- Grazing, trampling and habitat degradation by feral herbivores.
- Prolonged drought or other severe weather events.

The approved conservation advice for *Tylophora woollsii* identifies the following priority recovery and threat abatement actions that can be undertaken to support the recovery of the species and which are relevant to the management of the species in the offset site.

Avert habitat loss, disturbance and modification by:

- Monitoring known populations to identify key threats.
- Monitoring the progress of recovery, including the effectiveness of management actions and the need to adapt them if necessary.
- Ensuring road-widening, maintenance and forestry activities involving substrate or vegetation disturbance in areas where Tylophora woollsii occurs do not adversely impact on known populations.
- Avoid damaging wildfires or inappropriate fire regimes by:
- Developing and implementing a suitable fire management strategy for Tylophora woollsii.
- Providing maps of known occurrences to local and state Rural Fire Services and seeking inclusion of mitigation measures in bush fire risk management plan(s), risk register and/or operation maps.
- Avoid livestock impacts such as trampling, browsing or grazing.

Manage invasive weeds by:

- Developing and implementing a management plan for the control of invasive weeds in the region.
- Integrating weed control works on public lands into regional works programs, as appropriate.
- Ensuring chemicals or other mechanisms used to eradicate weeds do not have a significant adverse impact on the species (DECC, 2005a; Threatened Species Scientific Committee, 2008a).

Tylophora woollsii has been transplanted successfully from disturbance footprints as part of translocation programs and has been propagated successfully from rhizome pieces (Benwell and Watson 2011; Benwell, in. prep.).

Tylophora woollsii is a 'Site-managed species' under the Saving our Species program (OEH, 2015b). The Office of Environment and Heritage (OEH) has proposed five management sites where conservation activities need to take place to ensure the conservation of this species: Bald Rock NP in Tenterfield Local Government Area (LGA); Clouds Creek management site in Clarence Valley LGA; Kangaroo River State Forest in Clarence Valley LGA; Comboyne State in Greater Taree LGA; and Barrington Tops in Gloucester LGA (OEH, 2015b). Management actions and objectives proposed at these sites include:

- Reduce the risk of adverse fire at the site through active fire suppression and monitoring habitat.
- Minimise accidental damage on road/track edges through land manager consultation and monitoring disturbance impacts.
- Management of small population size by augmenting extant wild population(s) with seedbanking.
- Tracking species abundance / condition over time through flora monitoring (OEH, 2015b).

2.4 Koala

2.4.1 Conservation status

The combined populations of the Koala in Queensland, New South Wales and the Australian Capital Territory were determined to be a species for the purposes of the EPBC Act under the provisions of section 517 of the EPBC Act and are listed as a vulnerable species. In NSW, the Koala is also listed as a vulnerable species under the TSC Act and two populations are listed as endangered; one in the Hawks Nest and Tea Gardens LGAs; and one in Pittwater LGA. This section refers to the population of the Koala that comprises a vulnerable species under the EPBC Act, with particular focus on the regional population that occurs on the NSW North Coast.

2.4.2 Distribution and habitat

The Koala occurs in a range of eucalypt forest and woodland communities, including coastal forests, the woodlands of the tablelands and western slopes, and the riparian communities of the western plains. The quality of forest and woodland communities as habitat for Koalas is influenced by factors such as: species and size of trees present; vegetation structure; soil nutrient status; climate and rainfall. It is widely considered that the most important factor influencing Koala occurrence is the suite of tree species available with regional populations depending on specific primary and/or secondary food tree species. If primary food tree species are not present or occur in low density, Koalas will rely on secondary food tree species, but the carrying capacity of the habitat is likely to be lower (DECC, 2008).

Throughout NSW, Koalas have been observed to feed on 66 eucalypt and seven non-eucalypt species (Phillips, 2000). The *Comprehensive Koala Plan of Management for Eastern portion of Kempsey Shire LGA, Vol. 1* lists primary and secondary food tree species for the region surrounding the Norton and Boambee SF offset sites (KSC, 2011). Primary food trees exhibit a level of use that is significantly higher than that of other Eucalyptus species and independent of tree density. Koalas may use trees other than food trees, including non-eucalypts, for incidental browsing or for purposes such as daytime resting or shelter in hot or rainy weather (DECC, 2008).

Small, fragmented or highly disturbed habitats are less likely to be able to support Koalas in the long term due to edge effects, limited resource availability and increased mortality. Koalas utilise scattered trees in largely cleared environments however travelling across open ground leaves them more vulnerable to threats such as predation or vehicle collision (DECC, 2008).

2.4.3 Life history and population dynamics

The Koala is a tree-dwelling, medium-sized, herbivorous marsupial in the Family Phascolarctidae. Koalas live in breeding aggregations, generally comprising a dominant male, a small number of mature females and juveniles of various ages. The home range of Koalas varies depending on the quality of the habitat and the number of available food trees with average ranges of 10–15 ha recorded in the Pilliga region; 13–15 ha in north eastern NSW; and 0.2– 500 ha, with an average of 80–90 ha near Port Stephens (DECC, 2008c).The home range of the dominant male generally overlaps extensively with the home ranges of several females and adult Koalas generally remain within their individual home range areas throughout their life (DECC, 2008c).

Koalas reach sexual maturity at approximately two years though juvenile males are generally excluded from mating by the dominant male. The breeding season for the Koala peaks between September and February and animals are most active during this period. While female Koalas can theoretically breed every year, this rarely occurs due to the metabolic pressures of lactation and the low nutritional value of their food resources (DECC, 2008c).

The gestation period for the Koala is 35 days then, following birth, the young remains in the pouch for approximately six months and from about six to 12 months' age remains dependant on its mother and is carried on her back. Young can remain in the mother's home range for a further two to three years before animals of both sexes disperse to establish their own home range areas. Dispersal distances generally range from 1–11 km although movements in excess of 50 km have been recorded (DECC, 2008c).

The diet of the Koala primarily consists of Eucalyptus leaves which are low in nutrients and energy and high in indigestible components and toxic compounds. Koalas are able to cope with this diet because they have a slow metabolic rate, low nutrient requirements and a complex digestive tract. Koalas may also favour younger, more nutritious leaves and save energy by remaining inactive for much of the day (DECC, 2008c).

2.4.4 Threats and recovery actions

Since European settlement the size of the Koala population and the species' distribution have significantly declined in response to habitat loss and fragmentation and hunting (DotE, 2013). Contemporary habitat loss and fragmentation continue to threaten the Koala and compounds the species' susceptibility to direct mortality and injury from vehicle strikes, dog attacks, debilitating disease and the effects of climate change (DotE, 2013). Drought and incidences of extreme heat are also known to cause very significant mortality, and post-drought recovery may be substantially impaired by the range of other threatening factors (DSEWPaC, 2012b).

Dog attack is recognised as a significant threat to the viability of many Koala populations and the management of dogs is therefore an important impact mitigation measure (KSC, 2011). Management measures that reduce the risk of dogs coming into contact with Koalas include preventing domestic dogs roaming, through education and awareness for dog owners and control of feral dogs (KSC, 2011).

Chlamydia infection is frequently noted as a health problem amongst Koalas that come into human care and is believed to be present in all wild Koala populations in NSW. Chlamydia symptoms may be instigated or exacerbated by stress related to factors such as habitat clearing or disturbance. Female fecundity levels may be severely reduced by Chlamydia infection resulting in low to nil population increase (KSC, 2011).

The NSW Government has prepared a Koala recovery plan which aims to reverse the decline of the Koala in New South Wales, to ensure adequate protection, management and restoration of Koala habitat, and to maintain healthy breeding populations of Koalas throughout their current range (DECC, 2008c). The following specific objectives of the Koala recovery plan are applicable to this offset package and have been reflected in the specific management actions proposed for the Norton and Boambee SF sites:

- Specific objective 1a: Identify and conserve habitat important for Koala conservation.
- Specific objective 1e: Implement strategies which minimise the impacts of dogs on Koala populations.
- Specific objective 1f: Develop and implement strategies to reduce the impact of fires on Koala populations.
- Specific objective 2a: Revegetate and rehabilitate selected sites (DECC, 2008c).

2.5 Grey-headed Flying-fox

2.5.1 Conservation status

The Grey-headed Flying-fox is listed as a vulnerable species under the EPBC Act and the TSC Act.

2.5.2 Distribution and habitat

The Grey-headed Flying-fox is a large, nomadic fruit and blossom-feeding bat. It occupies forests and woodlands in the coastal lowlands, tablelands and slopes of southeast Australia from Bundaberg, Queensland to Geelong, Victoria. It is usually found at altitudes <200 metres. Few localities within this range support a continuous presence and patterns of occurrence and relative abundance within its distribution varies widely between seasons and between years. The Grey-headed Flying-fox is a highly mobile, nomadic species that relies on food sources with largely irregular patterns of productivity. When assessed at a local scale, the species is generally present intermittently and irregularly however broad trends in the distribution of plants with similar flowering and fruiting times coincide with annual cycles of movement and habitat use that are apparent at regional scales (DECCW, 2009).

The survival of Grey-headed Flying-foxes depends on a connected sequence of productive foraging habitats, the migration corridors or stopover habitats that link them, and suitable roosting habitat within nightly commuting distance of foraging areas. On this basis, the recovery plan for the Grey-headed Flying-fox explicitly identifies foraging habitat which is critical to the survival of the species as habitat that meets one or more of the following criteria:

- It is productive during winter and spring, when food bottlenecks have been identified.
- It is known to support populations of > 30 000 individuals within an area of 50 km radius (the maximum foraging distance of an adult).
- It is productive during the final weeks of gestation, and during the weeks of birth, lactation and conception (September to May).
- It is productive during the final stages of fruit development and ripening in commercial crops affected by Grey-headed Flying-foxes (months vary between regions).
- It is known to support a continuously occupied camp (DECCW, 2009).

The recovery plan for the Grey-headed Flying-fox explicitly identifies roosting habitat which is critical to the survival of the species as habitat that meets one or more of the following criteria:

- It is used as a camp either continuously or seasonally in > 50% of years.
- It has been used as a camp at least once in 10 years (beginning in 1995) and is known to have contained > 10 000 individuals, unless such habitat has been used only as a temporary refuge, and the use has been of limited duration.
- It has been used as a camp at least once in 10 years (beginning in 1995) and is known to have contained > 2 500 individuals, including reproductive females during the final stages of pregnancy, during lactation, or during the period of conception (i.e. September to May) (DECCW, 2009).

2.5.3 Life history and population dynamics

Reproduction in Australian flying-foxes is seasonal and synchronised. Grey-headed Flying-fox mating behaviour commences in January and conception occurs in April or May. Females give birth to single pups in October or November and lactate until around March. Individuals reach reproductive maturity in the second year of life however, there is evidence that few females younger than three years successfully raise young to independence and so this low reproductive potential inhibits the capacity of Grey-headed Flying-foxes to recover from population declines (DECCW, 2009).

Grey-headed Flying-foxes feed on blossom and fruit in canopy vegetation and forage over extensive areas. They disperse pollen and seeds of diet plants during their foraging bouts and in this way they contribute to the reproductive and evolutionary processes of forest communities

(DECCW, 2009). Forty species of plants in the recognised nectar diet of Grey-headed flying foxes occur in the Northeast NSW region, comprising 34 species in the Myrtaceae (two Angophora, five Corymbia, 25 Eucalyptus and one each of Lophostemon, Melaleuca and Syncarpia); three species in the Proteaceae (two Banksia and one Grevillea) and one species in the Fabaceae (*Castanospermum australe*) (Eby and Law, 2008). These blossom-bearing species are primarily found in sclerophyll forests and woodlands. There are a further 46 species of trees and lianas in the fruit diet of Grey- headed flying foxes in the Northeast NSW region, comprising members of 26 families and 30 genera, with five genera represented by more than one species. These fruit-bearing species are primarily found in rainforest and the floristic diversity decreases to the south of the region (Eby and Law, 2008). The majority of animals feed on nectar and pollen from eucalypts (genera Eucalyptus, Corymbia and Angophora), melaleucas and banksias. Grey-headed Flying-foxes forage over extensive areas: one-way trips of approximately 50 km have been recorded between camps and foraging areas although commuting distances are more often < 20 km (DECCW, 2009).

The species is colonial and roosts in large aggregations in the exposed branches of canopy trees (camps). When the camps are undisturbed their locations are generally stable through time and several camps have been known for over 100 years. Camp size fluctuates, and many camps may be empty for extended periods. Camps provide resting habitat, sites of social interactions and refuge for animals during significant phases of their annual cycle, such as birth, lactation and conception (DECCW, 2009). A total of seventy-four camps used by Grey-headed flying foxes have been documented in the north coast region of NSW with the majority occurring at altitudes below 200 m along the coastal lowlands and ranges (Eby and Law, 2008).

Patterns of occupation vary between sites and reflect the quality and distribution of food resources in the surrounding area. Camps can be broadly grouped as 1) sites occupied irregularly, which are associated with landscapes where few diet species occur and feeding habitat is limited; 2) camps occupied on a regular seasonal basis, but not through the year, which are associated with diverse but seasonal feeding habitat; and 3) camps occupied continuously which are associated with floristically diverse landscapes which provide an uninterrupted food supply (Eby, 2012).

2.5.4 Threats and recovery actions

Loss of foraging habitat is consistently identified as the primary threat to Grey-headed Flying-foxes. Reductions in nectar flow and fruit productivity occur as a result of forest clearance and degradation, reductions in floristic diversity, simplification of age structure from forestry practices, eucalypt dieback, drought, fire, climate change and the vulnerability of flowering and fruiting schedules to fluctuations in such factors as temperature and rainfall. Clearing of winter forage is a particular concern for the species as few diet plants flower in winter, and those that flower reliably occur on coastal lowlands in northern New South Wales and southern Queensland and are associated with population centres and development pressure (DECCW, 2009). Other threats include loss of roosting habitat, deliberate destruction or harassment associated with commercial horticulture, electrocution on power lines or entanglement in barbed wire, disease and potentially competition from the Black flying-fox (*Pteropus alecto*) (DECCW, 2009).

A Grey-headed Flying-fox recovery plan has been prepared the overall object of which is to: reduce the impact of threatening processes on Grey-headed Flying-foxes and arrest decline throughout the species' range; conserve the functional roles of Grey-headed Flying-foxes in seed dispersal and pollination; improve the standard of information available to guide recovery of the Grey-headed Flying-fox, in order to increase community knowledge of the species and reduce the impact of negative public attitudes on the species (DECCW, 2009). The following

specific actions of the recovery plan are applicable to this offset package and have been reflected in the specific management actions proposed for the Norton and Boambee SF sites:

- Action 1: Identify and protect foraging habitat critical to the survival of Grey-headed Flying-foxes across their range.
- Action 2: Enhance winter and spring foraging habitat for Grey-headed Flying-foxes.
- Action 7: Monitor population trends for the Grey-headed Flying-fox (DECCW, 2009).

2.6 Spotted-tailed Quoll

2.6.1 Conservation status

The southeast mainland population of the Spotted-tailed Quoll was determined to be a species for the purposes of the EPBC Act under the provisions of section 517 of the EPBC Act and is listed as an endangered species. In NSW, the Spotted-tailed Quoll is also listed as a vulnerable species under the TSC Act. This section refers to the mainland population of the subspecies *Dasyurus maculatus maculatus* that comprises an endangered species under the EPBC Act.

2.6.2 Distribution and habitat

The Spotted-tailed Quoll is known from a wide range of habitat types, including rainforest, wet and dry sclerophyll forest, coastal heathland, scrub and dunes, woodland, heathy woodland, swamp forest, mangroves, on beaches and sometimes in grassland or pastoral areas adjacent to forested areas. The majority of records are associated with forest vegetation in areas with relatively high (> 600 mm/yr) and predictable seasonal rainfall (Long and Nelson, 2009).

Spotted-tailed Quolls shelter in den sites such as caves or rock crevices, hollow trees or logs, dense vegetation, under buildings, burrows of rabbits or wombats or freshly dug burrows where suitable substrate is available. Individuals use up to 20 separate den sites and move between them every few days (Long and Nelson, 2009).

Habitat that is critical to the survival of the Spotted-tailed Quoll includes large patches of forest with adequate denning resources and relatively high densities of medium-sized mammalian prey, however, the threshold densities of these critical components required to maintain populations are unknown and so critical habitat has not been formally defined or mapped (Long and Nelson, 2009).

The Spotted-tailed Quoll has declined in distribution and abundance throughout its range, and many populations are now fragmented and isolated (Long and Nelson, 2009). In New South Wales, the Spotted-tailed Quoll remains widely distributed within large areas of contiguous forested land, from the Queensland border to the Victorian border, although the species is thought to have declined by at least 25–50% since European settlement (Lunney et al. 2000). Aspects of the ecology of Spotted-tailed Quolls render them especially susceptible to threatening processes: they occupy large home ranges at low population densities; they have a relatively short lifespan and a low overall reproductive output; they have a limited ability to recolonise fragmented patches of habitat; many prey species rely on hollows for shelter and breeding and are limited by timber harvesting or other practices that reduce these resources; and they may be limited by the availability of den sites. Consequently, Spotted-tailed Quoll populations are limited to large, relatively intact patches of forest and are significantly prone to threatening processes that reduce, degrade and fragment such habitat. Other threats include competition with and possibly predation by exotic carnivores, poison baiting programs to control these introduced carnivores, human persecution in areas where quolls may prey on domestic animals and vehicle collisions (Long and Nelson, 2009).

2.6.3 Life history and population dynamics

The Spotted-tailed Quoll is a medium-sized, marsupial carnivore in the Family Dasyurideae. The Spotted-tailed Quoll typically occurs at low densities, as adults are solitary and occupy large home ranges. Female home ranges are generally non-overlapping and 88–1515 ha in area. Male home ranges are 359–5512 ha in area, overlap and encompass multiple female home ranges. The species is capable of covering large distances, with animals recorded moving at least 8 km in a day and 19 km in a week. Spotted-tailed Quolls hunt on the ground or in trees and feed on a wide variety of prey and carrion, including mammals, birds, reptiles and invertebrates although medium-sized mammals constitute the bulk of the diet. Prey varies between the sexes and age-classes as well as seasonally, annually, geographically and in accordance with prey availability (Long and Nelson, 2009).

The average lifespan of the species is relatively short (three to five years) with sexual maturity at 11-12 months of age. The majority of females breed annually with an average litter size of five young. There is some evidence of high mortality during the period from birth until weaning, although high annual recruitment of sub-adults into study populations has also been recorded (Long and Nelson, 2009).

2.6.4 Threats and recovery actions

A Spotted-tailed Quoll recovery plan has been prepared, the overall objective of which is to: increase knowledge of the distribution, ecology, status of populations, and impact of threatening processes on Spotted-tailed Quoll populations and to reduce the impact of threatening processes throughout the species' range and subsequently halt the current decline in its distribution and abundance (Long and Nelson, 2009). The following specific actions of the recovery plan are applicable to this offset package and have been reflected in the specific management actions proposed for the Norton and Boambee SF sites:

- Action 3.1 Target landholders in areas where Spotted-tailed Quolls are known to occur to protect and manage their land in a manner that is compatible with maintenance of Spotted-tailed Quoll habitat, through voluntary conservation agreements.
- Action 3.2 Maintain and restore habitat corridors on unprotected freehold land.
- Action 5.5 Investigate alternative livestock protection methods that have fewer impacts on non-target species.
- Action 5.6 Review existing information on alternative poison delivery or biological control systems to identify systems with high target species specificity (Long and Nelson, 2009).

2.7 Giant Barred Frog

2.7.1 Conservation status

The Giant Barred Frog is listed as an endangered species under the EPBC Act and the TSC Act.

2.7.2 Distribution and habitat

The original distribution of the Giant Barred Frog was from Doongul Creek, Wongi State Forest, near Maryborough in south-eastern Queensland (Hines, 2003), south to Warrimoo in the Blue Mountains, New South Wales (Hines et al. 1999). The species is known from mid to low altitudes below 610 m above sea level (DotE, 2015). Declines appear to have occurred at the margins of the species' range, with no recent records in the Blue Mountains or other areas south of the Hawkesbury River and disappearances from a number of catchments in Queensland (OEH, 2015). The southern-most records of the Giant Barred Frog in recent years

are associated with five populations in the Watagan Mountains area (White 2000). The species is still recorded frequently in suitable habitat on the NSW north coast with a concentration of known populations in the Coffs Harbour-Dorrigo area (OEH, 2015).

Giant Barred Frogs are associated with freshwater streams with permanent or semi-permanent water, generally at lower elevations. Stream habitats are most often associated with 1st order to 3rd order drainage lines that are small, narrow and rapidly descending. Tadpoles have also been recorded in slower flowing 4th order streams with broad meanders and deeper pools. Giant Barred Frogs do not breed in ponds or ephemeral pools (Mahoney et. al., 1996).

The species most often occurs in moist, sheltered riparian habitats through rainforest or wet sclerophyll forest; however Giant Barred Frogs may sometimes occur in other riparian habitats, such as those in drier forest or degraded riparian remnants (OEH, 2015). Giant Barred Frogs have been observed to prefer a closed forest canopy with a relatively light cover of vegetation at ground level (Aland & Wood 2013; Lemkert, F., Niche, pers. comm). Deep, moist leaf litter is used by adult frogs for daytime shelter and is recognised as a critical habitat resource for the Giant Barred Frog (Pattinson et. al. 1999). These vegetation characteristics are typical of mature successional stages of wet sclerophyll forest and rainforest. Lemckert (1999) found that the Giant Barred Frog was less abundant in recently logged areas and at sites where there was little undisturbed forest.

The Giant Barred Frog is a stream breeding species. Eggs are deposited out of the water, under overhanging banks or on steep banks of large pools. The stream microhabitats used by the species for oviposition (i.e. placement of eggs) are limited (Knowles et al. 1998).

2.7.3 Life history and population dynamics

Breeding takes place from late spring to summer in suitable stream habitats. Males call during spring and summer from the ground, often on or buried in deep leaf litter (Anstis, 2002). Once eggs are laid and fertilised in the water, the female kicks them out of the water where they stick onto a suitable surface such as an overhanging or steeply sloped bank. Hero and Fickling (1996) and Morrison and Hero (2002) reported clutch sizes for the species as 4184 (one clutch counted) and 1343–3471 (13 clutches counted) respectively. Hatchlings drop or wriggle into the water. Tadpoles are strong-swimming bottom dwellers in still or slowly flowing pools or at the sides of streams (Anstis 2002). It may take up to 14 months between egg laying and the completion of metamorphosis of tadpoles (OEH, 2015).

Although generally found within about 20 metres of a stream containing suitable breeding habitat (Lemkert and Brassil, 2000), outside the breeding season, the Giant Barred Frog may disperse up to 50 metres or further away from the stream (Streatfeild, 1999). Monitoring of spatial movements of three adult male and three adult female frogs revealed that over six weeks, the average area used by females and males was 622 metres squared and 403 metres squared respectively and that individuals moved a maximum distance of 268 metres along the stream and 50 metres away from the stream (Streatfeild, 1999). Another study of spatial movements over two to five days revealed that adult frogs made nightly movements from zero to over 100 metres, all of which were within a 20 metre wide band either side of the stream (Lemckert & Brassil 2000). Longer term studies that include non-breeding times are required to adequately assess habitat usage of Giant barred Frogs (Hines et al., 2002).

The Giant Barred Frog is a generalist feeder, with large insects, snails, spiders and frogs included in its diet (DotE, 2015).

2.7.4 Threats and recovery actions

Upstream clearing, changes in water flow regimes, degradation of water quality, disturbance to riparian vegetation, feral animals, domestic stock and weed invasion have been identified as the main threats to the Giant Barred Frog (Hines et al. 2002).

Clearing or adverse modification of suitable habitat is likely to be the greatest threat to the Giant Barred Frog. The species is likely to be particularly susceptible to these impacts given its specific habitat requirements and the relatively small area of occupancy of adult individuals as described above.

A study of the impacts of selective logging on frogs in a forested area of northern New South Wales found that the Giant Barred Frog decreased in abundance in recently-logged areas and at sites where little undisturbed forest was available (Lemckert, 1999).

Tall, dense weed infestations can decrease the quality and amount of habitat available, particularly where there are canopy gaps in the riparian vegetation. Dense growth of weeds such as Lantana (*Lantana camara*), Crofton weed (*Ageratina adenophora*) and exotic grasses are likely to decrease habitat suitability by suppressing the accumulation of suitable leaf litter and foraging substrate and physically impeding frogs (OEH, 2015; Hines et al. 2002; Lemkert, L., Niche, pers. comm.).

Reduction in water quality or alterations to flow patterns of breeding habitat is recognised as a significant threat given the relatively specific breeding habitat required by the species. Embryos and tadpoles are likely to be harmed by siltation. Impacts on breeding habitat have been recognised as a result of inadequate protection of riparian habitat during forestry activities, land clearing and construction in catchments, grazing and physical disturbance by domestic stock or feral pigs (*Sus scrofa*) (OEH, 2015). There is also the potential for direct predation by feral pigs, though the greatest impact is likely to be from increased silt on embryos and tadpoles (H. Hines 2001, pers. comm. cited in DotE, 2015).

Chytridiomycosis is a disease caused by infection with the chytrid fungus (Batrachochytrium dendrobatidis) affecting amphibians worldwide. This highly virulent pathogen of amphibians is capable, at the minimum, of causing sporadic deaths in some populations, and 100% mortality in other populations (DEH, 2006). In some locations, the Giant Barred Frog is known to carry chronic infections of chytrid fungus; however it is unclear whether the Giant Barred Frog is currently declining from this cause (OEH, 2015).

Some individuals of the Giant Barred Frog have sometimes been killed in the mistaken belief that they are the introduced Cane Toad (*Bufo marinus*) (Hines et. al., 2002).

The Giant Barred Frog is included in the Recovery plan for Stream Frogs of South-east Queensland 2001–2005 (DotE, 2015) the overall objective of which is to significantly improve the conservation status and long term survival of the species through protection of its habitat, and through location of additional populations or expansion of existing populations into areas currently uninhabited (Hynes et. al., 2002). The following specific actions of the recovery plan are applicable to this offset package and have been reflected in the specific management actions proposed for the xxxxx site:

- Action 2. Monitor populations.
- Action 4. Protect populations and manage habitat.
- Action 4.2. Control feral pigs (Hynes et. al., 2002).

The NSW OEH identifies the following recovery actions for the species that have also been referenced in developing specific management actions proposed for the xxxxx offset site:

- Prevent clearing of riparian forest.

- Control infestations of riparian weeds, particularly tall grasses, tall herbs and shrubs.
- Ensure that logging activities do not impact riparian habitat.
- Minimise access to habitat by cattle.
- Manage upstream developments to minimise changes in water quality and flow.
- Ensure that chemical use near streams does not impact habitat and use alternative approaches where possible (OEH, 2015).

3. Existing Environment of the Norton Offset Site

3.1 Location and landuse

The Norton site is a parcel of privately owned land that was purchased by Roads and Maritime for the purpose of securing biodiversity offsets for various stages of the Pacific Highway upgrade project. It has been the subject of detailed ecological surveys to establish its suitability as a biodiversity offset as part of a preliminary assessment of candidate properties (Lewis and James, 2010), to complete a BioBanking agreement application (GHD, 2016) and to inform the preparation of this offset package and management plan.

The Norton offset site comprises part Lot 501 DP 1200647, Lot 53 DP 1162355, Lot 301 DP 1161894, Lot 302 DP 1161894, Lot 56 DP1165099, Lot 11 DP1194544 and Lot 21 1199597 adjacent to the Pacific Highway, at South Kempsey, NSW as shown on Figure 2. The site boundary and associated cadastre have recently been modified to accommodate the Pacific Highway upgrade and a proposed quarry expansion. This recent and proposed development is shown on Figure 2. A portion of Lot 56 DP1165099 is excluded from the biobank site, as this area will be maintained as a house site and home paddocks. Lot 56 DP1165099 is currently the subject of an application to the Land and Property Management Authority (LPMA) to update the cadastral boundary to accommodate the Kundabung to Kempsey section of the Pacific Highway upgrade in the southwestern corner of the Lot. The portion of Lot 56 DP1165099 that will be removed for the Pacific Highway upgrade has been excluded from the biobank site.

The Norton offset site is around 496 hectares in area and contains remnant and regenerating forest on gently undulating terrain. It is 56 kilometres south of the Project footprint in an equivalent position on near-coastal low hills (Figure 1). The Koala and Grey-headed Flying Fox have been recorded at the site (Lewis and James, 2010) and there are extensive areas of suitable habitat for these two species as well as the Spotted-tailed Quoll. The Norton offset site is a large and highly suitable offset site that is under risk of development and has considerable capacity for improvement and that will meet the majority of the Project's biodiversity offset requirements.

The Norton site is currently unoccupied. Previous land uses include timber harvesting, low intensity grazing and stockpiling of timber, rubbish and fill. There is a limited network of dirt access tracks across the site and some internal fences, generally in poor condition. An electricity easement runs north-south through the southwestern portion of the site and another runs along the southern boundary. Essential Energy have confirmed that the voltage in these electricity easements through the Norton biobank is 11kV (three phase). The width of the easement that is maintained for this voltage is 20 metres. These 20 metre-wide easements have been excluded from the offset site (Figure 2).

There is an unbuilt Crown Road (i.e. a 'paper road') through the centre of the site which Roads and Maritime are in the process of extinguishing.

Roads and Maritime currently owns the Norton site. A BioBanking agreement under the NSW *Threatened Species Conservation Act 1995* (TSC Act) will be entered into over the majority of the property to conserve the proposed conservation area in perpetuity. The BioBanking agreement will be registered on the property title and is binding on successors in title.

A site specific Management Action Plan (MAP) has been prepared to accompany the BioBanking agreement. The MAP presents the management actions that must be applied at the site under the BioBanking agreement. The plan includes the conditions the land owner must

observe in accordance with the BioBanking agreement and strategies to assist landholders to maintain and improve biodiversity values. The MAP is designed to complement existing environmental legislation, which continues to apply to the land. The approved MAP will be implemented by the landowner and/or Roads and Maritime along with the management requirements specified in this offset package.

Management actions required to maintain and enhance the habitat for the affected threatened biota were identified during the survey and are outlined in Section 6 of the report. A works program is developed to implement these activities and will be funded by the Roads and Maritime.

The Norton site will also provide biodiversity offsets for impacts of the Oxley Highway to Kempsey Pacific Highway upgrade (OH2K) project (GHD, 2013) and the NH2U project (GHD, 2016a). The policy allows a single offset site to provide biodiversity offsets for more than one project provided that the offsets are for different threatened species or MNES (DSEWPaC, 2012). However, consultation with the DotE has confirmed that a specific parcel of land at an offset site can only be used to offset the impacts of a single project. Therefore, separate parcels of land within the Norton site have been set aside to offset the impacts of the OH2K project, NH2U project and the WC2NH project (see Figure 2). The land that has been included as a biodiversity offset for the WC2NH project is the 'WCNH Norton offset area' as shown on Figure 2.

3.2 Landscape context

The Norton site is around 496 hectares in area and contains wet and dry sclerophyll forest on gently undulating, near-coastal hills. The southern portion of the site comprises a gentle slope, on fine grained sedimentary substrate and recent alluvium that drains northwards to Stumpy Creek. On the north side of Stumpy Creek there is a relatively steep, rocky ridge on fine grained volcanic substrate that rises to a height of 100 m elevation just to the west of the site. The northern portion of the offset site comprises moderate to steep slopes that drain northwards to Boat Harbour creek. There appears to be a transitional area of metamorphic geology between the sedimentary and volcanic portions of the site. This variable geology, combined with the site's disturbance history, is probably contributing to the complex and variable vegetation on site (see Section 3.3 below).

Stumpy Creek is a near-permanent, channel confined, third order stream that runs generally from west to east through the site. It follows a circuitous route through the southern portion of the site and along with its tributaries dominates the geomorphology of this area. Stumpy Creek is generally in good condition with intact riparian and in stream vegetation, intact channel and bank structure, continuous flow, very little weed infestation and no evidence of poor water quality.

Boat Harbour creek is a permanent, channel confined, third order stream that runs generally from southeast to northwest through the site. It is fed by multiple intermittent tributaries in narrow gullies running off the ridge through the centre of the site. Boat Harbour Creek is generally in moderate condition with partially cleared and regenerating riparian vegetation, healthy in stream vegetation, intact channel and bank structure, continuous flow, moderate weed infestation and some evidence of high turbidity.

Adjacent land uses include:

- The Pacific Highway, including the recently upgraded Kempsey Bypass section to the northwest and Kundabung to Kempsey section to the southwest.
- Farawell's Quarry, including a proposed expansion, a service centre and cleared land proposed for warehousing and light industrial land to the west.

- The north coast railway and sparsely cleared bush blocks and hobby farms to the north and northeast.
- The north coast railway and then the Maria National Park and vegetated private and Crown land to the east.
- Partially cleared grazing land, hobby farms and bush blocks to the southeast and south and beyond that the Maria River State Forest.

The Norton site includes a mapped regional fauna habitat corridor (Scotts et. al, 2003) that runs east-west connecting State forests to the west and south of the site with Maria National Park to the east.

The Norton site is part of a near continuous patch of native vegetation and habitat of many thousands of hectares. The recent and proposed development and the Pacific Highway to the west and north coast railway to the east will comprise barriers to fauna movement and other ecological processes. Kalateenee State Forest lies to the west of the Pacific Highway and beyond that there is an extensive network of native vegetation in national parks and State forests that stretches to the Great Dividing Range. The Norton site is partially connected to this extensive area of habitat via the riparian corridors of Boat Harbour and Stumpy Creek and associated culverts and underpasses. There are partial barriers to the south and southeast associated with partially cleared and/or fenced private land. The Maria River State Forest lies to the south of this land and is continuous with the Maria National Park and other native vegetation that stretches to the coast. The North Coast Railway is unfenced through the stretch adjacent to the site and would not comprise a complete barrier to fauna movement. East of the railway there is native vegetation in the Maria National Park and on private and Crown land that is part of the vegetated corridor to the coast.

The Norton site comprises appropriately situated habitat for each of the affected threatened species, notably including the Spotted-tailed Quoll is generally restricted to large patches of less-disturbed habitat (Long and Nelson, 2009). The Norton site comprises a valuable habitat link in terms of the riparian corridors it encompasses, its position between the coastal floodplain and ranges and as a conserved vegetated corridor around an area of relatively intense development.

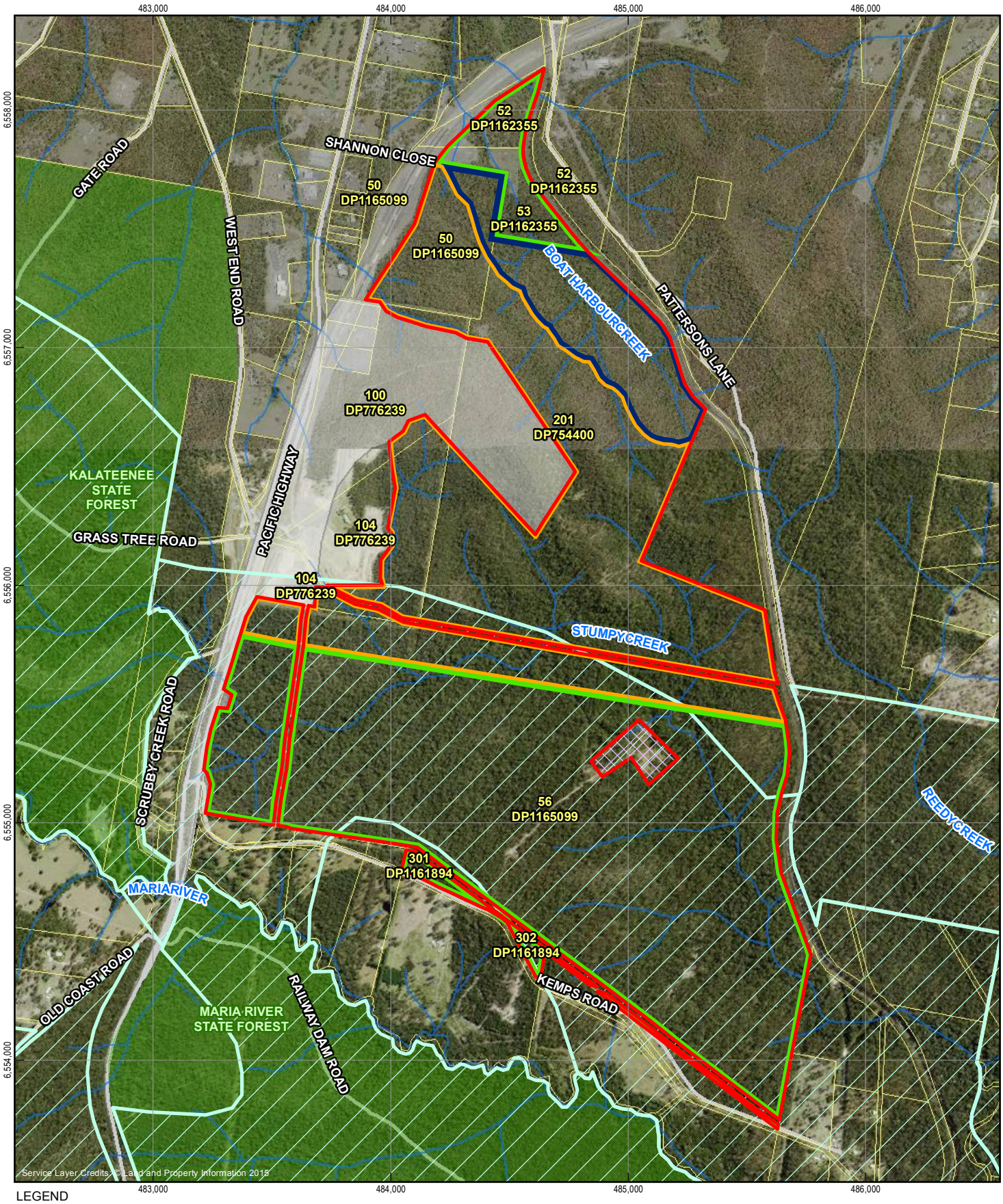
3.3 Vegetation

Vegetation communities were mapped within the Norton offset site by Lewis and James (2010) and then ground truthed and converted to NSW vegetation types and broad condition classes as part of the present study and the BioBanking assessment. Vegetation types within the Norton offset site are shown on Figure 3 and summarised in Table 3. A detailed description of the distribution, plant species composition and condition of vegetation at the site is provided in Appendix D.

Table 3 Vegetation in the Norton offset site

NSW Vegetation Type	Habitat type	NSW Veg. ID	Condition	Area in Norton offset site (ha)	Area in WC2NH Norton Offset Area	Plot/transects
Red Mahogany open forest	Dry sclerophyll forest	NR222	Moderate/good	30.2	15.6	41, 42, 1, 47
Spotted Gum – Grey Ironbark open forest	Dry sclerophyll forest	NR247	Moderate/good	19.5	19.5	21, 38, 39
Spotted Gum - Grey Ironbark - Pink Bloodwood open forest	Dry sclerophyll forest in low condition	NR246	Low	4.0	0.0	27, 28
Blackbutt – Tallowwood dry grassy open forest	Dry sclerophyll forest	NR119	Moderate/good	44.5	5.7	34, 44, 45, 46
Spotted Gum - Grey Ironbark - Pink Bloodwood open forest	Dry sclerophyll forest	NR246	Moderate/good	135.4	89.1	20, 23, 26, 24, 40, 3
Scribbly Gum – Red Bloodwood heathy open forest	Dry sclerophyll forest	NR228	Moderate/good	164.4	16.9	6, 35, 16, 5, 19, 51
Forest Red Gum - Swamp Box	Grassy woodland	NR161	Moderate/good	3.8	0.0	48, 49
Blackbutt – Turpentine – Tallowwood shrubby open forest	Wet sclerophyll forest	NR122	Moderate/good	33.4	12.4	18, 25, 31, 36
Flooded Gum – Tallowwood – Brush Box moist open forest	Wet sclerophyll forest	NR160	Moderate/good	7.4	4.1	30, 32, 33
Blackbutt - Pink Bloodwood shrubby open forest	Wet sclerophyll forest	NR117	Moderate/good	53.4	21.5	29, 4, 37, 43, 50
			Total	**496**	**185**	

Notes: All habitat types at the Norton offset site comprise occupied Koala and Grey-headed Flying Fox habitat and likely Spotted-tailed Quoll habitat.



LEGEND

- Norton offset site
- WC2NH Norton offset area
- NH2U Norton offset area
- OH2K Norton offset area
- Recent or proposed development
- House site and home paddocks
- Regional biodiversity corridor
- State forests
- Cadastre
- Waterways
- Roads

Paper Size A4

0 150 300 600

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

GHD

Roads and Maritime Services
Pacific Highway Upgrade
Warrell Creek to Nambucca Heads
Biodiversity Offset Package

Job Number 21-24927
Revision A
Date 02 Sep 2016

Norton offset site location

Figure 2

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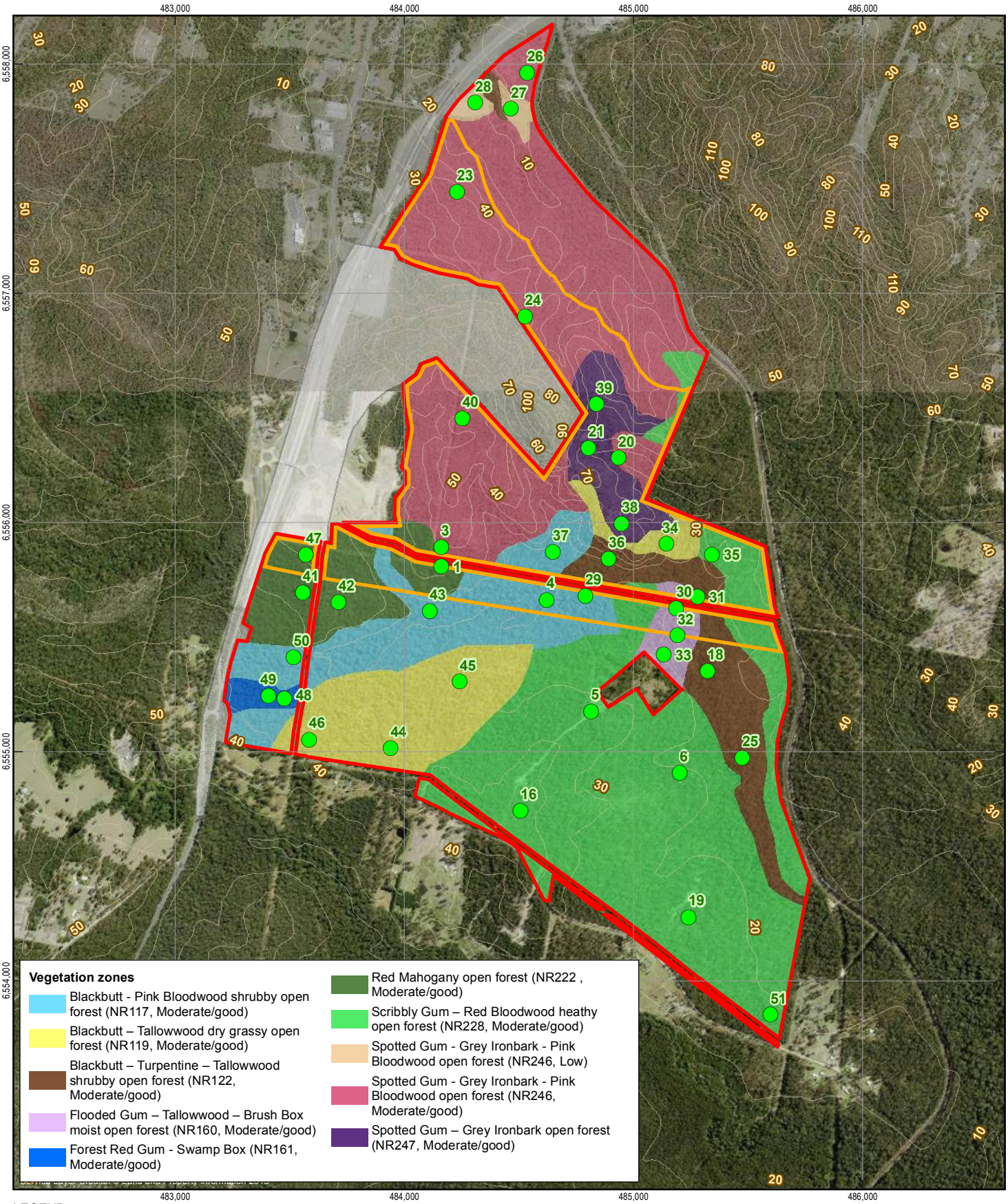
Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data Source: General topo - NSW LPI DTDB 2012, Geoscience Australia: 250k Data - Jan 2011; Aerial Imagery - Sixmaps 2016.jrichardson



LEGEND

- Norton offset site
- WC2NH Norton offset area
- Recent or proposed development
- Contours
- BioBanking plot/transect

Paper Size A4

0 200 400 800

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

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Roads and Maritime Services
Pacific Highway Upgrade
Warrell Creek to Nambucca Heads
Biodiversity Offset Package

Job Number 21-24927
Revision A
Date 02 Sep 2016

Norton offset site vegetation

Figure 3

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Data Source: General topo - NSW LPI DTDB 2012, Geoscience Australia: 250k Data - Jan 2011; Aerial Imagery - Sixmaps 2016.jrichardson

3.4 Habitat quality

This section describes the extent and quality of habitat for the affected threatened species in the Norton offset site based on the desktop assessment and field survey results. Habitat types, canopy plot survey locations and recorded observations of threatened fauna are shown on Figure 4. Canopy plots were sampled at the locations shown on Figure 4 and comprised counts of every tree in a 50 m x 20 m plot along with its height, species and canopy cover. Each tree species was then cross referenced to lists of food tree species for the affected threatened species to calculate the cover of food tree species. The results of canopy plot surveys used to quantify habitat resources for the affected threatened species are presented in Table 4. A detailed description of habitat quality for each species is provided below.

3.4.1 Koala

The Koala was recorded at the Norton site during the GHD survey and by Lewis and James (2010). The WC2NH Norton offset area contains around 185 hectares of occupied Koala habitat of varying quality associated with wet and dry sclerophyll forest (see Figure 4).

The *Comprehensive Koala Plan of Management for Eastern portion of Kempsey Shire LGA, Vol. 1* (KSC, 2011) identifies a riparian corridor through the Norton offset site as Secondary Class A habitat. Secondary Class A habitat comprises preferred Koala habitat that contains vegetation communities and/or associations wherein primary food tree species are subdominant components of the over storey tree species, growing in association with secondary food tree species (Phillips and Hopkins, 2008). The plan maps around 150 ha of moist sclerophyll forest habitat that comprises Secondary Class A habitat at the site and around 340 ha of dry sclerophyll forest that comprises Secondary Class B habitat (KSC, 2011).

The canopy plot results confirmed that the Norton site contains primary and secondary food trees for the Koala as defined in KSC (2011) and supplementary food tree species as defined in the North Coast management area of the *Approved Recovery Plan for the Koala* (*Phascolarctos cinereus*) (DECC, 2008c). The canopy plot data presented in Table 4, confirms that there is good cover of food trees (average 192 m^2 cover present as emergent, canopy or mid storey in each 1000 m^2 plot sampled across the site), including primary food trees (average 50 m^2 cover across the site) and secondary food tree (average 54 m^2 cover). There is one primary food tree species at the Norton site: Tallowwood (*Eucalyptus microcorys*), which is a sub-dominant canopy species in the majority of both wet and dry sclerophyll forest types at the site. There was up to 179 m^2 of foliage cover of Tallowwood in the plots sampled.

The secondary food tree species, Small-fruited Grey Gum (*Eucalyptus propinqua*), is a sub-dominant canopy species in dry sclerophyll forest types and White Stringybark (*Eucalyptus globoidea*) is a dominant canopy species in both wet and dry sclerophyll forest types at the site. There was up to 121 m^2 of foliage cover of secondary food tree species in the plots sampled. A supplementary food tree species, Red Mahogany (*Eucalyptus resinifera*) is also present at moderate densities throughout the Norton site and forms up to 53% cover in some vegetation types. Average over storey cover across the site was 36%, indicating a forest structure throughout and was generally within or above benchmark values for individual vegetation types (i.e. equivalent to intact examples of the vegetation type).

The Koala SAT plot results indicated that five out of 13 plots featured 'Medium (normal) use' for the 'East Coast (low) activity category' (Phillips and Callaghan, 2011). The remaining 8 SAT plots (zero scats) and the cumulative Koala SAT plot results across the site (scats beneath 2% of trees sampled) suggest low activity levels. Low activity levels recorded in what might otherwise be medium or high carrying capacity Koala habitat may be a result of contemporary population dynamics, landscape configuration and/or historical disturbances, including logging, mining, fire, agricultural activities and/or urban development (Phillips and Callaghan, 2011).

Such considerations should not necessarily detract from the potential importance of such habitat for longer-term conservation, particularly if preferred food trees are present and populations of Koala are known to occur in the general area (Phillips and Callaghan, 2011).

Habitat critical to the survival of the Koala is defined as habitat that is considered to be important for the species' long-term survival and recovery and specifically an area that scores five or more using the habitat assessment tool for the Koala in Table 4 of the DotE (2014) *EPBC Act Referral Guidelines for the vulnerable koala (combined populations of Queensland, New South Wales and the Australian Capital Territory),* (DotE, 2014). The habitat assessment tool scores for the Norton site are as follows:

- Koala occurrence — +2 (high) Evidence of one or more Koalas within the last 2 years (observed in the current surveys).
- Vegetation composition — +2 (high) Forest or woodland with 2 or more known Koala food tree species in the canopy (Tallowwood, Small-fruited Grey Gum, White Stringybark and Red Mahogany).
- Habitat connectivity — +2 (high) Area is part of a contiguous landscape ≥ 500 ha (the site contains around 500 ha of habitat and is connected to many thousands of hectares of habitat in the Maria State Forest to the south).
- Key existing threats — +1 (medium) Evidence of infrequent or irregular Koala mortality from vehicle strike or dog attack at present in areas that score 1 or 2 for Koala occurrence (no direct evidence noted, however some mortality is likely given the proximity to the Pacific Highway and presence of wild and domestic dogs).
- Recovery value — +2 (high) Habitat is likely to be important for achieving the interim recovery objectives for the relevant context (the site is a large connected area of Koala habitat that supports Koalas).

The Norton site has a total habitat score of nine. Therefore, the Norton site is habitat critical to the survival of the Koala.

Based on the above assessment of habitat quality, and consideration of the site context and species stocking rate attributes, the current habitat quality of the WC2NH Norton offset area was scored as 7/10 in the offset assessment guide calculations (see Section 9). This score reflects the presence of occupied habitat with moderate cover of primary food tree species as a part of an extensive patch of habitat but with some impact from weed infestation, timber harvesting, edge effects and probably also predatory pest fauna.

Table 4 Canopy plot results for the Norton offset site

Canopy Plot ID	Habitat type	Veg. Type ID	No. of trees	Avg. tree height (m)	Over storey cover	Over storey condition	Tree cover (m^2)[1]	Koala food tree cover (m^2, % of total cover)[2]	Koala primary food tree cover (m^2, % of total cover)[3]	Koala secondary food tree cover (m^2, % of total cover)[4]	Koala secondary food tree cover (m^2, % of total cover)[5]	GHFF diet plant cover (m^2, % of total cover)[6]	GHFF key diet plant cover(m^2, % of total cover)[7]	Koala activity level	Fauna observations
1	Dry Sclerophyll Forest	NR222	38	17.8	64%	Above benchmark	636	430 (68%)	49 (8%)	93 (15%)	288 (45%)	571 (90%)		3.33%	29 Koala scats beneath *E. propinqua*
2	Dry Sclerophyll Forest	NR263	31	22.0	11%	Within benchmark	107	76 (71%)		56 (52%)	20 (19%)	68 (64%)	25 (23%)		Possum/glider scratches beneath 3 x *E. propinqua*
3	Dry Sclerophyll Forest	NR247	22	15.1	18%	Within benchmark	178	97 (54%)	84 (47%)	8 (4%)	5 (3%)	88 (49%)	38 (21%)	6.66%	22 Koala scats beneath 2 x *E. propinqua*
4	Wet Sclerophyll Forest	NR119	15	21.5	21%	Within benchmark	210	90 (43%)	43 (20%)	47 (22%)		120 (57%)	120 (57%)		Echidna digging at base of *E. pilularis*
5	Dry Sclerophyll Forest poor	NR263	11	25.6	66%	Within benchmark	660	560 (85%)	30 (5%)		530 (80%)	600 (91%)	70 (11%)		
16	Dry Sclerophyll Forest	NR228	32	17.4	35%	Within benchmark	353	31 (9%)		25 (7%)	6 (2%)	252 (71%)	246 (70%)		
18	Wet Sclerophyll Forest	NR122	21	25.9	48%	Above benchmark	475	193 (41%)	65 (14%)	25 (5%)	103 (22%)	365 (77%)	262 (55%)		
19	Dry Sclerophyll Forest	NR227	13	20.5	24%	Below benchmark	240	15 (6%)		15 (6%)		90 (38%)	90 (38%)		
20	Wet Sclerophyll Forest	NR122	40	18.8	62%	Within benchmark	617	351 (57%)	179 (29%)	47 (8%)	125 (20%)	325 (53%)	123 (20%)	3.33%	Scuffed bark on 4 x *E. micrcorys* and 1 x *E. reisinifera*; 21 Koala scats beneath *E. propinqua*

Canopy Plot ID	Habitat type	Veg. Type ID	No. of trees	Avg. tree height (m)	Over storey cover	Over storey condition	Tree cover (m^2)[1]	Koala food tree cover (m^2, % of total cover)[2]	Koala primary food tree cover (m^2, % of total cover)[3]	Koala secondary food tree cover (m^2, % of total cover)[4]	Koala secondary food tree cover (m^2, % of total cover)[5]	GHFF diet plant cover (m^2, % of total cover)[6]	GHFF key diet plant cover(m^2, % of total cover)[7]	Koala activity level	Fauna observations
21	Dry Sclerophyll Forest	NR247	30	19.1	36%	Within benchmark	360	241 (67%)	70 (19%)	171 (48%)		225 (63%)	38 (11%)	10%	Scratches on 5 x *E. propinqua*; Resident Koala and 9 scats beneath *E. propinqua*; 2 koala scats beneath 2 x *E. propinqua*
22	Wet Sclerophyll Forest	NR122	21	13.0	29%	Below benchmark	287	61 (21%)	26 (9%)	35 (12%)		135 (47%)	25 (9%)		3 Brushtail Possum scats and scratches on 2 x *E. propinqua*
23	Dry Sclerophyll Forest	NR263	27	16.3	30%	Within benchmark	296	139 (47%)	77 (26%)	62 (21%)		106 (36%)	92 (31%)	3.33%	24 Koala scats beneath *E. microcorys*
24	Dry Sclerophyll Forest	NR246	32	15.9	30%	Within benchmark	303	212 (70%)	33 (11%)	121 (40%)	58 (19%)	205 (68%)	70 (23%)		
		Site average	**25.6**	**19.1**	**36%**		**363**	**192 (19%)**	**50 (5%)**	**54 (5%)**	**87 (9%)**	**242 (29%)**	**92 (13%)**	**2%**	

1 – Total cover of trees present in either the emergent, canopy or mid storey strata in the plot. Since separate strata overlap the total may be greater than the area of the plot ($1000m^2$).

2 - Total cover of Koala food trees as defined below in notes 3-5.

3 - Primary food trees for the Koala as defined in the Comprehensive Koala Plan of Management for Eastern portion of Kempsey Shire LGA, Vol. 1 (KSC, 2011).

4 - Secondary food trees for the Koala as defined in KSC (2011).

5- Supplementary food tree species are as defined in the North Coast management area listed in Appendix 2 of the Approved Recovery Plan for the Koala *Phascolarctos cinereus* (DECC, 2008).

6 – Diet plants in the blossom or fruit diet of the Grey-headed Flying-fox (GHFF) as defined in Eby, P. and Law, B. (2008).

7 – Key diet plants in the blossom or fruit diet of the Grey-headed Flying-fox (GHFF) as defined in Eby, P. and Law, B. (2008).

8 – Percentage of the 30 trees sampled in a Koala SAT plot that had at least one Koala scat (see Phillips and Callaghan, 2011).

3.4.2 Grey-headed Flying-fox

The Grey-headed Flying-fox was recorded at the Norton site by Lewis and James (2010). The WC2NH Norton offset area contains around 185 hectares of nectar and fruit-bearing foraging habitat for the known regional population of the Grey-headed Flying Fox associated with wet and dry sclerophyll forest. The broader Norton offset site contains a total of around 496 hectares of habitat for the species.

The canopy plot data presented in Table 4 confirms that there is good cover of plant species in the blossom diet of the Grey-headed Flying-fox (average 242 m^2 cover present as emergent, canopy or mid storey in each 1000m^2 plot sampled across the site), including key diet plant species (average 92 m^2 cover) (Eby and Law, 2008). The most abundant key diet plant species are Blackbutt, Pink Bloodwood and Red Bloodwood. The diet plants Turpentine, Small-fruited Grey Gum and Flooded Gum (*Eucalyptus grandis)* are also abundant at the site. Collectively these species could provide nectar throughout the entire year (Eby and Law, 2008). The Norton offset site contains large, mature individuals of these species and regenerating patches and is likely to comprise an abundant and secure source of foraging resources into the future.

The following species in the fruit diet of the Grey-headed Flying-fox (Eby and Law, 2008) were present in small numbers in the plots and occur intermittently across the Norton site: Rusty Fig (*Ficus rubiginosa*), Sandpaper Fig (*F. coronata),* Sweet Pittosporum (*Pittosporum undulatum*) and Blueberry Ash (*Eleaocarpus reticulatus*).

The Norton site comprises foraging habitat critical to the survival of Grey-headed Flying-foxes because it meets at least the following two identification criteria defined in the recovery plan for the species (DECC, 2009):

- It is productive during winter and spring, when food bottlenecks have been identified as confirmed by the presence of winter-flowering trees in the blossom diet of the species (Eby and Law, 2008), including good cover of Spotted Gum, Blackbutt and Turpentine.
- It is productive during the final weeks of gestation, and during the weeks of birth, lactation and conception (September to May) as confirmed by the presence of spring to autumn-flowering trees in the blossom diet of the species (Eby and Law, 2008), including good cover of Pink Bloodwood, Red Bloodwood and Red Mahogany.

The site is also likely to support (i.e. contribute to available foraging resources) for at least one continuously occupied roost camp: there are three known camps within the vicinity of the Norton offset site (see Section 3.5.2), including two which comprise roosting habitat critical to the survival of the species (Eby, 2012) as defined in the recovery plan (DECC, 2009).

Based on the above assessment of habitat quality, the site condition component of the current habitat quality of the WC2NH Norton offset area was scored as 7/10 in the offset assessment guide calculations (see Section 9). This score reflects the presence of occupied habitat with good cover of key diet tree species but with some impact from weed infestation, past clearing and edge effects.

3.4.3 Spotted-tail Quoll

The Spotted-tailed Quoll is known from a wide range of habitat types, the threshold densities of critical components required to maintain populations are unknown and critical habitat has not been formally defined or mapped (Long and Nelson, 2009). Therefore, identification of habitat for the species must be based on a subjective assessment and/or previous records of the species.

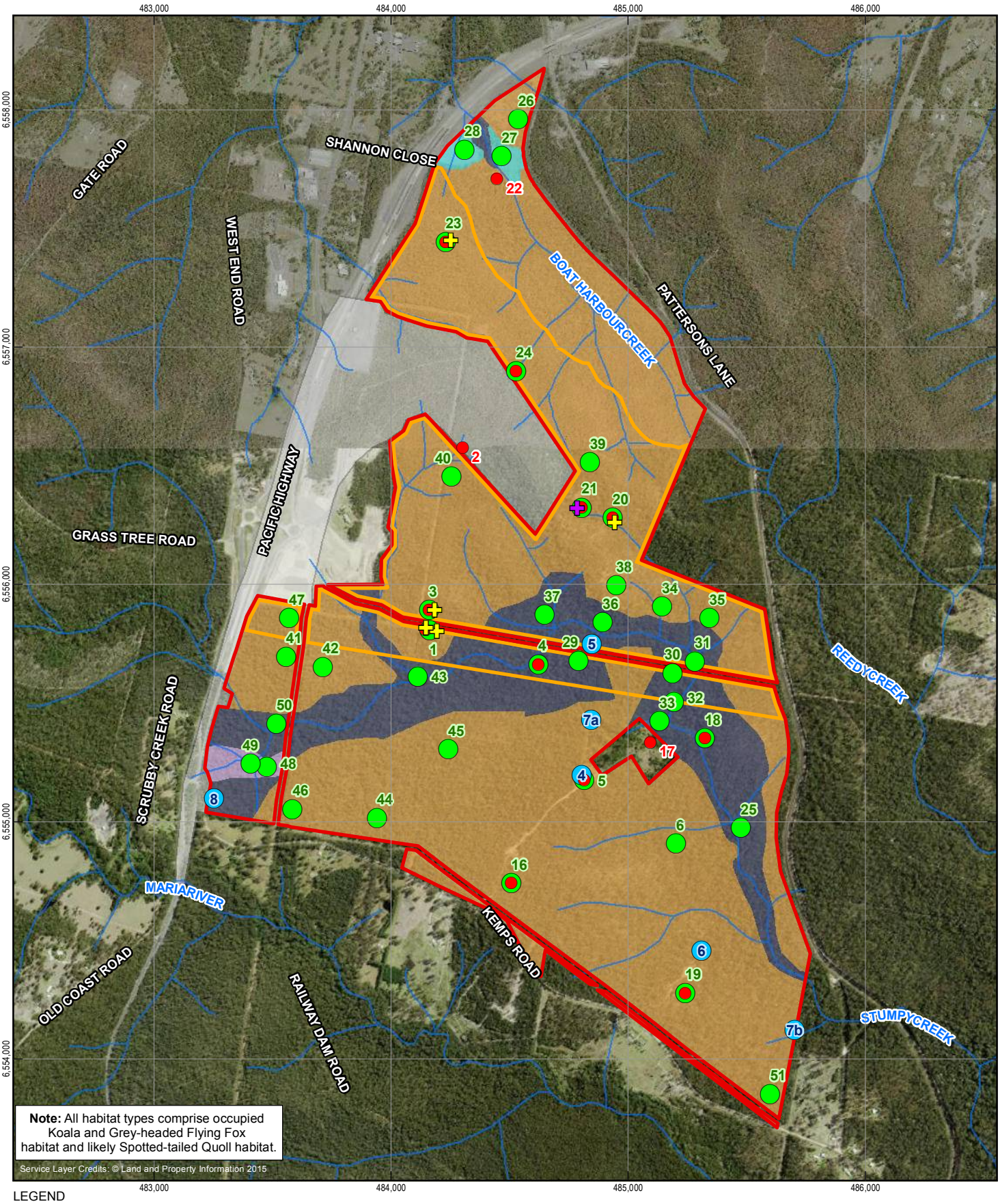
The Spotted Tailed Quoll has not been recorded at the Norton offset site. The WC2NH Norton offset area contains around 185 hectares of suitable habitat for the Spotted-tailed Quoll

associated with wet and dry sclerophyll forest, substantiated by confirmed local records (OEH, 2014b). This habitat has been identified based on the presence of the following characteristics identified in the recovery plan for the species (Long and Nelson, 2009):

- Forest vegetation in an area with high and predictable seasonal rainfall.
- A large, relatively intact patch of vegetation as confirmed by the plot/transect data which were at benchmark values for most attributes in the majority of plots sampled, as well as the species richness and general condition assessments provided by Lewis and James (2010).
- Moderate densities of medium-sized mammalian prey, including small wallabies, gliders and possums recorded in the present survey and by Lewis and James (2010) as well as moderate densities of hollow-bearing trees to support arboreal prey.
- Potential den sites associated with dense understorey vegetation, hollow-bearing logs and large quantities of woody debris.
- Its position in a vegetated habitat corridor that is continuous with vegetation containing known records of the species (Lewis and James, 2010; OEH, 2014b).

The broader Norton offset site contains a total of around 496 hectares of habitat for the species.

Based on the above assessment of habitat quality, the site condition component of the current habitat quality of the WC2NH Norton offset area was scored as 7/10 in the offset assessment guide calculations (see Section 9). This score reflects the presence of habitat in good condition and with moderate quantities of habitat resources such as woody debris and rock outcrops but with some impact from weed infestation, previous clearing, edge effects and predatory pest fauna.



LEGEND

- Norton offset site
- WC2NH Norton offset area
- Recent or proposed development
- Waterways
- BioBanking plot/transect
- Camera trap
- Canopy plot and Koala SAT

Threatened fauna

- Koala scat
- Observed Koala

Habitat types

- Dry sclerophyll forest
- Dry sclerophyll forest in low condition
- Grassy woodland
- Wet sclerophyll forest

Paper Size A4

0 150 300 600

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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Roads and Maritime Services
Pacific Highway Upgrade
Warrell Creek to Nambucca Heads
Biodiversity Offset Package

Job Number	21-24927
Revision	A
Date	02 Sep 2016

Norton offset site habitat for affected threatened biota Figure 4

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Data Source: General topo - NSW LPI DTDB 2012, Geoscience Australia: 250k Data - Jan 2011; Aerial Imagery - Sixmaps 2016.jrichardson

3.5 Populations of affected threatened biota

The purpose of this section is to describe the local and regional populations of each of the affected threatened species that may use habitat within the Norton offset site. This assessment is based on:

- Presence / absence of individuals on the Norton offset site as revealed by the field surveys.
- Previous records of the species in the locality (see Table 5) and characteristics of the local and regional population as revealed by the desktop assessment.
- Likely use of the habitat resources within the site, as described in Section 3.4 above.

Table 5 Records of the affected threatened species in the locality of the Norton offset site (OEH, 2014b)

Species	Wildlife Atlas records within 10 km	Closest Record	Date of Closest Record
Koala	242	Within site	2014
Grey-headed Flying Fox	57	Within site	2010
Spotted-tailed Quoll	14	2.4 km east in connected bushland; 3 km south in Maria River SF	2004; 1992

3.5.1 Koala

A single female Koala was recorded in the WC2NH Norton offset area during the September 2014 surveys. This individual was resting in a standing dead tree in an area of Spotted Gum - Grey Ironbark - Pink Bloodwood open forest in the north of the site. A total of 108 Koala scats were recorded in five separate canopy plots (see Table 4 and Figure 4), including one plot in the vicinity of the Koala observed. These scats were observed beneath Small Fruited Grey Gums (seven trees), Tallowwood (one tree) and one dead tree. All of these records were in dry sclerophyll forest in the northern portion of the Norton site. Scuffed bark and deep scratches which were probably indicative of Koala activity were also recorded on multiple trees across the site, mainly on Small Fruited Grey Gum, Tallowwood and Red Mahogany. The use of these tree species is consistent with the food trees identified in the Kempsey Koala plan of management (KSC, 2011) though Koalas appeared to be favouring Small Fruited Grey Gum at the time of the survey and this is listed as a secondary species in the plan.

Koala scats were recorded beneath several trees, including Tallowwood and Small-fruited Grey Gum, during the previous surveys (Lewis and James, 2010). Koala scats were recorded at five locations in the southern part of the site during these surveys and comprised three observations of aged scats (~6 months) in wet sclerophyll forest along Stumpy Creek and two of similar age located further to the south in dry sclerophyll forest (Lewis and James, 2010).

There are a total of 242 records of Koalas in the locality of the Norton offset site (OEH, 2014b). The Kempsey Koala plan of management (KSC, 2011) maps primary and secondary habitat within the site based on direct observations by the authors as well as habitat assessments conducted during the preparation of that plan.

Overall these results suggest that the Norton site contains a resident population of Koalas at a moderate density. Given the resident population, the extent and quality of Koala habitat in the site and its overall size, condition and landscape position, the Norton offset site will likely make

a valuable contribution to the viability of the local and regional population of the Koala. It is likely that the viability of the resident population of the Koala will improve with conservation of the offset site. In particular, the resident population is likely to benefit from continued regeneration or maturation of native vegetation containing food trees and control of dogs.

3.5.2 Grey-headed Flying-fox

Grey-headed Flying Foxes have been recorded in the Norton offset site with individuals observed foraging on Pink Bloodwood and Blackbutt (Lewis and James, 2010). There are a total of 57 records of Grey-headed Flying Foxes in the locality of the Norton offset site (OEH, 2014b). There are three known camps within the vicinity of the Norton offset site (Eby, 2012):

- The 'Crescent Head road' camp, around 1.4 km to the north, which contains critical foraging habitat, has supported >10,000 individuals at least once, supports >2,500 individuals during the reproductive season and comprises roosting habitat critical to the survival of the species as defined in the recovery plan (DECC, 2009).
- The 'Crescent Head' camp, around 10 km to the east, which contains critical foraging habitat, has supported >10,000 individuals at least once, supports >2,500 individuals during the reproductive season and comprises roosting habitat critical to the survival of the species as defined in the recovery plan (DECC, 2009).
- The 'East Kempsey' camp, around 1.5 km to the north west, which has not been confirmed to contain critical foraging habitat, has not supported >10,000 individuals at least once or >2,500 individuals during the reproductive season and does not comprise roosting habitat critical to the survival of the species as defined in the recovery plan (DECC, 2009).

No Grey-headed Flying Foxes were recorded during the present survey, presumably because individuals within the local population were using seasonal foraging resources in other vegetation types and/or in other parts of their range. This is despite high canopy cover of diet plants and significant diet plants for the Grey-headed Flying fox in the area (see Table 4), including Blackbutt and Turpentine which have flowering schedules that coincide with the field survey (Eby and Law, 2008). Patterns of habitat use by Grey-headed Flying Foxes are seasonal and sporadic in response to food sources with largely irregular patterns of productivity (DECCW, 2009). When assessed at a local scale, the species is generally present intermittently and irregularly and so this one off absence from the site does not exclude its likely value to the regional population of the species.

Overall these results suggest that the WC2NH Norton offset area is likely to provide critical foraging resources for a regional population of >10,000 Grey-headed Flying-foxes and help support two camps that are critical to the survival of the species. Given the nearby camps, the extent and cover of diet species at the site and its overall size, condition and landscape position, the Norton offset site will likely make a valuable contribution to the viability of the regional population of the Grey-headed Flying-fox. It is likely that the viability of the nearby camps will improve with conservation of the offset site. In particular, the regional population is likely to benefit from continued regeneration or maturation of native vegetation containing abundant food trees.

3.5.3 Spotted-tail Quoll

The Spotted-tailed Quoll has not been recorded at the Norton offset site. There are a total of 14 records of Spotted-tailed Quolls in the locality of the Norton offset site, including two records in connected native vegetation within three kilometres of the site (OEH, 2014b). This species is recorded intermittently and irregularly within its very large home ranges and so the lack of confirmed records at the site does not reduce its potential value to the species.

Habitat resources such as dense groundcover, fallen logs and abundant tree hollows for prey species within an area recognised as a regional habitat corridor suggest the site may be inhabited by a local population of the Spotted-tailed Quoll known from Wildlife Atlas records described above and in connected vegetation within the Maria National Park (Lewis and James, 2010).

Given the extent and quality of habitat at the site and its overall size, condition and landscape position, the WC2NH Norton offset area is likely to contribute to the viability of the local and regional population of the Spotted-tailed Quoll. Populations of the Spotted-tailed Quoll are likely to benefit from continued regeneration and maturation of native vegetation containing habitat resources and control of dogs.

The viability of the national population of the Spotted-tailed Quoll is likely to improve with conservation of the WC2NH Norton offset area through the conservation and continued regeneration of native vegetation containing abundant food trees.

4. Existing environment of the Boambee SF offset site

4.1 Location and land use

The offset site is located in the Boambee SF at Boambee on the North Coast of NSW. The Boambee SF offset site is owned and managed by Forestry Corporation NSW (FCNSW) as part of the State forest estate. Roads and Maritime will fund the titling and management of the Boambee SF offset site as a biodiversity offset for the Project. The site has been the subject of detailed ecological assessment for the current offset package and management plan as well as for the Pacific Highway Upgrade, Nambucca Heads to Urunga (NH2U) offset package (GHD, 2014, 2016b).

The Boambee SF offset site is in Coffs Harbour LGA. It is located around 6.5 kilometres west of the Pacific Ocean, 2.5 kilometres west of the Pacific Highway and 7 kilometres south west of the city of Coffs Harbour. The site location relative to the Project footprint and the region is shown on Figure 1.

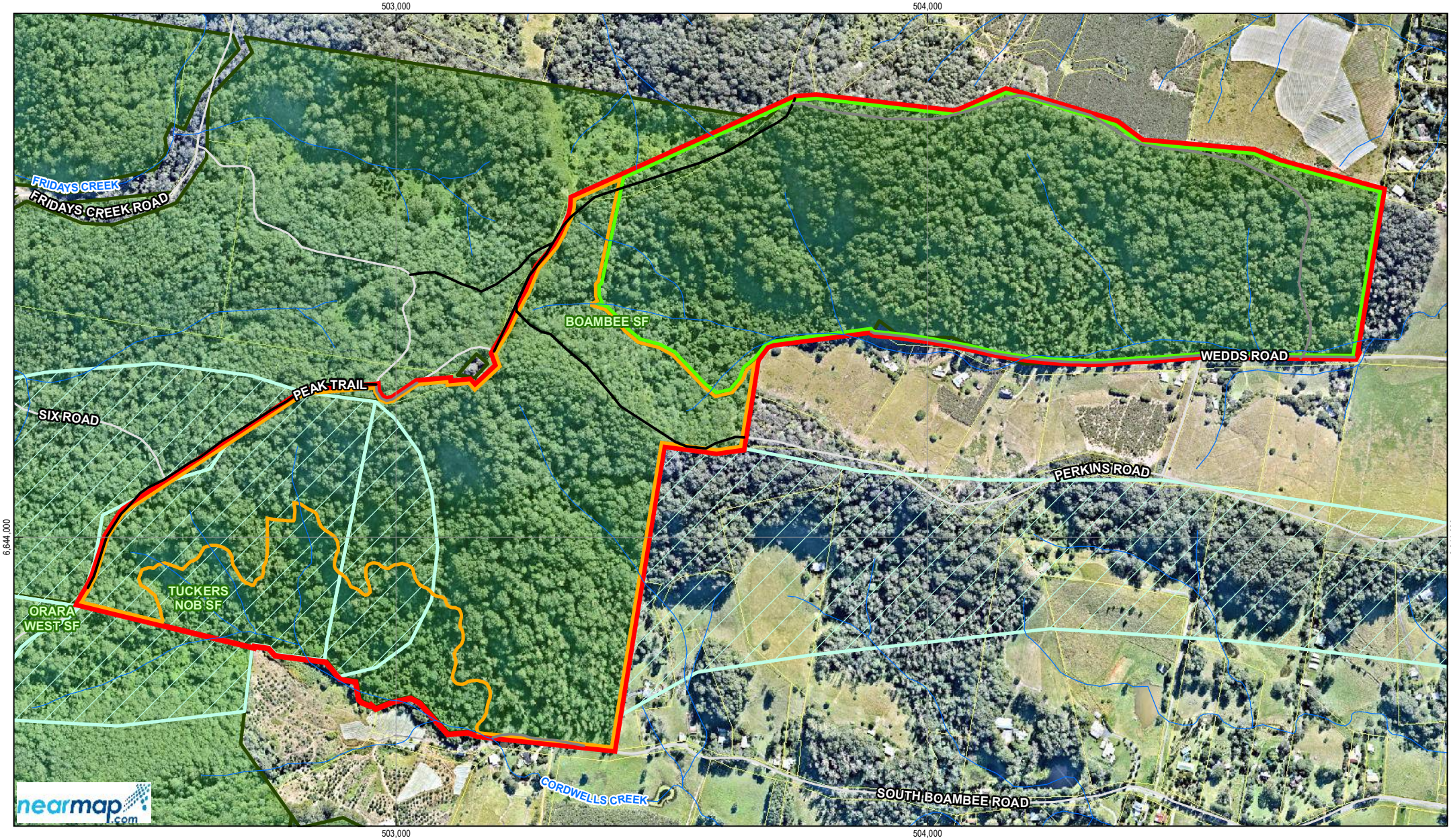
The Boambee SF offset site is accessed from the east via the suburb of Boambee and Wedds Road or South Boambee Road, or from the north via the village of Upper Orara and Fridays Creek Road. There is vehicle access around the northern boundary of the site via Fridays Creek Road and Peak Trail and partial access within the site via Perkins Road and the Foot Track. The site boundary and layout is shown on Figure 5.

The previous land use at the offset site was periodic timber harvesting as part of a State forest. Evidence of timber harvesting, track construction and partial clearing was noted during field surveys. Based on the presence of over mature and hollow-bearing trees, it appears that the site has never been clear-felled however given the comparative scarcity of larger trees it would appear to have been harvested relatively intensively in the past.

Land uses surrounding the site include:

- Partially cleared rural residential land to the east, south-east and south.
- Banana plantations to the north of the eastern portion of the offset site and to the northeast.
- State forest to the north of the western portion of the offset site and to the north-west, west and south-west (see Figure 5).

The Boambee SF offset site will also provide biodiversity offsets for impacts of the NH2U project (GHD, 2014, 2016b). The policy allows a single offset site to provide biodiversity offsets for more than one project provided that the offsets are for different threatened species or MNES (DSEWPaC, 2012). However, consultation with the DotE has confirmed that a specific parcel of land at an offset site can only be used to offset the impacts of a single project. Therefore, separate parcels of land within the Boambee SF offset site have been set aside to offset the impacts of the NH2U project and the WC2NH project (see Figure 5). The 55 hectares of land that has been included as biodiversity offsets for the WC2NH project is the 'WCNH Boambee SF offset area' as shown on Figure 5.



Paper Size A4

0 75 150 300

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Boambee SF offset site
- WC2NH Boambee SF offset area
- NH2U Boambee SF offset area
- Regional biodiversity corridor
- State forest
- Cadastre
- Waterways
- Four wheel drive track
- Unsealed road
- Public roads

Roads and Maritime Services
Pacific Highway Upgrade
Warrell Creek to Nambucca Heads
Biodiversity Offset Package

Job Number 21-24927
Revision A
Date 02 Sep 2016

Boambee SF offset site location

Figure 5

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Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data Source: NSW Department of Lands: Cadastre - Jan 2011; Geoscience Australia: 250k Data - Jan 2011, Aerial imagery - ESRI 2016 and Nearmap 2016 (image extracted 17/18/2016, image taken 05/05/2016).jrichardson

4.2 Landscape context

The Boambee SF offset site is around 121 hectares in area and contains wet and dry sclerophyll forest and rainforest on steep, near-coastal hills on the east face of the Great Dividing Range. The site comprises steep to very steep, south or east draining slopes that are incised by multiple steep sided gullies. The underlying geology is Permian metasediments.

The eastern and south-eastern portions of the offset site, at lower elevations, fall within the 'Brooms Head – Kempsey Coastal Ramp' Mitchell landscape (DECC 2008a). This landscape comprises hills and low ranges of the coastal fall on Permian Phyllite and schistose sandstone. General elevation is 50 to 450m with local relief of up to 300m. Soils consist of thin, stony gradational loam and sandy loam on the slopes grading to yellow-brown texture-contrast soils on lower slopes and in valleys (DECC 2008b).

The western and northern portions of the offset site, at higher elevations, are part of the Nymboida Great Escarpment Mitchell landscape (DECC 2008a). This landscape comprises ranges, peaks and steep escarpments on Permian/Carboniferous volcanics within extensive area of moderately deformed Silurian-Devonian sedimentary rocks. General elevation is 400 to 1400m with local relief up to 500m. Soils vary from shallow gritty sandy loam through red and yellow earthy gradational profiles to deep siliceous sands and loams on valley floors (DECC 2008b).

There are extensive areas of rock outcrop and scree slopes at the site. Vegetation at the site varies in response to aspect and topographic position (see Section 4.3 and Figure 6 below).

The southern portion of the site is drained by a number of unnamed first and second order streams. These streams are bedrock confined, intermittent 'chain of pools' type drainage lines with sand or gravel substrate. They are generally in good condition with intact riparian and in stream vegetation, intact channel and bank structure, slight to moderate weed infestation and no visible evidence of poor water quality.

The second order stream that runs parallel to Wedds Road in the northeast of the site has been dammed and excavated in places to form deep pools or straight channels. These earthworks appear to have been completed many decades ago and the riparian corridor features mature regrowth vegetation and has considerable habitat value. However the hydrology and geomorphology of the drainage line has been substantially modified and in its present form is unlikely to comprise suitable breeding habitat for the Giant Barred Frog and other stream breeding frogs.

The offset site lies within a mapped regional fauna habitat corridor (Scotts et. al., 2003) that runs east-west connecting State forests to the west and south of the site with coastal vegetation to the east.

The Boambee SF offset site is part of a near continuous patch of native vegetation and habitat of many thousands of hectares. Partially cleared rural residential land in the locality of Boambee and the Pacific Highway to the east would comprise barriers to fauna movement and other ecological processes. Boambee SF and Tuckers Nob SF extend to the west of the offset site and beyond that there is an extensive network of native vegetation in national parks and State forests that stretches along the Great Dividing Range. The offset site is connected to this extensive area of habitat via continuous vegetation in Boambee SF. This vegetation is partially interrupted by small dirt or gravel tracks, including along the entire northern boundary of the site. These tracks would not comprise a significant gap in habitat and would not be a barrier to pollination, seed fall or other ecological processes in the life history of the affected threatened plants. There are partial barriers to the north, south and southeast associated with partially cleared and/or fenced private land, including banana plantations. Near continuous vegetation is present around or between these gaps in habitat.

There is evidence of edge effects around the perimeter of the Boambee SF offset site where it adjoins disturbed, cleared land as well as along tracks. There is localised, moderate to severe weed infestation associated with these disturbed edges.

The offset site comprises appropriately situated habitat for the long term maintenance of populations of the affected threatened species. In this landscape context, the offset site comprises a valuable habitat link in terms of the extensive area of occupied habitat it encompasses, its position between the coast and ranges and as a conserved vegetated corridor around an area of rural residential development.

4.3 Vegetation

Vegetation types have been mapped within the offset site by OEH (2012) and this mapping was ground truthed and converted to NSW vegetation types by the project botanists listed in Table 2 as part of the present study. Vegetation types within the offset site are shown on Figure 6 and summarised in Table 6.

Plant species recorded in plot/transects sampled in these vegetation types are listed in Table 2 of Appendix A.

4.4 Habitat quality

This section describes the extent and quality of habitat for the affected threatened species in the Boambee SF offset site based on the desktop assessment and field survey results.

Marsdenia longiloba and *Tylophora woollsii* recorded at the Boambee SF offset site and occupied and potential habitat are mapped on Figure 7.

Fauna habitat types and canopy plot survey locations are shown on Figure 8. Canopy plots were sampled at the locations shown on Figure 8 and comprised counts of every tree in a 50 m x 20 m plot along with its height, species and canopy cover. Each tree species was then cross referenced to lists of food tree species for the affected threatened species to calculate the cover of food tree species. The results of canopy plot surveys to quantify habitat resources for the affected threatened fauna species are presented in Table 7.

A detailed description of habitat quality for each species is provided below.

4.4.1 *Marsdenia longiloba* and Tylophora woollsii

The Boambee SF offset site was identified in the desktop review of potential offset sites conducted for the threatened flora offset strategy for the NH2U project (GHD 2014). The criteria used to select the Boambee SF offset site as a candidate site were:

- Presence of sheltered, south facing slopes and presence of mapped wet sclerophyll forest as predictors of suitable habitat for *Marsdenia longiloba* and *Tylophora woollsii*.
- Large lot size, suitable tenure (i.e. State forest) and continuity with a large patch of vegetation which are factors that make the site more suitable for effective management for conservation (GHD 2014).

The presence of suitable habitat was confirmed by a preliminary site survey conducted by Dr Andrew Benwell over two days in April 2015. Dr Benwell confirmed the presence of sheltered slopes and wet sclerophyll forest and recorded several *Marsdenia longiloba* and *Tylophora woollsii* stems across the site.

The extent and quality of habitat was subsequently confirmed through a detailed survey of the Boambee SF offset site over six days in May 2015. Targeted searches for threatened plants confirmed the presence of extensive local populations of *Marsdenia longiloba* and *Tylophora woollsii* (see Section 4.5.1). 'Occupied habitat' for the affected threatened plants was mapped

around the clusters of stems that were directly observed and then extrapolated out to include continuous vegetation with appropriate structure, aspect and disturbance history and minor or localised weed infestation.

M. longiloba and *T. woollsii* recorded at the Boambee SF offset site and occupied habitat are mapped on Figure 7. The mapped area of occupied habitat is likely to contain more *M. longiloba* and *T. woollsii* stems than those directly recorded and shown given the cryptic nature of the two plant species. The WC2NH offset area has been selected and mapped around dense clusters of *M. longiloba* and *T. woollsii* stems and an extensive area of occupied habitat (as well as habitat for the affected threatened fauna). The WC2NH offset area contains around 34 hectares of occupied habitat.

There is evidence of edge effects around the perimeter of the Boambee SF offset site where it adjoins disturbed, cleared land as well as along tracks. There is localised, moderate to severe weed infestation associated with these disturbed edges. These edges may also be less suitable habitat for *Marsdenia longiloba* and *Tylophora woollsii* because they tend to be drier and more exposed. *Marsdenia longiloba* and *Tylophora woollsii* stems were observed with around 20 metres of the boundary of the offset site and agricultural land and as close as two metres from tracks (see Figure 13) and so these edge effects appear to be having a minor overall impact on the quality of habitat. Weed management will be important for minimising these impacts and maintaining the quality of habitat.

Additional areas of 'potential / poorer quality threatened plant habitat' were mapped that contained less suitable aspects or vegetation structure, more recent disturbance or more severe and/or extensive weed infestation (see Figure 7). Areas of potential/poorer quality habitat in the WC2NH offset area have not been included in offset assessment guide calculations but will still be managed as part of the offset package. Potential habitat will help maintain populations of *Marsdenia longiloba* and *Tylophora woollsii* by providing a partial buffer area around occupied habitat. Potential habitat may develop into occupied habitat in the future with active management as well as natural successional changes to vegetation structure. The WC2NH offset area contains around nine hectares of potential / poorer quality habitat.

There is a dry, north-facing slope in the WC2NH Boambee SF offset area that does not contain any occupied or potential habitat for *Marsdenia longiloba* and *Tylophora woollsii.* This area has been excluded from the offset calculations.

The baseline condition of occupied habitat in the WC2NH offset area was assessed using BioBanking plot/transects and compared with benchmark data from matching NSW vegetation types (see Appendix A). Benchmarks are a quantitative measure of vegetation condition where there is relatively little evidence of modification by humans (DECC 2008) and provide a reliable measure of the relative condition of vegetation sampled by plot/transects. The plot/transect data confirmed that the vegetation associated with occupied habitat is in good condition with benchmark values for the majority of attributes in the majority of plot/transects that were sampled. Notably, native over storey cover was high (24.5% to 48.5% cover) and within the range of benchmark values in all plot/transects which indicates mature forest and which would be contributing to a suitable microclimate for the affected threatened plants. One plot/transect in the area of threatened plant habitat was slightly below benchmark values for native species richness and three had below benchmark scores for native mid storey cover. Five out of the seven plot/transects sampled within threatened plant habitat featured minor weed infestation (0% to 10% cover) and two featured moderate infestation (16 to 24% cover), mainly associated with Lantana (*Lantana camara*).

Past timber harvesting at the site has had a negative impact on localised areas such as old timber harvesting tracks and log dumps. These areas are in various stages of regeneration but generally appeared to be developing well into native vegetation communities.

Based on the above assessment of habitat quality, the site condition component of the current habitat quality of the WC2NH offset area was scored as 7/10 in the offset assessment guide calculations (see Section 10.4). This score reflects the presence of occupied habitat with some impact from weed infestation, timber harvesting and edge effects.

Table 6 Vegetation in the Boambee SF offset site

Coffs Harbour LGA Vegetation Community (OEH 2012)	Habitat type	Area in Boambee offset site (ha)	Area in WC2NH offset area (ha)	Plot/transects	Coffs Harbour LGA Map Unit Code (OEH 2012)	Plant Community Type Code (OEH, 2014a)	Condition
Hinterland and Escarpment Tallowwood - Blackbutt - Blue Gum Wet Ferny Forest	Wet sclerophyll forest	40.8	14.1	W2, 1	CH_WSF10	NR120	Moderate/good
Northern Escarpment Blackbutt - Apple Wet Ferny Forest	Wet sclerophyll forest	24.7	17.3	W4, 2, 5	CH_WSF09	NR120	Moderate/good
Coast and Hinterland Riparian Flooded Gum Bangalow Wet Forest	Wet sclerophyll forest	26.4	11.5	W3, 3, 4	CH_WSF01	NR159	Moderate/good
Total	**Wet sclerophyll forest[1]**	**91.9**	**42.9**				
Coast and Escarpment Blackbutt Dry Forest	Dry sclerophyll forest	1.5		-	CH_DOF01	NR117	Moderate/good
Foothills Grey Gum - Ironbark - Mahogany Dry Forest	Dry sclerophyll forest	6.2	6.2	W5	CH_DOF05	NR263	Moderate/good
Total	**Dry sclerophyll forest[1]**	**7.7**	**6.2**				
Escarpment and Lowland Bangalow - Carabeen - Black Booyong Palm Gully Rainforest	Rainforest[2]	21		W1, 4	CH_RF11	NR111	Moderate/good
Exotic vegetation	Exotic scrub	0.4	0.4		CH_EX04	n/a	Low
Total		**121**	**49.5**				

Notes: 1) comprises occupied Koala and Grey-headed Flying Fox habitat and likely Spotted-tailed Quoll habitat 2) comprises occupied Grey-headed Flying Fox habitat and likely Spotted-tailed Quoll habitat.

4.4.2 Koala

The Koala was recorded at three locations at the Boambee SF offset site in the current surveys, through observations of scats at two separate locations and hearing the calls of an adult male. An adult male was also heard calling in a patch of connected vegetation to the south of the site (see Figure 7). The WC2NH Boambee offset area contains around 49 hectares of habitat for the known local population of the Koala associated with wet and dry sclerophyll forest.

The canopy plot results confirmed that the Boambee SF site contains extensive areas of primary and secondary food trees for the Koala as defined in the Coffs Harbour City Koala plan of management (Lunney et. al., 1999) and/or in the North Coast management area of the recovery plan (DECC, 2008). In the Coffs Harbour region, Tallowwood (*Eucalyptus microcorys*) is the tree species most preferred by Koalas. Swamp Mahogany (*E. robusta)*, Small-fruited Grey Gum (*E. propinqua*), Broad-leaved Paperbark (*Melaleuca quinquenervia*), Flooded Gum (*E. grandis*), Blackbutt (*E. pilularis*) and Forest Oak (*Allocasuarina torulosa*) are also used and are considered secondary food tree species in this region (Lunney et. al., 1999).

The canopy plot data presented in Table 7 confirms that there is high cover of food trees (average 464 m^2 cover present as emergent, canopy or mid storey in each 1000m^2 plot sampled across the site) and primary food trees (average 318 m^2 cover across the site). There is one primary food tree species at the site: Tallowwood. Tallowwood is a dominant or sub-dominant canopy species in all wet and dry sclerophyll forest vegetation types at the site. There was up to 600 m^2 of foliage cover of primary food trees in the plots sampled. At least one secondary food tree species also occurs as a dominant or sub-dominant canopy species in all wet and dry sclerophyll forest vegetation types at the site. These include either Flooded Gum, Blackbutt or Forest Oak as identified in the Coffs Harbour City Koala plan of management (Lunney et. al., 1999) or Red Mahogany (*Eucalyptus resinifera*) as identified in the North Coast management area of the recovery plan (DECC, 2008).

Average over storey cover across the site was 40.1%, indicating a forest structure throughout and was consistently within benchmark values for individual vegetation types (i.e. equivalent to intact examples of the vegetation type).

The Coffs Harbour City Koala Plan of Management does not identify Koala habitat within State forests however there are mapped patches of Primary and Secondary habitat type on private land immediately adjoining the Boambee SF offset site (Lunney et. al., 1999). The plan specifically identifies a strip of land that runs south through Boambee SF to the far southeast of the region as one of the areas that contains the majority of the primary habitat in the region and the highest level of Koala records and activity (Lunney et. al., 1999).

The Boambee SF offset site is mapped as a 'locally significant link' in the Coffs Harbour City Koala Plan of Management, connecting State forest at higher elevations in the west of the region with coastal vegetation around Sawtell to the southeast (Lunney et. al., 1999).

The Koala SAT plot results indicated that two out of 10 plots featured 'Medium (normal) use' for the 'East Coast (low) activity category' (Phillips and Callaghan, 2011). The remaining 8 SAT plots (zero scats) and the cumulative Koala SAT plot results across the site (scats beneath <1% of trees sampled) suggest low activity levels. Low activity levels recorded in what might otherwise be medium or high carrying capacity Koala habitat may be a result of contemporary population dynamics, landscape configuration and/or historical disturbances, including logging, mining, fire, agricultural activities and/or urban development (Phillips and Callaghan, 2011). Such considerations should not necessarily detract from the potential importance of such habitat for longer-term conservation, particularly if preferred food trees are present and populations of the Koala are known to occur in the general area (Phillips and Callaghan, 2011) as is the case at the Boambee SF offset site.

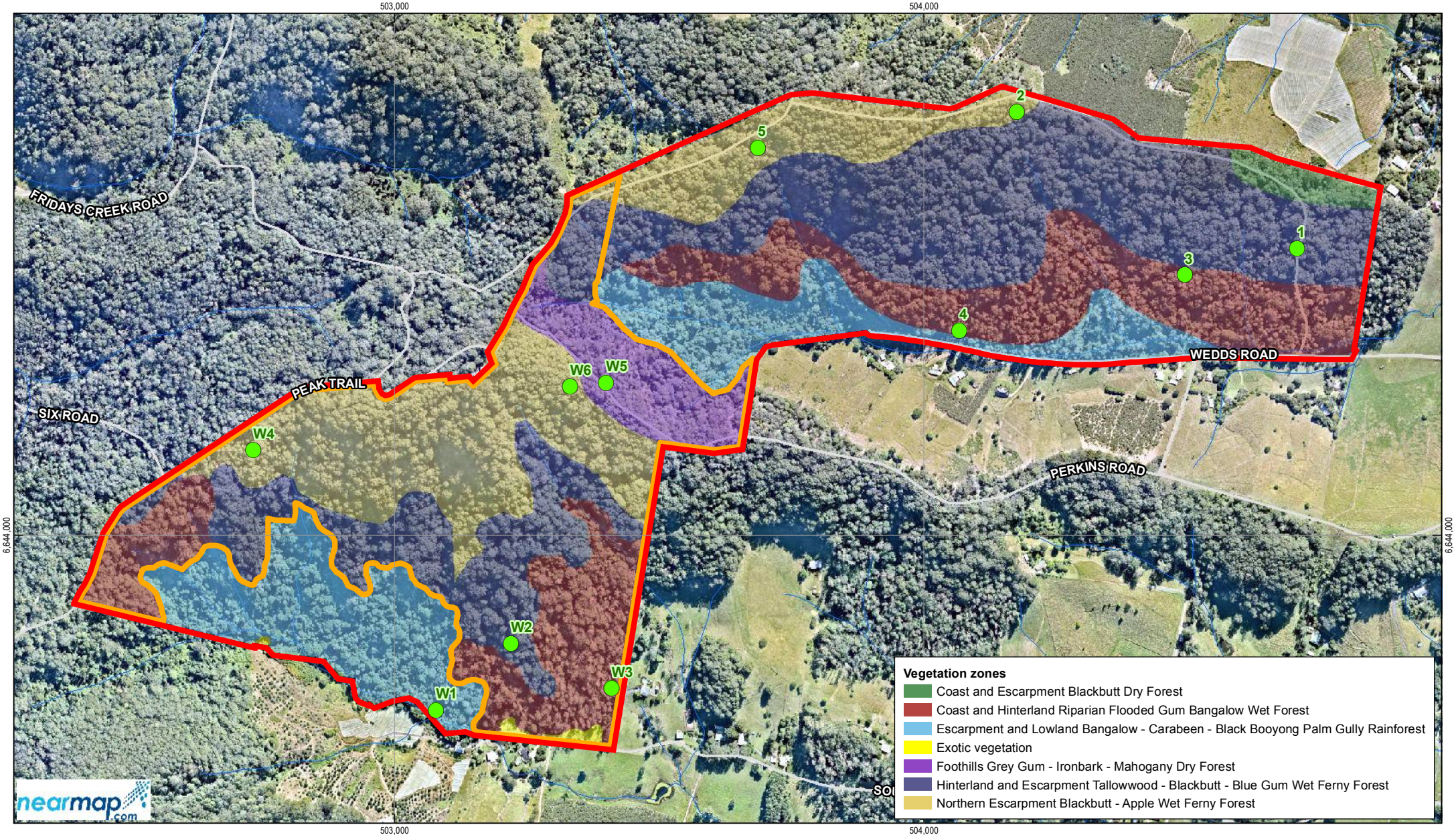
Habitat critical to the survival of the Koala is defined as an area that scores five or more using the habitat assessment tool for the Koala in Table 4 of the DotE (2014) guidelines. The habitat assessment tool scores for the Boambee SF site are as follows:

- Koala occurrence — +2 (high) Evidence of one or more koalas within the last 2 years (recorded on site in the GHD surveys).
- Vegetation composition — +2 (high) Forest or woodland with 2 or more known Koala food tree species in the canopy (Tallowwood, Flooded Gum and Blackbutt).
- Habitat connectivity — +2 (high) Area is part of a contiguous landscape ≥ 500 ha (the site is connected to many thousands of hectares of habitat in State forests to the west).
- Key existing threats — +1 (medium) Evidence of infrequent or irregular Koala mortality from vehicle strike or dog attack at present in areas that score 1 or 2 for Koala occurrence (collection of direct evidence is outside the scope of this assessment. Some mortality is likely given the presence of roads within and adjoining the site, agricultural land adjoining the site and likely presence of wild dogs).
- Recovery value — +2 (high) Habitat is likely to be important for achieving the interim recovery objectives for the relevant context (the site and adjoining land is recognised as an area of primary habitat and a key corridor in the regional plan of management (Lunney et. al., 1999)).

The Boambee SF site has a total habitat score of nine. Therefore, the Boambee SF site is habitat critical to the survival of the Koala.

The baseline condition of occupied Koala habitat in the WC2NH offset area was assessed using BioBanking plot/transects and compared with benchmark data from matching NSW vegetation types (see Appendix A). The plot/transect data confirmed that the vegetation associated with occupied habitat is in good condition with benchmark values for the majority of attributes in the majority of plot/transects that were sampled. Notably for this species, over storey cover and regeneration were at benchmark values. Past timber harvesting at the site has had a negative impact on localised areas such as old timber harvesting tracks and log dumps. These areas are in various stages of regeneration but generally appeared to be developing well into native vegetation communities.

Based on the above assessment of habitat quality, and consideration of the site context and species stocking rate attributes the current habitat quality of the WC2NH Boambee offset area was scored as 8/10 in the offset assessment guide calculations (see Section 9). This score reflects the presence of occupied habitat with high cover of primary food tree species as a part of an extensive patch of habitat but with some impact from weed infestation, timber harvesting, edge effects and probably also predatory pest fauna.



Paper Size A4

0 75 150 300

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Boambee SF offset site
- WC2NH Boambee SF offset area
- BioBanking plot/transect
- Roads
- Waterways

Roads and Maritime Services
Pacific Highway Upgrade
Warrell Creek to Nambucca Heads
Biodiversity Offset Package

Job Number 21-24927
Revision A
Date 02 Sep 2016

Boambee SF offset site vegetation Figure 6

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Data Source: NSW Department of Lands: Cadastre - Jan 2011; Geoscience Australia: 250k Data - Jan 2011, Aerial imagery - ESRI 2016 and Nearmap 2016 (image extracted 17/18/2016, image taken 05/05/2016).jrichardson

Table 7 Canopy plot results for the Boambee SF offset site

Canopy Plot ID	Habitat type	Veg. Type ID	No. of trees	Average tree height (m)	Over storey cover	Over storey condition	Tree cover (m^2)[1]	Koala food tree cover (m^2, % of total cover)[2]	Koala primary food tree cover (m^2, % of total cover)[3]	Koala secondary food tree cover (m^2, % of total cover)[4]	GHFF diet plant cover (m^2, % of total cover)[5]	GHFF key diet plant cover(m^2, % of total cover)[6]	Koala activity level[7]	Fauna observations
W2	Wet Sclerophyll Forest	NR120	31	23	46	Within benchmark	890	810 (54%)	290 (19%)	520 (35%)	600 (40%)	470 (31%)	3.33%	One Koala scat beneath *E. microcrys*
W3	Wet Sclerophyll Forest	NR159	31	22	48.5	Within benchmark	740	220 (15%)		220 (15%)	705 (47%)	60 (4%)		
W4	Wet Sclerophyll Forest	NR120	37	22	39.5	Within benchmark	1105	925 (62%)	601 (40%)	324 (22%)	504 (34%)	270 (18%)		
W5	Dry Sclerophyll Forest	NR263	27	13	29	Within benchmark	266	41 (3%)		41 (3%)	103 (7%)	71 (5%)		
W6	Wet Sclerophyll Forest	NR120	37	18	39.5	Within benchmark	593	488 (33%)	366 (24%)	122 (8%)	219 (15%)	140 (9%)		
W8	Wet Sclerophyll Forest	NR120	31	19	41.5	Within benchmark	676	601 (40%)	454 (30%)	147 (10%)	210 (14%)	195 (13%)	3.33%	One Koala scat beneath *E. microcrys*
W9	Dry Sclerophyll Forest	NR263	20	18	41	Within benchmark	652	110 (7%)	75 (5%)	35 (2%)	290 (19%)	290 (19%)		Scratch marks on *E. microcorys*
W10	Wet Sclerophyll Forest	NR159	36	18	24.5	Within benchmark	1207	520 (35%)	125 (8%)	395 (26%)	830 (56%)	355 (24%)		
		Site average	**30.8**	**18.8**	**40.1**		**847.1**	**464.4**	**318.5**	**225.5**	**415.1**	**231.4**	**0.66%**	

1 – Total cover of trees present in either the emergent, canopy or mid storey strata in the plot. Since separate strata overlap the total may be greater than the area of the plot (1000m^2).

2 – Total cover of Koala food trees as defined in categories 2-4.

3 - Primary food trees for the Koala as defined in the Coffs Harbour City Koala plan of management (Lunney et. al., 1999) and/or in the North Coast management area of the recovery plan (DECC, 2008).

4 - Secondary food trees for the Koala as defined in the Coffs Harbour City Koala plan of management (Lunney et. al., 1999).

5 – Diet plants in the blossom or fruit diet of the Grey-headed Flying-fox (GHFF) as defined in Eby, P. and Law, B. (2008).

6 – Key diet plants in the blossom or fruit diet of the Grey-headed Flying-fox (GHFF) as defined in Eby, P. and Law, B. (2008).

7 – Percentage of the 30 trees sampled in a Koala SAT plot that had at least one Koala scat (see Phillips and Callaghan, 2011).

4.4.3 Grey-headed Flying-fox

The WC2NH Boambee offset area contains around 49 hectares of nectar or fruit-bearing foraging habitat for the known regional population of the Grey-headed Flying Fox associated with wet and dry sclerophyll forest. There is around 72 hectares of additional connected habitat at the Boambee SF offset site that will be set aside to offset the impacts of other projects.

The canopy plot data presented in Table 7 confirms that there is good cover of plant species in the blossom diet of the Grey-headed Flying-fox (average 415 m^2 cover present as emergent, canopy or mid storey in each 1000m^2 plot sampled across the site), including key diet plant species (average 318 m^2 cover across the site) (Eby and Law, 2008). The most abundant key diet plant species are Blackbutt, Turpentine (*Syncarpia glomulifera* subsp. *glomulifera*) and Sydney Blue Gum (*E. saligna*). Collectively these species could provide nectar throughout the entire year (Eby and Law, 2008). Each of these species is a dominant canopy species in the forest types at the site. The Boambee SF offset site contains large, mature individuals of these species and regenerating patches and is likely to comprise an abundant and secure source of foraging resources into the future.

The following species in the fruit diet of the Grey-headed Flying-fox (Eby and Law, 2008) are present at moderate cover in the plots and across the Boambee SF site: Bangalow Palm (*Archontophoenix cunninghamiana*), Rusty Fig (*Ficus rubiginosa*), Sweet Pittosporum (*Pittosporum undulatum*) and Blueberry Ash (*Eleaocarpus reticulatus*). These species are mainly present in the mid storey. In some areas they form dense stands that would yield abundant fruit. Fruit resources would be likely to peak in Spring and Summer but would be available at varying quantities throughout the year (Eby and Law, 2008).

The following additional species in the fruit diet of the Grey-headed Flying-fox (Eby and Law, 2008) were present in small numbers in the plots and occur intermittently across the Boambee SF site: Southern Melodinus (*Melodinus australis*), Cockspur Thorn (*Maclura coccinensis*), Five-leaf Water Vine (*Cissus hypoglauca*), Rusty Fig (*Ficus rubiginosa*), Sweet Pittosporum (*Pittosporum undulatum*) and Native Passionfruit species (*Passiflora* species).

The Boambee SF site comprises foraging habitat critical to the survival of the Grey-headed Flying-fox because it meets at least the following two identification criteria defined in the recovery plan for the species (DECC, 2009):

- It is productive during winter and spring, when food bottlenecks have been identified as confirmed by the presence of winter-flowering trees in the blossom diet of the species (Eby and Law, 2008) such as Grey Ironbark (*E. siderophloia*).
- It is productive during the final weeks of gestation, and during the weeks of birth, lactation and conception (September to May) as confirmed by the presence of spring to autumn-flowering trees in the blossom diet of the species (Eby and Law, 2008), including extensive areas of forest dominated by Blackbutt and Sydney Blue Gum.
- The site is also likely to support at least one continuously occupied roost camp: there are two known camps within the near vicinity of the Boambee SF offset site (CHCC, 2007; OEH and DSEWPac 2013) both of which comprise roosting habitat critical to the survival of the species (CHCC, 2007) as defined in the recovery plan (DECC, 2009).

The baseline condition of occupied Grey-headed Flying-fox habitat in the WC2NH Boambee SF offset area was assessed using BioBanking plot/transects and compared with benchmark data from matching NSW vegetation types (see Appendix A). As described above for other species, the plot/transect data confirmed that the vegetation associated with occupied habitat is in good condition. Notably for this species over storey cover, mid storey cover and regeneration were at benchmark values.

Based on the above assessment of habitat quality, the site condition component of the current habitat quality of the WC2NH Boambee SF offset area was scored as 8/10 in the offset assessment guide calculations (see Section 9). This score reflects the presence of occupied habitat with high cover of key diet tree species but with some impact from weed infestation, timber harvesting and edge effects.

4.4.4 Spotted-tail Quoll

The Spotted-tailed Quoll is known from a wide range of habitat types, the threshold densities of critical components required to maintain populations are unknown and critical habitat has not been formally defined or mapped (Long and Nelson, 2009). Therefore, identification of habitat for the species must be based on a subjective assessment and/or previous records of the species.

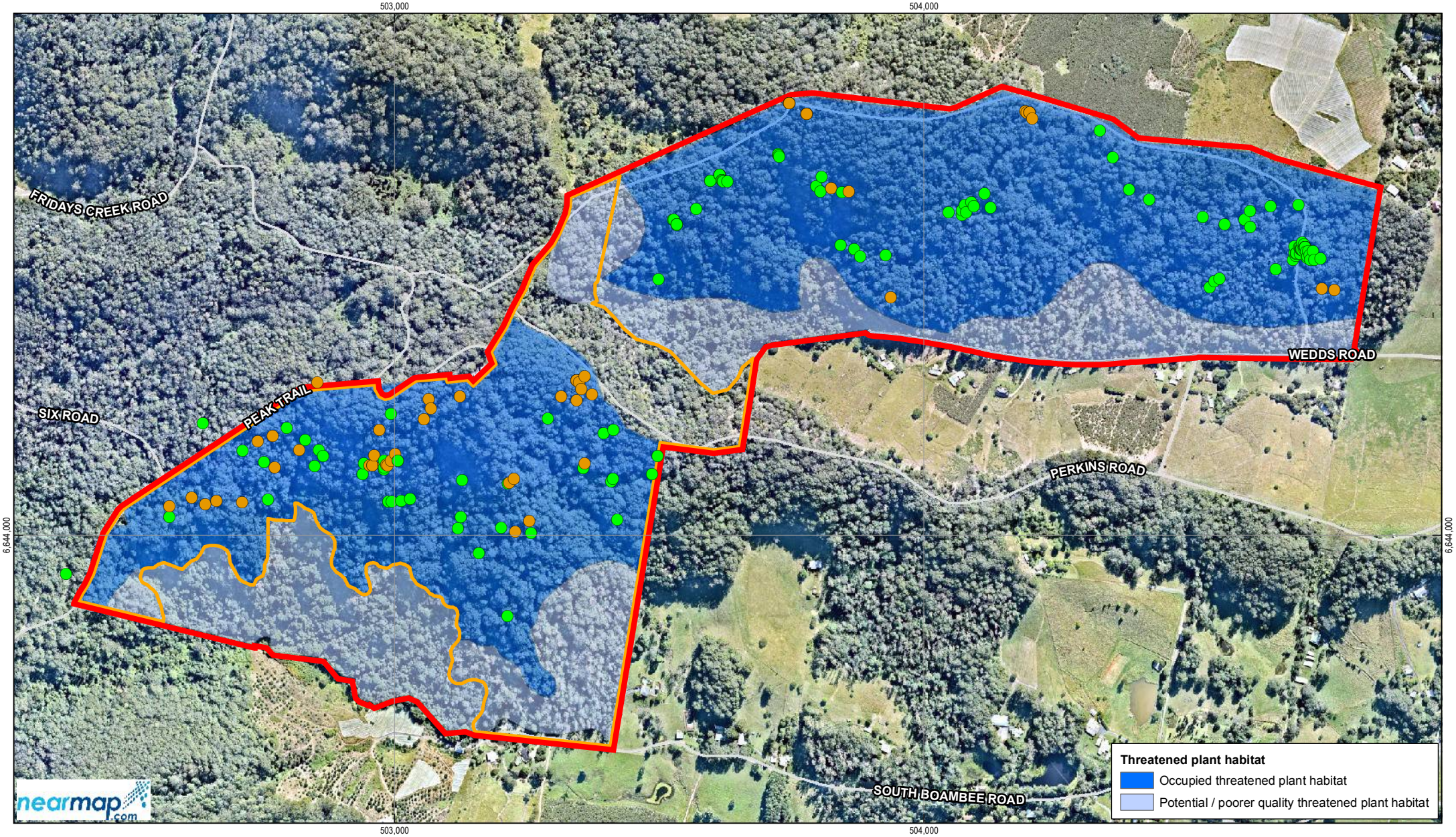
The Spotted Tailed Quoll has been recorded at the Boambee SF offset site in 2005 (OEH, 2015b). The WC2NH Boambee SF offset area contains around 49 hectares of habitat for the Spotted Tailed Quoll in wet and dry sclerophyll forest. There is around 72 hectares of additional connected habitat at the Boambee SF offset site that will be set aside to offset the impacts of other projects.

This habitat has been identified based on the presence of the following characteristics identified in the recovery plan for the species (Long and Nelson, 2009):

- Forest vegetation in an area with high and predictable seasonal rainfall.
- A large, intact patch of vegetation in good condition as confirmed by the plot/transect data which were at benchmark values for most attributes in all plots sampled.
- Moderate densities of medium-sized mammalian prey, including wallabies, gliders, rats and possums recorded in the present survey as well as moderate densities of hollow-bearing trees to support arboreal prey.
- Potential den sites associated with dense understorey vegetation, rock outcrops and caves, hollow-bearing logs and large quantities of woody debris.
- Its position in a vegetated habitat corridor that is continuous with vegetation containing known records of the species (OEH, 2015b).

The baseline condition of Spotted-tailed Quoll habitat in the WC2NH Boambee SF offset area was assessed using BioBanking plot/transects and compared with benchmark data from matching NSW vegetation types (see Appendix A). As described above for other species, the plot/transect data confirmed that the vegetation associated with occupied habitat is in good condition. Notably for this species, vegetation cover in most strata and the amount of fallen logs were at benchmark values in all plot/transects. There were no hollow-bearing trees in some of the plot/transects sampled however when averaged across the site each vegetation type present would meet benchmark condition for this habitat criterion.

Based on the above assessment of habitat quality, the site condition component of the current habitat quality of the WC2NH Boambee SF offset area was scored as 8/10 in the offset assessment guide calculations (see Section 9). This score reflects the presence of habitat in good condition and with good quantities of habitat resources such as woody debris and rock outcrops but with some impact from weed infestation, timber harvesting, edge effects and probably also predatory pest fauna.



Paper Size A4

0 75 150 300

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
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N

LEGEND

- Boambee SF offset site
- WC2NH Boambee SF offset area
- *Marsdenia longiloba*
- *Tylophora woollsii*
- Roads

Roads and Maritime Services
Pacific Highway Upgrade
Warrell Creek to Nambucca Heads
Biodiversity Offset Package

Job Number 21-24927
Revision A
Date 02 Sep 2016

Boambee SF offset site habitat for affected threatened flora

Figure 7

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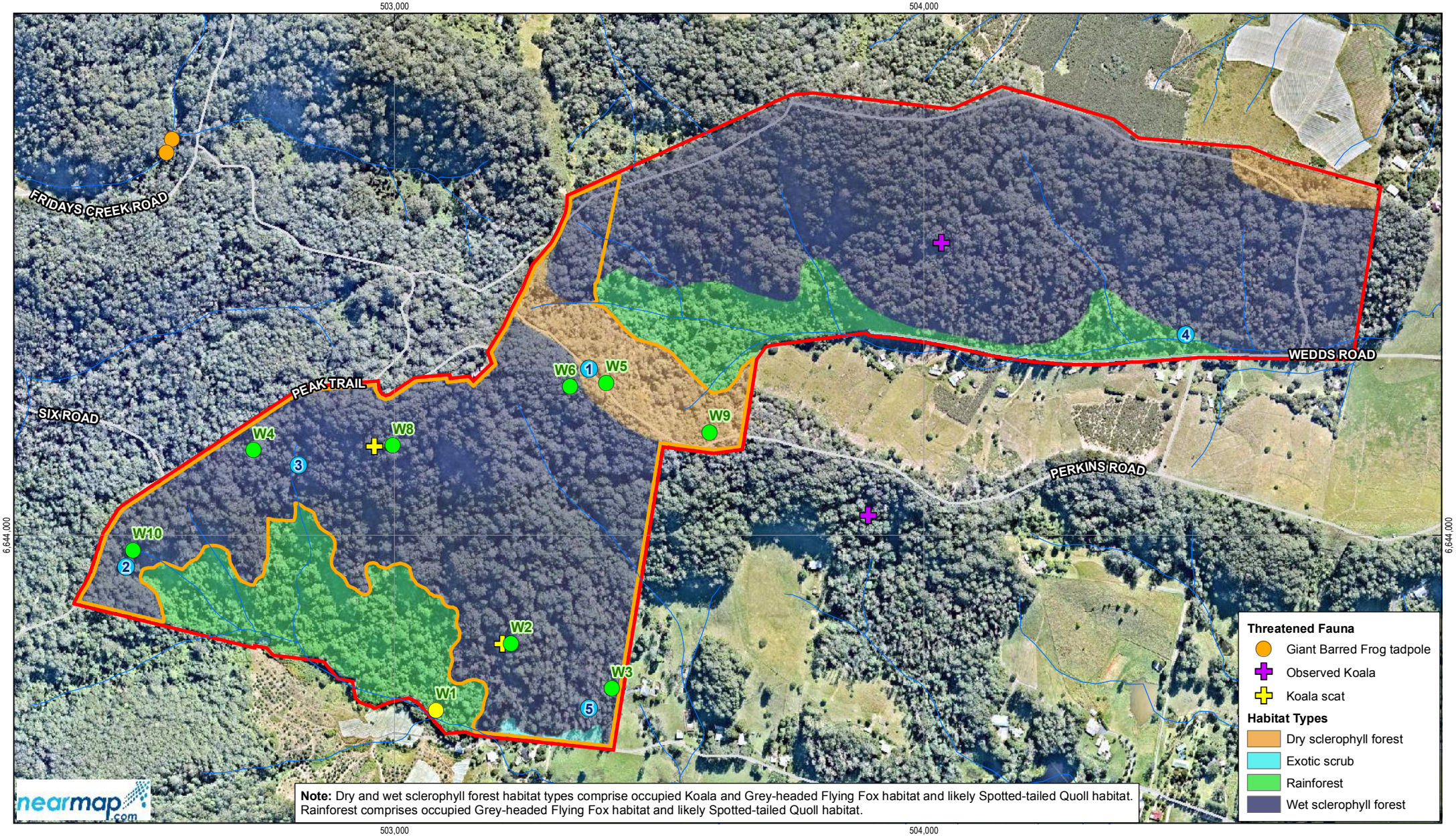
Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data Source: NSW Department of Lands: Cadastre - Jan 2011; Geoscience Australia: 250k Data - Jan 2011, Aerial imagery - ESRI 2016 and Nearmap 2016 (image extracted 17/18/2016, image taken 05/05/2016).jrichardson



Paper Size A4

0 75 150 300

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Boambee SF offset site
- WC2NH Boambee SF offset area
- Camera trap
- BioBanking plot/transect and canopy plot
- BioBanking plot/transect, canopy plot and Koala SAT
- Roads
- Waterways

Roads and Maritime Services
Pacific Highway Upgrade
Warrell Creek to Nambucca Heads
Biodiversity Offset Package

Job Number 21-24927
Revision A
Date 02 Sep 2016

Boambee SF offset site habitat for affected threatened fauna

Figure 8

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Level 15, 133 Castlereagh Street Sydney NSW 2000 T 61 2 9239 7100 F 61 2 9239 7199 E sydmail@ghd.com.au W www.ghd.com.au

Data Source: NSW Department of Lands: Cadastre - Jan 2011; Geoscience Australia: 250k Data - Jan 2011, Aerial imagery - ESRI 2016 and Nearmap 2016 (image extracted 17/18/2016, image taken 05/05/2016).jrichardson

4.5 Populations of affected threatened biota

The purpose of this section is to describe the local and regional populations of each of the affected threatened species that may use habitat within the Boambee SF offset site. This assessment is based on:

- Presence / absence of individuals at the Boambee SF offset site as revealed by the field surveys.
- Previous records of the species in the locality (see Table 8) and characteristics of the local and regional population as revealed by the desktop assessment.
- Likely use of the habitat resources within the site, as described in Section 4.4 above.

Table 8 Records of the affected threatened species in the locality of the Boambee SF offset site

Species	Wildlife Atlas records within 10 km (OEH, 2014b)	Closest Record	Date of Closest Record
Marsdenia longiloba	22	90 stems within the WC2NH offset area and 210 in total at the Boambee SF offset site	2015
Tylophora woollsii	3	57 stems within the WC2NH offset area and 83 in total at the Boambee SF offset site	2015
Koala	901	One observation and two scats within the offset site and a second observation in habitat connected to the site during current surveys. Previous records within site, southeastern corner and within site on northwestern boundary (OEH, 2014b)	2015 2001 2003
Grey-headed Flying Fox	69	Around five individuals were observed foraging immediately to the south of the site during the present surveys. Previous records 2.51 km south over open grassland and 2.51 km north in connected habitat	2015 2000 2011
Spotted-tailed Quoll	20	Previous records within site on northern boundary (OEH, 2014b)	2005
Giant Barred Frog	94	Around five tadpoles were observed in Fridays Creek around 1 km north of the WC2NH offset area. Previous records around 0.3 km north and 0.5 km west in connected bushland. Point locations are not accurate and location details have been withheld due to OEH sensitive threatened species policy (OEH, 2014b).	2015 2013, 2000

4.5.1 *Marsdenia longiloba* and *Tylophora woollsii*

The field surveys of the Boambee SF offset site revealed extensive local populations of the affected threatened plants. Clusters of threatened plants observed during field surveys are shown on Figure 7 along with the extent of occupied threatened plant habitat and potential or poorer quality threatened plant habitat. Details of the threatened plants recorded are included in Appendix B, including the height and number of stems recorded at the location of each of the clusters of stems shown on Figure 7.

A total of 90 *Marsdenia longiloba* were recorded in the 34 hectares of occupied habitat in the WC2NH Boambee SF offset area that will be set aside specifically to offset impacts of the Project based on the offset assessment guide calculations included in Section 10.4. Of these stems 70 were adults and 20 were seedlings. A total of 212 *Marsdenia longiloba* stems were recorded at the broader Boambee SF offset site comprising 156 adults and 56 seedlings.

A total of 57 *Tylophora woollsii* stems were recorded in the 34 hectares of occupied habitat in the WC2NH Boambee SF offset area comprising 43 adults and 14 seedlings. A total of 83 *Tylophora woollsii* stems were recorded at the broader Boambee SF offset site comprising 63 adults and 20 seedlings.

Many of the stems featured relatively sparse foliage and there was some evidence of herbivory by invertebrates. This is not unusual for either species since they are both recognised as being slender stemmed and cryptic. A healthy plant may persist as a rhizome with no above ground tissue for months or years of its lifespan. It is not possible to accurately gauge the health of individual plants without destructive surveys to expose the rhizome but based on visual inspection of above ground tissue all of the plants in the survey area were apparently healthy.

The numbers of stems of each species recorded should be treated as estimates because of the limitations associated with surveying these two species. Both species are cryptic and may have no, or very limited above ground tissue for much of the year. They are also very similar to one another and it can be difficult to distinguish the two species from one another in the field.

Based on the above assessment of the populations of threatened plants at the site the species stocking rate component of the current habitat quality of the WC2NH offset area was scored as 8/10 (see Section 10.4).

4.5.2 Koala

The Koala was recorded at three locations at the Boambee SF offset site in the current surveys, through observations of scats at two separate locations and hearing the calls of an adult male. An adult male was also heard calling in a patch of connected vegetation to the south of the site (see Figure 7). A relatively small number of scats were located during Koala SAT searches at eight locations across the site. This does not necessarily indicate low population densities. Scat searching conditions were very difficult at this site because of the steep terrain, thick leaf litter, recent heavy rainfall and rain during much of the current survey period. Further, this species is often recorded irregularly within home ranges and is dispersive over large distances at different stages of its life cycle (DECC, 2008). Koalas may be more abundant at the site at other times of year. There are at least two previous records of the species at the site (OEH, 2015b).

There are a total of 900 records of Koalas in the locality of the Boambee SF offset site (OEH, 2015b). There are several observations of the species in patches of connected habitat in the vicinity of the site (OEH, 2015b).

The Boambee SF offset comprises habitat critical to the survival of the Koala according to the DSEWPaC (2013) guidelines given the presence of a known population, Koala food tree species in the canopy, habitat connectivity and recovery value. Conservation of the Boambee SF offset site is likely to contribute to the viability of the regional population of the Koala through

continued regeneration and maturation of native vegetation containing food trees, maintenance of vegetated fauna movement corridors and control of dogs.

4.5.3 Grey-headed Flying-fox

Around five Grey-headed Flying Foxes were observed foraging in exotic vegetation immediately to the south of the site during the present surveys. Additional flying foxes were observed flying over the Boambee SF offset site in the present surveys but could not be confidently distinguished as the Grey-headed Flying-fox from the other two flying fox species present in the region. There are a total of 69 records of over 30, 000 individual Grey-headed Flying Foxes in the locality of the Boambee SF offset site (OEH, 2015b). There are several known camps within the locality of the Boambee SF offset site (OEH and DSEWPac 2013) of which the two most significant are:

- The 'Coffs Creek' camp, around 6.9 kilometres to the north east, which contains critical foraging habitat, has been continuously occupied, has supported >10,000 individuals and over 30,000 at least once, supports >2,500 individuals during the reproductive season (CHCC, 2007) and as such comprises roosting habitat critical to the survival of the species as defined in the recovery plan (DECC, 2009).
- The 'Boambee, Englands Road' camp, around 2.15 kilometres to the north east, which contains critical foraging habitat and is used is used as a camp seasonally in > 50% of years (CHCC, 2007) and as such comprises roosting habitat critical to the survival of the species as defined in the recovery plan (DECC, 2009).

The Coffs Creek Flying-fox Camp is recognised as a significant maternity camp in the Coffs Harbour region and the only permanent maternity camp between Grafton (Susan Island) and Bellingen (Bellingen Island) (CHCC, 2007).

The Boambee, Englands Road camp appears to be used annually but on a temporary, seasonal basis during winters when swamp forests containing the key diet plants Broad-leaved Paperbark (*Melaleuca quinquinervia)* and Swamp Mahogany (*Eucalyptus robusta*) in the local area are in blossom and during years when food resources are not available in other areas (CHCC, 2007).

No Grey-headed Flying Foxes were recorded foraging at the site during the present survey, presumably because individuals within the regional population were using seasonal foraging resources in other vegetation types and/or in other parts of their range at the time of survey. This is despite high canopy cover of diet plants and significant diet plants for the Grey-headed Flying fox area (see Table 7). Patterns of habitat use by Grey-headed Flying Foxes are seasonal and sporadic in response to food sources with largely irregular patterns of productivity (DECCW, 2009). When assessed at a local scale, the species is generally present intermittently and irregularly and so this one off absence from the site does not exclude its likely value to the regional population of the species.

Overall these results suggest that the Boambee SF site is likely to provide critical foraging resources for a regional population of >10,000 Grey-headed Flying-foxes and help support at least two camps that are critical to the survival of the species. Given the nearby camps, the extent and cover of diet species at the site and its overall size, condition and landscape position, the Boambee SF offset site will likely make a valuable contribution to the viability of the regional population of the Grey-headed Flying-fox. It is likely that the viability of the nearby camps will improve with conservation of the offset site. In particular, the regional population is likely to benefit from continued regeneration or maturation of native vegetation containing abundant food trees.

4.5.4 Spotted-tail Quoll

The Spotted-tailed Quoll has been recorded at the Boambee SF offset site in 2005 (OEH, 2015b). It was not recorded during the current surveys. This species is recorded intermittently and irregularly within its very large home ranges and so the lack of recent, confirmed records at the site does not exclude its potential occurrence and value to the species.

There are 20 records of Spotted-tailed Quolls in the locality of the Boambee SF offset site (OEH, 2014b). Habitat resources such as dense groundcover, fallen logs, rock outcrops, caves and tree hollows for prey species within an area recognised as a regional habitat corridor suggest the site may be inhabited by a local population of the Spotted-tailed Quoll.

Given the extent and quality of habitat at the site and its overall size, condition and landscape position, the Boambee SF offset site is likely to contribute to the viability of the local and regional population of the Spotted-tailed Quoll. Populations of the Spotted-tailed Quoll are likely to benefit from continued regeneration and maturation of native vegetation containing habitat resources and control of dogs.

5. Existing environment of the xxxxx offset site

5.1 Location and landuse

The xxxxx site is a parcel of privately owned land at Upper Corindi. The site has been purposefully identified and three privately owned properties included in this offset package to provide offsets for the Giant Barred Frog, because an appropriate area of occupied habitat could not be secured at the Norton or Boambee SF offset sites. The landowners intend to establish BioBanking agreements over the property and then to sell biodiversity credits to Roads and Maritime for the purpose of securing biodiversity offsets for various stages of the Pacific Highway upgrade project. Roads and Maritime are assisting the landowners through this process, including funding ecological surveys to establish the site's suitability as a biodiversity offset and to inform the preparation of this offset package and management plan.

The xxxxx offset site includes part Lot xxxxx, part Lot xxxxx and part Lot xxxxx and is located at xxxxx, Upper Corindi (see Figure 9). The proposed biobank site boundary within these lots and the WC2NH xxxxx offset area that is the subject of this management plan are shown on Figure 9.

The xxxxx offset site is around 97.4 hectares in area and contains remnant and regenerating forest on gently undulating terrain. It is 69 kilometres north of the Project footprint in an equivalent position on near-coastal low hills (see Figure 1). The Giant Barred Frog has been recorded at the site and there are extensive areas of suitable habitat for the species. The xxxxx offset site is a large and highly suitable offset site that is under risk of degradation by agricultural activities or development and has considerable capacity for improvement. The xxxxx offset site will meet the Project's biodiversity offset requirements for the Giant Barred Frog.

The xxxxx site is an occupied rural residential property. The previous land use at the offset site was cattle and sheep grazing. Evidence of grazing as well as previous timber harvesting, track construction and partial clearing was noted during field surveys. Based on the presence of over mature and hollow-bearing trees, it appears that the site has never been clear-felled, however given the comparative scarcity of larger trees it would have been selectively harvested at some point in the past.

BioBanking agreements will be entered into over the majority of the property to conserve the proposed offset area in perpetuity. The BioBanking agreements will be registered on the property title and are binding on successors in title.

Site specific Management Action Plans (MAPs) will be prepared to accompany the BioBanking agreements. The MAPs will specify the management actions that must be applied at the site. The MAP includes the conditions the land owner must observe in accordance with the BioBanking agreement and strategies to assist landholders to maintain and improve biodiversity values. The MAP is designed to complement existing environmental legislation, which continues to apply to the land. The approved MAP and the management actions specified in this offset package will be implemented by Roads and Maritime and/or the landowner.

Management actions required to maintain and enhance the habitat for offsets were identified during the survey and are outlined in Section 8. These management actions will improve the quality of habitat for the affected threatened species by increasing the extent, health and productivity of native vegetation containing habitat resources.

5.2 Landscape context

The xxxxx site is around 97.4 hectares in area and contains wet and dry sclerophyll forest on gently undulating, near-coastal hills and valley floors.

xxxxxx Creek flows from north to south through the centre of the site and is fed by numerous first and second order tributaries. xxxxx Creek is a near-permanent, channel confined, third order stream. The upstream reaches of xxxxx Creek through the WC2NH xxxxx offset area and the majority of the offset site are generally in good condition with intact riparian and in stream vegetation, intact channel and bank structure, continuous flow, very little weed infestation and no evidence of poor water quality.

Some downstream reaches of xxxxx Creek pass through cleared agricultural land. These reaches do not have any native riparian vegetation though there is moderate cover of native wetland plants along with exotic pasture grasses and environmental weeds. The channel and banks are generally intact though in places there is evidence of trampling by cattle. High turbidity was noted and there is probably also poorer water quality as a result of nutrient enrichment from livestock waste. These reaches are all downstream the WC2NH xxxxx offset area and do not affect the quality of Giant Barred Frog habitat in the offset area.

The xxxxx offset includes a mapped regional fauna habitat corridor (Scotts et. al, 2003) that runs north-south connecting State forests to the west and south of the site with National Parks in coastal vegetation to the northeast (see Figure 9).

The xxxxx offset site adjoins partially cleared agricultural land that is managed by the same family that will manage the three biobank sites at the site. It is bordered to the east and west by near-intact native vegetation on large lot rural residential properties. There is partially cleared grazing land to the south and southeast. There is extensively cleared land with more intensive agricultural activities such as banana and blueberry plantations to the north and northeast.

The xxxxx site is part of a near continuous patch of native vegetation and habitat of many thousands of hectares. Agricultural land to the north and northeast would comprise partial barriers to fauna movement and other ecological processes. Sherwood State Forest and Sherwood Nature Reserve lie to the west of the xxxxx site and beyond that there is an extensive network of native vegetation in national parks and State forests that stretches to the Great Dividing Range. The xxxxx site is connected to this extensive area of habitat via native vegetation in private land and State forests. There are partial barriers to the south and southeast associated with partially cleared and/or fenced private land. Conglomerate State Forest lies to the south of this land and is continuous with many thousands of hectares of State forest on near coastal hills.

The xxxxx site comprises appropriately situated habitat for the Giant Barred Frog. In this landscape context, the xxxxx site comprises an area of valuable breeding habitat in a relatively undisturbed catchment that is surrounded by an extensive patch of native vegetation.

5.3 Vegetation

Vegetation types have been mapped within the offset site by OEH (2012) and this mapping was ground truthed and converted to NSW vegetation types by the project botanists listed in Table 2 as part of the present study. Vegetation types within the xxxxx offset site are shown on Figure 10 and are summarised in Table 9.

Table 9 Vegetation in the xxxxx offset site

Vegetation Zone	NSW Veg type ID	Condition	Habitat type	Area in xxxxx offset site (ha	Area in WC2NH xxxxx offset area (ha)	Plot/transects
Flooded Gum - Brush Box moist forest (NR159, moderate/good-high)	NR159	Moderate/good-high	Wet Sclerophyll Forest	25.4	5	1, 4
Flooded Gum - Brush Box moist forest (NR159, moderate/good-poor)	NR159	Moderate/good-poor	Wet Sclerophyll Forest	2.2		2
Flooded Gum - Brush Box moist forest (NR159, low)	NR159	Low	Wet Sclerophyll Forest in low condition	1.5		3
Tallowwood - Small-fruited Grey Gum dry grassy open forest (NR263, moderate/good)	NR263	Moderate/good	Wet Sclerophyll Forest	36.5		5
Blackbutt - Tallowwood moist ferny open forest (NR120, moderate/good)	NR120	Moderate/good	Wet Sclerophyll Forest	9.4		
Blackbutt - Turpentine - Tallowwood shrubby open forest (NR122, moderate/good)	NR122	Moderate/good	Wet Sclerophyll Forest	5.1		
Bailey's Stringybark - Needlebark Stringybark heathy woodland on sandstones (NR104, moderate/good)	NR104	Moderate/good	Dry Sclerophyll Forest	13.4		
Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands (NR117, moderate/good)	NR117	Moderate/good	Dry Sclerophyll Forest	2.8		
Black Booyong - Rosewood - Yellow Carabeen subtropical rainforest (NR111, moderate/good)	NR111	Moderate/good	Rainforest	1.0		
			Total	**97.4**	**5**	

Figure 9 Configuration of the xxxxx offset site at Upper Corindi (removed to protect privacy)

Figure 10 Vegetation mapped on the xxxxx offset site (removed to protect privacy).

5.4 Habitat quality

This section describes the extent and quality of habitat for Giant Barred Frog at the xxxxx offset site based on the desktop assessment and field survey results. Habitat types and recorded observations of the Giant Barred Frog are shown on Figure 11.

The Giant Barred Frog was recorded at the xxxxx offset site in March and April 2016 by the ecologist listed in Table 2 as part of the current surveys, through observations of up to 15 adults (see Figure 11). There are previous records of five adult Giant Barred Frogs at the site, from December 2013 (Andren, M. OEH, pers. comm.) which provides further confirmation that the offset area meets DotE's definition of 'occupied habitat'.

The WC2NH xxxxx offset area contains five hectares of habitat for the known local population of the Giant Barred Frog associated with wet sclerophyll forest. This area was defined around a maximum 50 metre buffer either side of the centre line of the reach of occupied breeding habitat in xxxxx Creek. 50 metres was selected because it encompasses the known area of occupancy of adult frogs as revealed by a tracking study (Streatfeild, 1999) and matches the methodology for calculating the area of impact of the Project that was included in the referral for the Project.

This area of occupied habitat has been defined based on the presence of the following characteristics identified in the recovery plan for stream breeding frogs (Hines et. al., 2002) and/or the threatened species profile for the Giant Barred Frog (DotE, 2015):

- Breeding habitat in xxxxx Creek, which is a third order stream with permanent water as indicated by the observed volume of water, size of the catchment and number of tributaries.
- The stream character of xxxxx Creek and its tributaries, which are small, narrow and rapidly descending.
- Moist, sheltered riparian vegetation in rainforest or wet sclerophyll forest with deep, moist leaf litter.
- Appropriate stream microhabitats used by the species for oviposition including steep or overhanging banks adjacent to large pools that are free of dense fringing vegetation.

The baseline condition of Giant Barred Frog habitat in the WC2NH offset area was assessed using BioBanking plot/transects and compared with benchmark data from matching NSW vegetation types (see Figure 10 for the location of plot/transects and Appendix C for survey data). The plot/transect data confirmed that the vegetation associated with the occupied habitat is in good condition.

Based on the above assessment of habitat quality, the site condition component of the current habitat quality of the WC2NH offset area was scored as 8/10 in the offset assessment guide calculations (see Section 10.4). This score reflects the presence of occupied breeding habitat in good condition and with the specific habitat features favoured by this species but with some impacts from weed infestation and probably also pest fauna.

Figure 11 xxxxx offset site habitat for affected threatened biota (removed to protect privacy).

5.5 Populations of affected threatened biota

The Giant Barred Frog was recorded at the xxxxx offset site in March and April 2016 by the ecologists listed in Table 2 as part of the current surveys, through observations of up to 15 adults (see Figure 7). There are previous records of five adult Giant Barred Frogs at the site, from December 2013 (Andren, M. OEH, pers. comm.).

There are 24 BioNet records of the Giant Barred Frog in the locality in the last 10 years the majority of which are located in State forests to the south of the site (OEH, 2015b). The Coffs Harbour – Dorrigo region surrounding the site is recognised as a 'stronghold' for the species with a relatively abundant and secure regional population (Hines et. al., 2002; DotE, 2015).

Given the extent and quality of occupied breeding habitat at the site and the overall size, condition and landscape position of surrounding native vegetation, the xxxxx offset site is likely to contribute to the viability of the local and regional population of the Giant Barred Frog. Populations of the Giant Barred Frog are likely to benefit from averted risk of impacts in the catchment that may degrade the quality of breeding habitat, continued regeneration and maturation of native vegetation containing habitat resources and control of pest fauna.

6. Management of the Norton offset site

6.1 Conservation mechanism and funding arrangements

The Norton offset site will be conserved under a BioBanking agreement under the *Threatened Species Conservation Act 1995* (the TSC Act). The NSW Government established BioBanking under Part 7A of the TSC Act. The *Threatened Species Conservation (Biodiversity Banking) Regulation 2008* and the BioBanking Assessment Methodology complete the legal framework that provides for the creation of biodiversity credits that can be sold on the open market.

Credits are created when a landowner enters into a biobanking agreement to maintain or improve their land's biodiversity values by undertaking management actions. The land is then known as a biobank site. The agreement is attached to the land title and includes provisions that require current and future landowners to:

- Carry out management actions to improve biodiversity values on the site.
- Not undertake activities that will reduce the biodiversity values of the site.

When a landowner sells their credits, a specified minimum amount from the sale proceeds (a portion or all of the Total Fund Deposit) is paid into the BioBanking Trust Fund. Annual payments are then made to the landowner from the fund. This endowment runs with the land in perpetuity to benefit current and future owners.

As the landowner of the Norton offset site, Roads and Maritime will initiate a BioBanking agreement with the Office of Environment and Heritage (OEH), retire 100% of the credits generated on the property and deposit all of the Total Fund Deposit required into the BioBanking Trust Fund prior to on-selling the property to a third party with the BioBanking agreement in place.

Roads and Maritime will purchase and retire all of the biodiversity credits associated with the WC2NH Norton offset area. This will secure the conservation covenant over the area of land, ensure that the credits cannot be used to offset the impacts of another development and provides for the management of the site in perpetuity.

OEH assume responsibility for monitoring, compliance and enforcement of all BioBanking agreements as outlined in the BioBanking Compliance Assurance Strategy (DECC, 2008). OEH monitor compliance through annual reports submitted by owners of biobank sites, inspections and compliance audits. OEH has a range of enforcement responses at its disposal, applied on a risk basis. These include:

- Requests for remedial action, warning letters and inspections.
- Withholding annual payments from the BioBanking Trust Fund if management actions have not been carried out.
- Directing the owner of a biobank site to carry out work at their own cost to rectify a breach of a biobanking agreement.
- Allowing OEH to enter the land to carry out necessary work where the owner has failed to comply with a Ministerial direction.
- Allowing OEH to seek an award of damages against the owner of a biobank site for breaching a biobanking agreement.
- Applying to the Land and Environment court to have the land transferred to a more responsible land manager where a person has contravened a biobanking agreement.

A BioBanking agreement is the strongest covenant available on private lands and extinguishes all land uses other than conservation unless the BioBanking agreement is varied or terminated by the NSW Minister for the Environment to permit alternative uses. Certain mining rights may be granted over a biobank site, and certain development can be carried out by public authorities on a biobank site, but any impacts from these activities must be offset again as an addition to any offsetting activities required by a given project in its own right. Therefore, the risk of loss of the offset sites with the BioBanking agreement in place has been assessed as 3 per cent for the purposes of the offset assessment guide calculations.

The draft BioBanking assessment and MAP for the Norton biobank is included as Appendix D and includes additional detail about the management actions that will be performed at the site. The BioBanking assessment and MAP will be finalised in consultation with OEH.

The precise terms of the BioBanking agreement will be developed by the OEH in consultation with Roads and Maritime, but will include the following broad conditions:

- Exclusion of activities that will result in impacts on habitat for the affected threatened species, including timber harvesting, vegetation clearing, grazing, apiary, exclusion of cats or dogs from the conservation area, or uncontrolled public access.
- Management of the property in accordance with the MAP which will include reference to site specific management activities consistent with Section 6.2 of this offset package.
- Ongoing monitoring in accordance with Section 6.3 of this offset package.

6.2 Management plan

6.2.1 Management strategies

The following broad management strategies and related actions at the Norton offset site will improve the value and extent of habitat for the affected threatened species:

- Property maintenance, through:
  - Establishment and maintenance of appropriate fences, gates and signs.
  - Removal of rubbish.
  - Maintenance of tracks.
  - Maintenance of easements.
- Conservation and improvement of habitat, through:
  - Bush regeneration and facilitated improvement in the condition of native vegetation.
  - Natural regeneration and supplementary planting where appropriate in cleared or degraded land.
  - Weed control.
  - Exclusion of domestic stock grazing and management of human disturbance.
  - Retention of dead timber, rocks and other habitat resources.
  - Fire management.
- Pest fauna control.

An overview of these management strategies and how they relate to the site and to populations of the affected threatened species is provided below. The following sections provide specific detail of the management actions that will be performed, including a plan for their delivery, a works program and the minimum standards and objectives that will be achieved. Property management actions are illustrated on Figure 12.

The management strategies and actions will be implemented across the entire Norton biobank under an overarching Management Actions Plan (MAP) (GHD, 2016 included as Appendix D) prepared in accordance with this offset package, the *Pacific Highway Upgrade, Nambucca Heads to Urunga Norton and Griffin Offset Management Plan* (GHD, 2016a) and any other relevant plans. The implementation of management strategies and actions in accordance with the MAP for the biobank will be funded by the purchase and retirement of biodiversity credits by Roads and Maritime with costs allocated to the offset area for individual projects.

Property maintenance

The Norton offset site is currently unoccupied and comprises remnant and regenerating native vegetation with small areas of cleared or degraded land. The site will be maintained as native vegetation in a biobank site. Infrastructure such as fences, gates, signs and access tracks will be maintained to support these land uses as shown on Figure 12. This infrastructure is important to clearly define the biobank site, exclude harmful activities and facilitate efficient management.

The proposed house site and home paddocks area currently contains exotic or low condition native vegetation and cleared land. This location has been selected to provide for private ownership and management of the site with minimal impacts on biodiversity values. Initial treatment of existing weed infestations, removal of the unoccupied house and associated rubbish, construction of boundary fences and gates, maintenance of tracks and management of weeds around the boundary of the home paddocks have been included as actions in this offset package.

Construction and maintenance of a new dwelling, maintenance of any other infrastructure and management of vegetation and livestock within the 'house site and home paddocks' area shown on Figure 12 are not included as actions in this offset package. The landowner will maintain this area so as to avoid any indirect impacts on the remainder of the Norton offset site and in accordance with the BioBanking agreement and associated plan of management for the site.

The Norton offset site contains small areas of dumped building refuse and other rubbish at the locations shown on Figure 12. This rubbish will be removed to avoid the risk of contamination or physical injury to animals and to make the property more attractive to potential owners. There are also substantial areas of woody debris, including timber harvesting residues and dumped bridge timbers, particularly in the south of the site. Woody debris provides fauna shelter and foraging substrate, can reduce the risk of erosion or weed infestation and will break down naturally in the longer term. Woody debris will be left in place at the site.

Where woody debris is mixed with inorganic rubbish or crosses proposed access tracks or fence lines it will be separated and/or moved to the nearest practical area of retained or regenerating vegetation to function as a habitat resource. The relocation of any woody debris will be undertaken in a manner that minimises disturbance to vegetation and surface soil, and such debris will be placed to emulate naturally occurring habitat as far as possible (i.e. not stacked).

There is an existing network of access tracks across the site (see Figure 12). These tracks are likely to be adequate for weed management, fire management, monitoring and other activities. These tracks will be maintained as single lane, dirt 'bush tracks'.

The entire western boundary of the Norton offset site adjoins the Pacific Highway road corridor and other recent or proposed development. These developments include existing and/or required floppy-top fauna fencing or stock-proof fencing as well as appropriate sediment control devices on the outside of the fence. This offset package includes provision for monitoring of these fences and communication with neighbours about their maintenance. A new stock-proof fence will be constructed around the house site and home paddocks.

The entire northern, southern and eastern boundaries of the site adjoin near-intact native vegetation with small areas of land that has been cleared for domestic stock. There are domestic stock on properties to the south and southwest of the Norton offset site. Each of these properties feature small (<20 hectares) areas set aside for grazing and relatively low numbers of stock. Each of these properties featured intact boundary fences at the time of the field survey. Given the impacts associated with fence construction, the risk of injury to Koalas and other fauna from fences and the relatively minor risk from stock outside the site, no boundary fence construction is proposed.

Short sections of fence or other vehicle barriers will be maintained on either side of gates to prevent unauthorised vehicle access. Discontinuous fences are unlikely to pose a threat to resident fauna.

There are sections of poorly maintained and/or obsolete fencing within the site that will be removed to improve habitat connectivity and reduce the risk of injury to Koalas and other fauna (see Figure 12).

Conservation and improvement of habitat

Around 495.5 hectares of habitat at the Norton offset site will be managed as a biobank site under the BioBanking agreement. This biobank site includes 185 hectares of habitat for the Koala, Grey-headed Flying-fox and Spotted-tailed Quoll in the WC2NH Norton offset area that has been included in Offset assessment guide calculations in this offset package. Conservation and management of this vegetation will improve the quality of habitat for the affected threatened species and especially the quality of foraging resources by increasing the extent, health and productivity of vegetation containing food tree species.

The majority of the site contains near-intact vegetation or mature regeneration. There are around four hectares of low condition vegetation in the north of the site associated with a disused orchard and pig sties. This area would be subject to supplementary planting to assist with natural regeneration (GHD, 2016).

There are other small areas of cleared land associated with previous timber harvesting activities, particularly in the south of the site. Each of these areas featured natural regeneration, including the majority of canopy species, a mix of mid storey and groundcover species and overall high native species richness. This natural regeneration is likely to continue and so no supplementary planting or seed broadcasting is proposed.

Natural regeneration will be complemented by exclusion of domestic grazing, management of human disturbance and retention of dead timber, rocks and other habitat resources.

Weed control will be an important part of vegetation conservation at the site and will comprise three main activities:

- Treatment of localised woody weed infestations, including Lantana (*Lantana camara*), Privet (*Ligustrum* species), Wild Tobacco (*Solanum mauritianum*) and Camphor Laurel (*Cinnamonum camphora*) in the areas shown on Figure 12. This activity will be required in the first two years of the implementation of this plan to manage the localised, severe infestations currently present at the site. Additional control rounds will be performed as required to achieve performance targets.
- Treatment of exotic grasses such as Giant Parramatta Grass (*Sporobolus fertilis*), Phalarus species and Whiskey Grass (*Andropogon virginicus*) and herbaceous weeds such as Fireweed (*Senecio madagascariensis*) and dandelions in the areas shown on Figure 12. This activity will also be required along access tracks and any other areas where vegetation adjoins disturbed land.

- Broad scale weed monitoring and bush regeneration activities throughout the entire site. Bush regeneration will comprise treatment of localised, minor infestations of weeds such as Lantana, exotic grasses and herbs throughout forested areas and Groundsel Bush (*Baccharis halmifolia*) along drainage lines.

Fire management

The biobank site owner will actively manage fire at the Norton site to help maintain the structure and function of ecological communities. Ecological fire management will be coordinated with hazard reduction activities in accordance with the fire management plan included in Section 3 of the MAP for the Norton biobank (GHD, 2016) that is included as Appendix D of this offset package.

The site has been split into management zones according to vegetation types and the locations of tracks (see Appendix D). The landowner will meet the ecological fire requirements of vegetation at the site by maintaining a fire interval within each management zone of greater than 7 years and less than 25 years and avoiding successive fires of intensity sufficient to scorch or consume dominant tree crowns. In accordance with Section 3 of Appendix D the landowner will:

- Carry out ecological burns for each management zone according to the method and frequency described in the 'Fire requirements for vegetation types and threatened species' table;
- Carry out the actions listed in the 'Ecological burning actions table' and the 'Other fire management activities' table.
- Undertake monitoring and inspections in accordance with the 'Fire management monitoring' table.

Ecological burns and bushfire hazard reduction works will be undertaken in accordance with a Bush Fire Hazard Reduction Certificate issued under the Rural Fires Act or a notification received under that Act, or in accordance with a Bush Fire Risk Management Plan that may apply to the land.

Pest fauna control

Dog attacks are recognised as a significant threat to Koalas that is managed by preventing domestic dogs from roaming and control of feral dogs (KSC, 2011). Dog, fox and feral cat attack and/or competition comprise a threat to the Spotted-tailed Quoll (Long and Nelson, 2009). Direct evidence of both feral dogs and roaming domestic dogs was observed during the field survey of the Norton site. It is expected that foxes and cats are also likely to occur.

Under the *Companion Animals Act 1998* dogs must be under the control of a competent person when in public places and must not roam or attack other animals, though in practice, enforcement of these aspects of the Act can be difficult (KSC, 2011). Education of dog owners is essential to achieving effective dog control and minimising the risk to Koalas. The community will be made aware of the nature of the threat to Koalas, the requirements of the law and the penalties for breaches (KSC, 2011). At the Norton offset site this will be achieved through a condition prohibiting the landowner from having cats or dogs in the conservation area and through site signage and targeted communication with neighbours.

Feral dogs, cats and foxes will be managed through a trapping and shooting program. Pest fauna populations will be monitored in consultation with the Local Land Services control officer and include techniques such as setting of camera traps, setting up of sand pits with bait stations and free feed and coordination with ongoing regional control programs as appropriate. Poison

baiting is not the preferred control method at the Norton offset site because of the risk of harm to the Spotted-tailed Quoll (Long and Nelson, 2009).

Any baiting should preferably be conducted using Canid Pest Ejectors (CPEs). CPEs are a spring triggered device that fires a dose of 1080 into the mouth of dogs/foxes that pull hard and upwards at a bait lure. Once set, a CPE is only activated by a direct pull on the lure head that activates the spring loaded plunger to propel the contents of the capsule directly into the mouth of the wild dog or fox. The firm upward pulling action required to trigger the poison delivery, is easily achieved by foxes and wild dogs, but much less so by most non-target species (Hunt, 2010).

As the ejector can only be activated by an animal with an upward pull force of >1.6kg, many small nontarget animals are excluded from activating ejectors. Researchers in Victoria identified that “only red foxes, wild dogs and feral cats had been recovered in field trials when cyanide was used as the active agent, suggesting a high level of target specificity” (Busana et al., 1998; Marks et al., 2003).

An assessment of risk in known Spotted-tailed Quoll habitat did not record any CPE activations despite quolls being present within 1m of an ejector on five occasions at different locations (Hunt, 2010). Additional research in northern NSW has shown no adverse impact on quoll populations from 1080 baiting programs even though some baits may be taken by quolls (Kortner, 2007, Claridge and Mills, 2007).

Annual pest fauna control programs will be developed in response to monitoring and in consultation with the Local Land Services wild dog officer and will be consistent with regional plans and programs. Coordination with group control programs that include pest fauna control on the site and adjoining properties is likely to increase the effectiveness of pest fauna control (Thorman, M., local land services, pers. comm.).

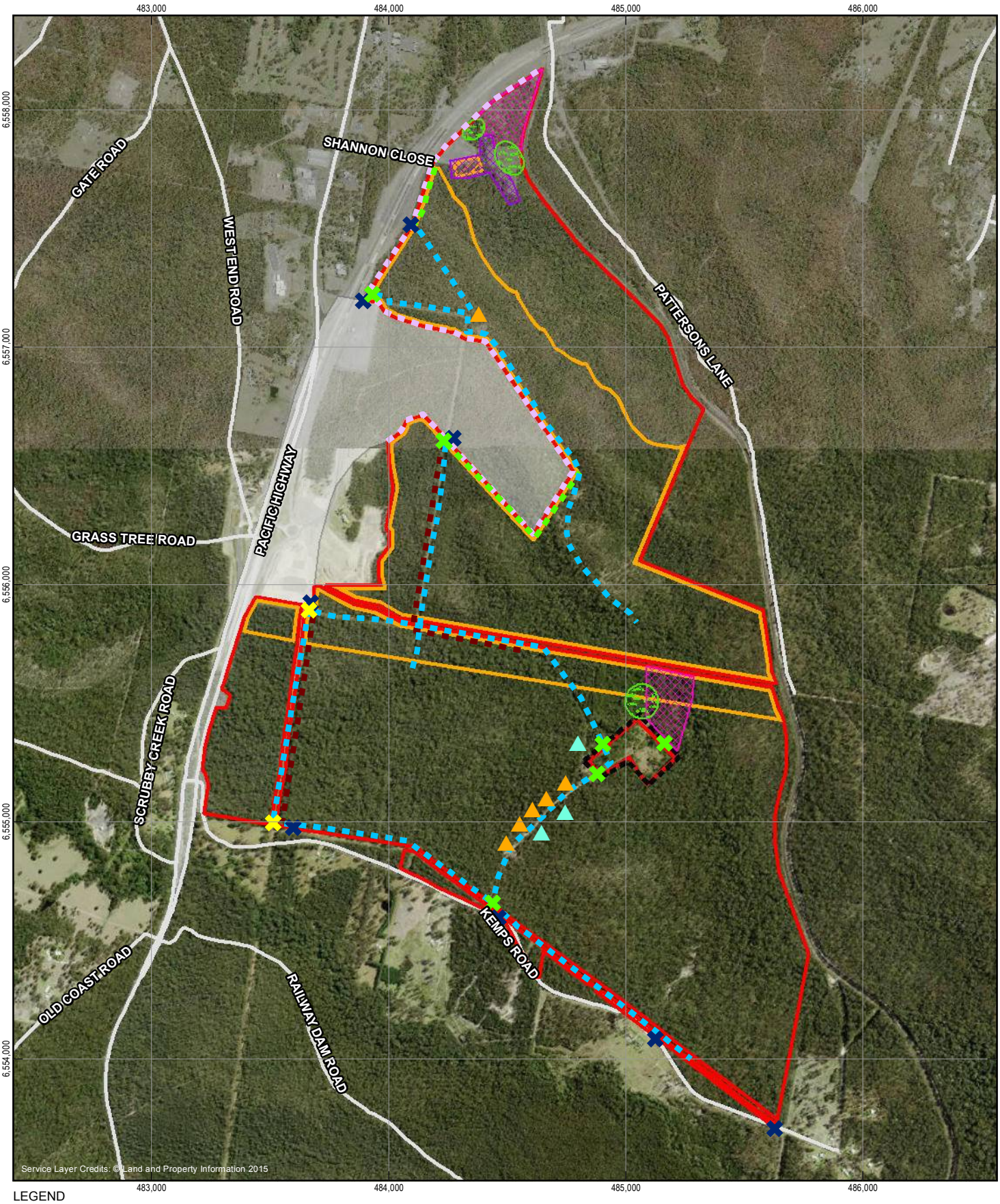
Feral pigs and exotic herbivores such as feral cattle, deer or rabbits will be controlled as required based on the results of the biodiversity monitoring and consultation with the Local Land Services control office. No specific evidence of any of these species, or environmental degradation as a result of their presence, was noted during field surveys. Active management of these pest fauna would commence if they are recorded at the site. Control methods are likely to include: active trapping; shooting from the ground; and/or strategic baiting. As above the type and method of baiting will need to consider the presence of native fauna and their feeding habits, especially the Spotted-tailed Quoll.

6.2.2 Relationship with other documents

The Norton property will be managed in accordance with the following documents prepared in conjunction with the OEH:

- An in perpetuity BioBanking agreement (conservation covenant) registered in the title of the property and tailored to suit the site.
- The ‘Norton Biobank Site Management Action Plan’ included as Appendix D, which has been prepared with reference to this offset package, and which sets out the management strategies that must be applied at the site to manage the property in accordance with the BioBanking agreement.

It is recommended that weed and pest fauna control is conducted with reference to the *NPWS North Coast Regional Pest Management Strategy (*OEH, 2012).



LEGEND

- Norton offset site
- WC2NH Norton offset area
- Heavy Lantana infestation - 3ha
- Low - moderate Lantana infestation - 9.2ha
- Exotic grasses - 3.5ha
- New fence
- Old farm pigsty
- Recent or proposed development
- General rubbish removal
- Logs/sleepers pile
- Existing gate
- New gate
- Signage
- Maintain track
- New track
- Existing strands to be removed
- Existing fence to be maintained

Paper Size A4

0 150 300 600

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

GHD

Roads and Maritime Services
Pacific Highway Upgrade
Warrell Creek to Nambucca Heads
Biodiversity Offset Package

Job Number	21-24927
Revision	A
Date	02 Sep 2016

Norton offset site property action plan

Figure 12

N:\AU\Sydney\Projects\21\24927\GIS\Maps\Deliverables\21_24927_Z008_NortonPAP.mxd

Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data Source: General topo - NSW LPI DTDB 2012, Geoscience Australia: 250k Data - Jan 2011; Aerial Imagery - Sixmaps 2016.jrichardson

6.2.3 Management action plan

Table 10 presents the specific actions required to implement the strategies described above, including specifications, standards, objectives and timeframes for delivery. The landowner will be responsible for implementing these actions in accordance with the MAP and this biodiversity offset package. OEH will be responsible for monitoring performance against the MAP. Property management actions are illustrated on Figure 12. The funding amounts for each action were developed by GHD during the BioBanking assessment. The funding is calculated over an initial 20 year period, with an additional sum set aside for in-perpetuity payments to landowners from the Biodiversity Trust Fund. Once the BioBanking Agreement is finalised and annual payments commence, landowners will be required to continue to manage the land in line with their BioBanking agreement and Management Action Plan and other relevant legislative requirements. The draft BioBanking assessment and MAP for the Norton biobank are included as Appendix D and include additional detail about the management actions that will be performed at the site.

Table 10 Norton offset site management actions plan

Activity no.	Activity	Quantity	Activity details	Performance target	Corrective action	Timeframe
1	New fencing around house site and home paddocks	Fence line shown on Figure 12.	Electric or plain wire fences must contain a minimum of 6 wires to be considered sufficient to control stock. Steel post spacing not to exceed 5 meters. The fence must be considered permanent, and all materials used are new or 'as new'. A plain wire fence is recommended (with minimum steel post spacing + maxi posts) to avoid injury to native fauna. Fence to have no top barb (to avoid injury to gliders, kangaroos or owls, etc.), and will consider measures to avoid kangaroo entanglement.	Fences to be fully functional. Exclude stock from the Conservation Area	Maintenance and/or replacement of fence lines.	Installation by June 30 2017. Maintenance ongoing as required.

Activity no.	Activity	Quantity	Activity details	Performance target	Corrective action	Timeframe
2	New gates and signs	Gates and signs at locations shown on Figure 12.	Installation of gates and signs at the locations shown on Figure 12. Gates must be stock proof, lockable, considered permanent, and all materials used new or 'as new'. 10 metre wide fences in accordance with activity 1, or alternative vehicle barriers, are to be installed on either side of gates where no perimeter fence is present. Signs will clearly identify that the property is subject to a conservation covenant.	Permanent gates and signs on all entry points to the site. Minimise unauthorised access to the site and harmful activities.	Maintenance and/or replacement of signs.	Gates will be installed and signs will be erected on finalisation of BioBanking Agreement (expected by June 2017).
3	Fence, gate and sign monitoring, repair and maintenance	Fence lines, gates and signs at locations shown on Figure 12.	Annual (as a minimum) dedicated monitoring and routine inspection of the new fences specified in activity 1 and the perimeter fences, gates and signs shown on Figure 12 to prevent public or stock access. Repair and maintenance as required to correct issues identified during monitoring. Electric or plain wire fences must contain a minimum of 6 wires to be considered sufficient to control stock. Steel post spacing not to exceed 5 meters. Signs to be clear and legible. Gates to be fully functional.	Exclusion of stock access and damaging activities. Minimise unauthorised access to the site and harmful activities.	Maintenance and/or replacement of fence lines. To be done in partnership with neighbours.	Annual dedicated monitoring and routine inspection during other activities. Maintenance ongoing as required.

Activity no.	Activity	Quantity	Activity details	Performance target	Corrective action	Timeframe
4	Rubbish removal	Rubbish in around 6.5 ha. Estimated as five 20 tonne dumper loads	Rubbish at the locations shown on Figure 12 to be characterised by an appropriately qualified specialist and a safe and sustainable plan for its removal prepared. The removal plan is to include due consideration of any hazardous materials (e.g. asbestos sheeting). All non-organic rubbish at the locations shown on Figure 12 is to be removed and disposed of at an appropriately credited landfill or in accordance with the specific requirements for the material. Woody debris is to be left in place except where it is mixed with inorganic rubbish or crosses proposed access tracks or fence lines. In these instances, the woody debris will be separated and/or moved to the nearest practical area of retained or regenerating vegetation. The relocation of any woody debris will be undertaken in a manner that minimises disturbance to vegetation and surface soil, and such debris will be placed as naturally as possible (i.e. not stacked). Remove illegally dumped materials using staff and/or specialised contractors.	Safe and sustainable removal of all rubbish at the locations shown on Figure 12, any unexpected finds and any illegally dumped materials.	Characterisation and removal of rubbish as required.	Removal of rubbish at the locations shown on Figure 12 to be completed by end 2017. Ongoing as required.

Activity no.	Activity	Quantity	Activity details	Performance target	Corrective action	Timeframe
5	Fence strand removal	Old fence lines as shown on Figure 12.	Fence strands at the locations shown on Figure 12 to be removed and appropriately disposed of at licensed landfill	Removal of fence strands.		Completion 30 June 2017.
6	Track maintenance	Tracks shown on Figure 12. Estimated one day of slasher and crew when required	All tracks shown on Figure 12 to be maintained as single-lane, dirt tracks along with appropriate surface water and sediment controls where required. The single creek crossing will be maintained as a shallow 'ford' to maintain fish passage. Locally sourced, clean, rock material will be used as substrate if required to avoid impacts on channel or bank stability.	Maintenance of access for management and fire control activities. Entire perimeter and strategic internal trails open and ready prior to each fire season.	Quarterly monitoring and supplementary maintenance as required.	At least annually, prior to each fire season. Additional maintenance as required to achieve performance targets.

Activity no.	Activity	Quantity	Activity details	Performance target	Corrective action	Timeframe
7	Treatment of Lantana infestations and woody weeds	Around 3.5 ha at locations shown on Figure 12. Additional scattered individuals throughout the site.	Treatment of moderate and severe Lantana infestations and woody weeds in accordance with best practice, including: • Splatter gun with high concentration of glyphosate for dense infestations of Lantana. • Spot spraying of isolated infestations. • Cut and paint/fill of planted citrus trees in the north of the site. • Hand pulling/crowning of scattered individual weeds • Spot spraying of seedlings. Weed waste is to be left on site. Plants with a heavy fruit or seed load are to be piled, covered with black plastic and composted.	Control of noxious and environmental weeds in the areas indicated on Figure 12. Weed management activities are to be undertaken by suitably qualified operators. Operators are to provide report of works undertaken, which includes mapping of area treated, primary species treated and photo monitoring points. Weed control works will aim to achieve the following outcomes: • Lantana reduced to less than 20% of original distribution by the end of year 2. • Lantana reduced to less than 10% of original distribution by the end of year 5. • Lantana maintained at less than 10% of original distribution from year 6.	Additional control rounds as required to achieve performance targets.	Lantana infestations: • 6 sessions per year during years 1* to 3. • 4 sessions per year during years 4 – 10. Scattered woody weeds: • 2 sessions per year in years 1 and 2. Planted citrus trees: • 2 sessions in year 1. Follow up treatment and monitoring as required under activity 9 ‘broad scale weed monitoring and bush regeneration’.

Activity no.	Activity	Quantity	Activity details	Performance target	Corrective action	Timeframe
8	Treatment of exotic grasses and herbaceous weeds	At locations shown on Figure 12.	Control of exotic grasses and herbs. Active spraying will be used to 'open up' patches. Over time it is anticipated that natural regeneration will shade out the introduced grasses. Methods may include: • spot spraying using 'back packs' throughout all zones. • hand pulling/crowning of weeds. Weed waste is to be left on site.	Control of noxious and environmental weeds in the areas indicated on Figure 12. Weed management activities are to be undertaken by suitably qualified operators. Operators are to provide report of works undertaken, which includes mapping of area treated, primary species treated and photo monitoring points. Exotic grasses and herbaceous pasture weeds maintained at less than 10% of original distribution in all native vegetation zones by the end of year 10. Note: access tracks will not be actively managed to control introduced grasses, rather activities will focus on restricting introduced grasses from recruiting in remnant vegetation.	Additional control rounds as required to achieve performance targets.	• 6 sessions per year in years 1* to 3 • 4 sessions per year in years 4 – 10. Follow up treatment and monitoring as required under activity 9 'broad scale weed monitoring and bush regeneration'.

Activity no.	Activity	Quantity	Activity details	Performance target	Corrective action	Timeframe
9	Broad scale weed monitoring and bush regeneration	Entire site.	Monitoring of native vegetation throughout the biobank site and treatment of weeds as follows: • Splatter gun with high concentration of glyphosate for dense infestations of Lantana. • Spot spraying of isolated infestations. • Cut and paint/fill. • Spot spraying of seedlings. Weed waste is to be left on site. Plants with a heavy fruit or seed load are to be piled, covered with black plastic and composted.	Control of noxious and environment weeds. Bush Regeneration activities to be undertaken by suitably qualified operators. Operators to provide report of works undertaken, which includes mapping of area treated, primary species treated and photo monitoring points. Weed control work within these management zones will aim to achieve the following outcomes: • Mature woody weeds maintained at less than 10% of original distribution in all zones from year 10 and in perpetuity. • Other herbaceous and pasture weeds maintained at less than 10% of original distribution in all zones from year 10 and in perpetuity. Note: access tracks will not be actively managed to control introduced grasses, rather activities will focus on restricting introduced grasses from recruiting in remnant vegetation.	Additional control rounds as required to achieve performance targets.	Years 1* to 10, coordinated with other weed control activities. Year 11 on, follow-up weed control, 6 sessions per year in perpetuity.

Activity no.	Activity	Quantity	Activity details	Performance target	Corrective action	Timeframe
10	Pest fauna control	Entire site	Annual dedicated monitoring of pest fauna populations in consultation with the Local land services control officer and including techniques such as setting of camera traps, setting up of sand pits with bait stations and free feed and coordination with ongoing local/regional control programs as appropriate. Annual rounds of pest fauna control, principally targeting wild dogs, foxes and cats, using soft-jaw trapping and shooting undertaken by appropriately licensed and qualified staff. Control programs to be developed in consultation with the Local Land Services wild dog officer and to be consistent with regional plans and programs. Control programs to be targeted to other pest fauna (e.g. goats, pigs, rabbits) as appropriate if populations or impacts are detected during monitoring.	Pest control to be undertaken by appropriately licensed and qualified practitioners. Practitioners to provide a report of monitoring locations, presence/absence and control activities undertaken. The matters to be contained in the report are outlined in Section 6.3.4 of the offset package. Where activities are co-ordinated by landholders, landholders shall complete the landholder report in the Management Funding Contract, and include copies of any tax receipts associated with control activities.	Pest control and monitoring to be reviewed annually. Adjustments implemented and documented.	Annual monitoring; Annual pest fauna control rounds, or as required in response to monitoring or landholder observations, ongoing.

Activity no.	Activity	Quantity	Activity details	Performance target	Corrective action	Timeframe
11	Management of fire for conservation	Entire Norton offset site	The landowner must implement, and at all relevant times, comply with the fire management plan included in Section 3 of the MAP for the Norton biobank (GHD, 2016). The landowner must carry out ecological burns for each management zone according to the method and frequency described in the 'Fire requirements for vegetation types and threatened species' table in Section 3 of the MAP for the Norton biobank (GHD, 2016). The landowner must also carry out the actions listed in the 'Ecological burning actions table' and the 'Other fire management activities' table in Section 3 of the MAP for the Norton biobank (GHD, 2016). Monitoring and inspections must be carried out in accordance with the 'Fire management monitoring' table in Section 3 of the MAP for the Norton biobank (GHD, 2016).	Meet the ecological fire requirements of vegetation at the site by maintaining a fire interval of greater than 7 years and less than 25 years. Avoid successive fires of intensity sufficient to scorch or consume dominant tree crown.	In the event that wildfires did not occur for more than 25 years on the property, a prescribed ecological burn would be conducted. Fire management activities will be documented. Prescribed burn schedules The schedule will be adjusted in the event of a wildfire or activities undertaken under the *Rural Fires Act (RFA) 1997* to ensure the minimum frequencies between ecological burns.	Inter fire interval for individual cells greater than 7 years, less than 25 years. It is anticipated the first ecological burn will occur in Year 7 (ie 2023). Burns would be conducted in April/May and/or August/September.
12	Exclusion of grazing and harmful activities	Entire Norton offset site, enforced by BioBanking agreement.	Exclude activities that will result in impacts on habitat for the affected threatened species, including grazing, vehicle based camping, domestic animal access, hunting, apiary or uncontrolled public access.	Exclusion of all grazing and other harmful activities.	Immediate halting of grazing or any other harmful activities if detected in the biobank site. Clear delineation of the biobank site via signs, fences and gates.	Ongoing, in perpetuity.

Note: * - it is assumed that 'year one' begins in the first quarter of 2017 for the purposes of weed control and implementation of the MAP. In practice management would commence upon finalisation of BioBanking Agreement (expected by June 2017).

6.2.4 Management actions program

Table 11 Norton offset site management actions program

Activity no.	Activity	Works timing (periods for actions to be completed by Landholder)												Timeframe
		July-Dec 2016	Jan-Jun 2017	July-Dec 2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027 –	
1	New fencing around house site and home paddocks														Completion by June 30 2017.
2	New gates and signs														Completion by 30 June 2017 when protected under a secure conservation mechanism.
3	Fence, gate and sign repair and maintenance														Ongoing as required.
4	Rubbish removal														Completion by 30 June 2017.
5	Fence strand removal														Completion by June 30 2017.
6	Track maintenance														Ongoing as required.
7	Treatment of woody weeds – Lantana infestations														6 sessions per year during years 1* to 3. 4 sessions per year during years 4 – 10.
	Scattered woody weeds														2 sessions per year in years 1 and 2.
	Planted citrus trees														2 sessions in year 1.
8	Treatment of exotic grasses and herbaceous weeds														6 sessions per year in years 1 to 3 4 sessions per year in years 4 – 10.

Activity no.	Activity	Works timing (periods for actions to be completed by Landholder)												Timeframe
		July-Dec 2016	Jan-Jun 2017	July-Dec 2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027 –	
9	Broad scale weed monitoring and bush regeneration														Coordinated with other weed control activities
	Follow-up weed control and bush regeneration														6 sessions per year in perpetuity.
10	Pest fauna control														Annual monitoring; annual pest fauna control rounds, or as required ongoing
11	Management of fire for conservation														Inter fire interval for individual cells greater than 7 years, less than 25 years. It is anticipated the first ecological burn will occur in year 7 (ie 2023). Burns would be conducted in April/May and/or August/ September.

Note: * - 'year one' begins in the first quarter of 2017 for the purposes of weed control and implementation of the MAP.

6.3 Monitoring program

6.3.1 Overview

The following monitoring programs and reports will apply to the Norton site:

- Management actions performance monitoring, from the approval of the Biobanking agreement. Annual reports will be prepared by the landowner and submitted to OEH.
- A vegetation and habitat survey and a targeted threatened species survey at year five to further confirm the presence and condition of occupied habitat for the affected threatened biota.
- Pest fauna control monitoring, comprising annual monitoring of pest fauna populations and documenting of control activities from the approval of this offset package. Reports are to be completed by suitably qualified practitioners in accordance with Section 5.3.3 and maintained by the landholder.
- OEH monitoring and auditing to be completed on an ongoing basis from approval of the BioBanking agreement.

These monitoring programs and reports are summarised in Table 12 and described below.

Table 12 Norton offset site monitoring program

Monitoring program	Report	Dates for monitoring reports to be submitted by Landholder																						Timeframe
		2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037 on	
Management actions performance	Annual report prepared by biobank site owner and submitted to OEH																							Reports completed annually in perpetuity.
Year 5 targeted threatened species survey																								One off report. Completed by end 2021
Pest fauna control	Annual 'Pest fauna monitoring and control' summary reports prepared by pest control contractor as appropriate.																							Annual summary reports, until at least 2036.
OEH monitoring and auditing																								Ongoing review of annual monitoring reports, inspections, auditing and additional stewardship as required.

6.3.2 Management actions performance

The landowner will monitor and record the completion of management actions through each year through collection of receipts, performance reports from contractors, diaries etc. The landowner will complete an Annual Report in accordance with works program milestones and submit to the OEH in perpetuity. The report will be prepared in accordance with OEH's standard template and include a summary of the following topics:

- Fence maintenance.
- Feral animal presence.
- Feral animal control.
- Weed presence (including extent and severity of infestations and presence of any new infestations).
- Weed control.
- Description and proof of current reporting years' activities, including one-off or irregular events (fence replacement, fire management etc).

The OEH will confirm that activities have been completed in accordance with the MAP and/or recommend additional actions to achieve performance objectives.

Photo points would be maintained at five locations in the WC2NH Norton offset area and at representative points in each vegetation zone in the broader biobank site to document the condition of habitat and the effectiveness of management actions. Photo point locations have been waypointed using a GPS and marked with star pickets to facilitate locating during subsequent monitoring events and consistent photo capture (see Table 13). Photo point monitoring will be conducted annually. A photo illustrating vegetation condition and structure will be taken and notes taken on general vegetation condition, extent of weed infestation, ground cover, any management issues such as erosion or dieback and any observed change since the last monitoring round.

6.3.3 Targeted threatened species survey

The affected threatened biota are each cryptic and/or prone to population fluctuations and/or mobile and transitory in their use of habitat as stated in Section 2. The management action plan for the offset site does not include trigger levels based on threatened species abundance because that would impose monitoring and management requirements on biobank site owners that are not practical or achievable. Vegetation condition and habitat quality will be monitored as a surrogate for the status of threatened species populations. The link between management actions and improvements in habitat quality and protection of populations is demonstrated in Section 9.3.

A targeted threatened species survey of the WC2NH Norton offset area will be conducted five years after the offset site is formally established to further confirm the presence and condition of occupied habitat for the affected threatened biota, the link between the proposed management actions and habitat quality and the security of threatened species. Five years is the 'Offset calculator – Time horizon – Time until ecological benefit' value that was entered in the Offset assessment guide calculations and so this is the critical period after which it is necessary to confirm that the biodiversity offset has been delivered as planned.

The targeted threatened species survey will comprise the following techniques:

- A detailed vegetation and habitat monitoring survey, focussing on the extent and quality of specific habitat resources of relevance to the affected threatened species, including:
  - Food tree species for the Koala.
  - Vegetation type and structure, presence and quality of woody debris, caves rock outcrops and other potential den sites for the Spotted-tailed Quoll.
  - Critical foraging habitat for the Grey-headed Flying-fox.
  - Riparian breeding habitat for the Giant Barred Frog.
- Sampling of five 'Canopy plots' nested in five BioBanking plot/transects, comprising counts of every tree in the 50 m x 20 m plot along with its height, species, canopy cover and any evidence of fauna activity. Each tree species will then be cross-referenced to lists of food tree species for the Koala and Grey-headed Flying-fox to calculate the cover of food tree species.
- Five Koala 'Spot Assessment Technique' (SAT) searches for scats and evidence of Koala activity with reference to Phillips and Callaghan (2011).
- Nocturnal surveys targeting the Koala, Spotted-tailed Quoll and Grey-headed Flying-fox over two sets of four person-hour survey rounds on two separate nights, including walked spotlighting transects, quiet listening periods and call playback.
- At least four motion sensing camera traps targeting the Koala and Spotted-tailed Quoll and placed for as long as is possible, split between the main habitat types and targeting potential fauna movement corridors such as fire trails and drainage lines.
- Preparation of a 'Targeted threatened species monitoring' report, including survey results, plot/transect data and comparisons with the baseline survey round and benchmark values, photos, assessment of vegetation condition and regeneration, assessment of the quality and extent of habitat resources, description of any observed management problems or threats and proposed remedial action as required.

6.3.4 Pest fauna control

The landowner will arrange annual dedicated monitoring of pest fauna populations. The monitoring program will be developed in consultation with the Local Land Services control officer and will be consistent with regional plans and programs.

Practitioners will be required to prepare an annual pest fauna control report comprising:

- Dates and locations of monitoring activities.
- Numbers and species of animals recorded during monitoring.
- A brief description of group control programs that encompass the site or other relevant programs coordinated by Local Land Services and related to the year's pest control activities.
- Dates and locations of pest fauna control activities.
- Numbers and species of animals captured or killed during pest fauna control activities.
- Incidental observations of native animals.
- A summary of general observations of pest fauna abundance and activity throughout year.

Control programs will be targeted to other pest fauna (e.g. goats, pigs, rabbits) as appropriate if populations or impacts are detected during monitoring.

Table 13 Monitoring locations in the WC2NH Norton offset area

Photo point	Plot/ transect ID	NSW Vegetation Type	NSW Veg. ID	Condition	Habitat type	Notes	Eastings	Northings
3	3	Spotted Gum - Grey Ironbark - Pink Bloodwood open forest	NR246	Moderate/good	Dry sclerophyll forest	Abundant Koala food trees.	484161	6555892
E	30	Flooded Gum – Tallowwood – Brush Box moist open forest	NR160	Moderate/good	Wet sclerophyll forest	Abundant Koala food trees.	485187	6555625
F	34	Blackbutt - Tallowwood dry grassy open forest	NR119	Moderate/good	Dry sclerophyll forest		485144	6555906
G	38	Spotted Gum – Grey Ironbark open forest	NR247	Moderate/good	Dry sclerophyll forest	Abundant Koala food trees.	484949	6555995
23	23	Spotted Gum - Grey Ironbark - Pink Bloodwood open forest	NR246	Moderate/good	Dry sclerophyll forest		484229	6557443

6.4 Responsibilities

Condition f) viii. for the Project states that this offset package must provide details of the various parties responsible for the management, monitoring and implementation of the management activities at offset sites, including their experience and qualifications and employment or engagement status. As management actions are proposed on the offset sites in-perpetuity it is not possible to provide details on every individual party, including future landowners, contractors or consultants, that will be engaged to undertake these activities. It is more appropriate to express this information in terms of the roles responsible for implementing management actions and the minimum experience and qualifications for the parties that will fulfil these roles. Table 14 outlines the management roles and the standard of qualifications and experience required for the parties who will be implementing the management actions at the Norton offset site.

Table 14 Parties responsible for implementing this offset package at the Norton offset site

Role / management actions	Responsible party	Qualifications / experience
Site manager / supervising the implementation of this offset package and the MAP.	Roads and Maritime offset site manager (initially). Biobank site owner (upon purchase of the site and then in perpetuity).	Complies with OEH's 'fit and proper' person requirements. Signatory to the BioBanking agreement.
EPBC Act offset package auditor / ensuring compliance with this offset package.	Roads and Maritime offset site manager.	Tertiary qualifications in environmental science or ecology / demonstrated senior professional experience in an environmental management role.
Biobank site auditor / ensuring compliance with the BioBanking agreement and MAP.	NSW Office of Environment and Heritage (OEH)	Tertiary qualifications in environmental science or ecology / professional experience in BioBanking unit.
Ecologist / Detailed vegetation and habitat monitoring and targeted threatened species survey in year five.	Consultant ecologist engaged by Roads and Maritime	Tertiary qualifications in environmental science or ecology / demonstrated professional experience in ecological survey and assessment.
Site maintenance contractor / installation and maintenance of fences, signs and tracks. Fence strand and rubbish removal as required.	Appropriately qualified and experienced contractors engaged by Roads and Maritime offset site manager (initially) and biobank site owner (upon purchase of the site and then in perpetuity).	Trade qualifications appropriate to the individual task / demonstrated professional experience in the individual task.
Bush regeneration contractor / Treatment of mapped weed infestations, ongoing broad scale weed monitoring and bush regeneration.	Appropriately qualified and experienced bush regeneration contractors engaged by Roads and Maritime offset site manager (initially) and biobank site owner (upon purchase of the site and then in perpetuity).	Certificate III Conservation & Land Management (or interstate equivalent) / minimum one year full-time equivalent experience as a bush regenerator.
Pest fauna controller / pest fauna monitoring, control and reporting.	Appropriately qualified and experienced contractor engaged by Roads and	Endorsement of Local Land Services wild dog officer /

Role / management actions	Responsible party	Qualifications / experience
	Maritime offset site manager (initially) and biobank site owner (upon purchase of the site and then in perpetuity). Control programs to be developed in consultation with the Local Land Services wild dog officer and to be consistent with regional plans and programs	demonstrated professional experience.

7. Management of the Boambee SF offset site

7.1 Conservation mechanism and funding arrangements

A secure conservation mechanism is necessary to ensure that offset sites are protected in perpetuity and to support the 'averted risk' of the offset assessment guide. The Boambee SF offset site will remain in the State forest estate and will be secured as a Flora Reserve and managed for conservation by FCNSW. The portion of the State forest within the Boambee SF offset site will be set aside as a Flora Reserve under the *Forestry Act 2012* (Forestry Act). The land that is dedicated as a Flora Reserve will *not* be limited so as to exclude any land lying below the surface of the land pursuant to Section 16 (2) of the Forestry Act (i.e. mining will be prohibited within or below the Flora Reserve). Subject to the Forestry Act, a Flora Reserve cannot be revoked wholly or in part otherwise than by Act of Parliament. The NSW OEH recognises that Flora Reserves offer a similar level of security and protection to biodiversity as National Parks and Nature Reserves (OEH, 2011).

Conservation as a Flora Reserve meets the Commonwealth standards for inclusion within the National Reserve System which state that a reserve must be:

- Statutorily defined and resourced.
- Reserved in perpetuity.
- And that any change in management status must have Ministerial or statutory approval (NRMMC 2010).

A fundamental requirement of any area's eligibility for inclusion within the National Reserve System is that it must meet the IUCN definition of a 'protected area' A clearly defined geographical space, recognised, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values' (NRMMC 2010). Conservation as a Flora Reserve through Section 16 of the Forestry Act meets the definition of 'Legal means': Land is brought under control of an Act of Parliament, specialising in land conservation practices, and requires a Parliamentary process to extinguish the protected area or excise portions from it (NRMMC 2010).

The Forestry Act requires the preparation of working plans for each Flora Reserve that specifies the operations to be carried out in or in relation to the Flora Reserve with the objective of the plan the preservation of native flora. The working plan will exclude activities such as timber harvesting, grazing and apiary that are inconsistent with the preservation of native flora and specify management measures such as weed management, fire management, track maintenance and erosion control.

Roads and Maritime will make an appropriate financial contribution to FCNSW to compensate for the loss of access to the timber resource and other economic potential within the Flora Reserve and to ensure that funds are available to manage the Flora Reserve for conservation.

Roads and Maritime and FCNSW are in the process of applying this approach to the 'Cairncross offset site' within Cairncross SF which has been set aside as an offset for impacts on threatened flora arising from the Oxley Highway to Kempsey stage of the Pacific Highway upgrade.

7.2 Management plan

7.2.1 Management strategies

The following broad management strategies and related actions at the Boambee SF offset site will improve the value and extent of habitat for the affected threatened species:

- Exclusion of timber harvesting.
- Property maintenance, through:
  - Establishment and maintenance of appropriate fences, gates and signs.
  - Removal of rubbish.
  - Maintenance of tracks.
- Conservation and improvement of habitat, through:
  - Facilitated improvement in the condition of native vegetation.
  - Natural regeneration of cleared or degraded land.
  - Weed control.
  - Exclusion of domestic grazing and management of human disturbance.
  - Retention of dead timber, rocks and other habitat resources.
- Fire management.
- Pest fauna control.

An overview of these management strategies and how they relate to the site and to populations of the affected threatened species is provided below. The following sections provide specific detail of the management actions that will be performed, including a plan for their delivery, a works program and the minimum standards and objectives that will be achieved. Property management actions are illustrated on Figure 13.

The management strategies and actions will be implemented across the entire Boambee SF offset site under a coordinated working plan for the Flora Reserve prepared by FCNSW in accordance with this offset package, the GHD (2016b) *Pacific Highway Upgrade, Nambucca Heads to Urunga Threatened Flora Offset Management Plan* and any other relevant plans. The implementation of management strategies and actions in accordance with the working plan will be funded by Roads and Maritime with costs allocated to the offset area for individual projects.

Exclusion of timber harvesting and other harmful activities

The majority of the Boambee SF offset site is currently within Forest Management Zone 4 (FMZ 4) 'General Management' and is available for timber harvesting and other activities that are likely to harm the affected threatened species and/or reduce the quality of habitat. The offset site will be changed to FMZ 1 'Special Protection' and protected as a Flora Reserve. Activities that are not permitted in a Flora Reserve include timber harvesting, removal of forest products and materials and grazing by domestic stock (State Forests NSW 2000). This Titling mechanism is a similar level of security to conservation in the National Parks Estate and is highly unlikely to be ever overturned to permit timber harvesting or other damaging activities. This scenario supports the 'risk of loss' calculations that are included in the Offset assessment guide calculations.

Exclusion of grazing, timber harvesting and unauthorised access will avoid direct impacts such as removal or degradation of habitat and vehicle strike of threatened fauna. Exclusion of harmful activities will also help avert secondary impacts such as erosion and sedimentation and introduction or spread of disease. Root rot caused by the fungus *Phytophthora cinnamomi* is recognised as a threat to *Tylophora woollsii* (DECC, 2005b; Threatened Species Scientific

Committee, 2008b) and probably also the closely related *Marsdenia longiloba* and many of the food tree species for the affected threatened fauna. Timber harvesting will involve broad scale disturbance of soil and vegetation and movement of vehicles and equipment throughout patches of habitat and will comprise a significant vector for transmission of disease. Under the proposed management of the site there will be minimal disturbance of soil or vegetation, vehicles will be restricted to tracks and there will be only occasional foot traffic through patches of habitat. This will substantially reduce the risk of erosion, sedimentation or transmission of disease.

The proposed Flora Reserve includes 49 hectares of habitat for the Koala, Grey-headed Flying-fox and Spotted-tailed Quoll and 34 hectares of habitat for *Marsdenia longiloba* and *Tylophora woollsii* in the WC2NH Boambee SF offset area that have been included in Offset assessment guide calculations in this offset package. Conservation and management of the Flora Reserve will improve the quality of habitat for the affected threatened species.

Property maintenance

The WC2NH Boambee State forest offset area is currently a State forest, managed for timber production and comprises remnant and regenerating native vegetation with small areas of cleared or degraded land. The entire site will be maintained as native vegetation. Infrastructure such as signs and access tracks will be maintained to support these land uses as shown on Figure 13. This infrastructure is important to clearly define the conservation area, exclude harmful activities and facilitate efficient management.

Public access is permitted to the Boambee SF. Access from public roads is indirect and not clearly sign posted and so visitation rates are likely to be relatively low. Potential public access is unlikely to reduce the value of the site as a biodiversity offset provided that harmful activities or threats such as camping, fires, domestic animals, walking or driving off marked trails etc. are excluded. These activities are routinely prohibited in Flora Reserves (State Forests NSW 2000). There are no gates at the boundaries of the Boambee SF offset site because public access is not restricted to the State forest. Appropriate signage will help to exclude these potentially harmful activities.

The Boambee SF offset site contained small areas of dumped building refuse and other rubbish at the location shown on Figure 13. The site management budget will include funds to ensure that rubbish will be removed to avoid the risk of contamination or physical injury to plants or animals. Where woody debris is mixed with inorganic rubbish or crosses proposed access tracks or fence lines it will be moved to the nearest practical area of retained or regenerating vegetation to function as a habitat resource. Woody debris moved in this way will be moved so as to minimise disturbance of vegetation and surface soil and placed as naturally as possible (i.e. not stacked).

There is an existing network of access tracks across the site (see Figure 13). These tracks are likely to be adequate for weed management, fire management, monitoring and other activities. These tracks will be maintained in their current state as single lane, dirt or gravel tracks. Track maintenance will occur within the entire Boambee SF offset site and from the site boundary to the nearest junction with a public road.

The majority of the perimeter of the Boambee SF offset site adjoins intact native vegetation. Given the impacts associated with fence construction, the risk of injury to native fauna from fences and the surrounding land uses, no additional perimeter fence construction is proposed. The eastern and northeastern boundaries of the WC2NH offset area adjoin private agricultural land with livestock (see Figure 13). Annual inspection and maintenance of these fences is proposed to ensure exclusion of any neighbouring livestock. This activity will be undertaken in partnership with neighbours.

Conservation and improvement of habitat

Conservation and management of the Boambee SF offset site will improve the quality of habitat for the affected threatened flora and reduce the impact of threats.

The majority of the site contains near-intact vegetation or mature regeneration. There are small areas of cleared land associated with previous timber harvesting or cleared trail margins. Each of these areas featured natural regeneration, including the majority of canopy species, a mix of mid storey and groundcover species and overall high native species richness. This natural regeneration is likely to continue and so no supplementary planting or seed broadcasting is proposed. Natural regeneration would be facilitated through the exclusion of timber harvesting and grazing and the management of human disturbance.

Habitat resources such as dead timber, rocks, hollow-bearing trees and mature, structurally complex vegetation would be retained and would continue to develop over time.

Weed control will be an important part of conserving threatened plant habitat at the site and will comprise three main activities:

- Treatment of localised, severe noxious weed infestations, especially Lantana in the areas shown on Figure 13. Treatment of Lantana will be an important management action because this weed species can form particularly severe infestations in wet sclerophyll forest and rainforest habitat and is identified as a specific threat to *Marsdenia longiloba* and *Tylophora woollsii* (DECC, 2005a; DECC, 2005b). This activity will be required in the first two years of the implementation of this plan in order to manage the current severe infestations currently present at the site. Additional control rounds will be performed as required to achieve performance targets.
- Targeted threatened plant monitoring and bush regeneration of occupied habitat. This activity will be coordinated with the monitoring program outlined in Section 7.3 and will comprise targeted treatment of weeds in the immediate vicinity of identified stems of *Marsdenia longiloba* and *Tylophora woollsii* to remove specific threats to the health and vigour of individual plants.
- Broad-scale weed monitoring and bush regeneration activities throughout the entire site. This will include treatment of localised, minor infestations of weeds throughout the site This activity will be required throughout all native vegetation for a minimum of 20 years. More intensive weed management activities may be required from time to time if severe infestations are detected.
- Weed control will be conducted with reference to the locations of weed infestations shown on the property action plan (see Figure 13). Weed control will also consider the locations of threatened plants shown on Figure 4 and/or the results of the monitoring program outlined in Section 7.3. No weed spraying will be undertaken in the vicinity of identified stems of *Marsdenia longiloba* and *Tylophora woollsii* or other threatened plants or in the vicinity of aquatic habitat. Alternative weed control methods such as hand weeding or targeted herbicide application (cut and paint, stem scrape etc.) will be performed in these sensitive areas.

Fire management

Fire management is likely to play an important role in the management of habitat for the affected threatened plants. *Marsdenia longiloba* and *Tylophora woollsii* are sensitive to fire (DECC, 2005a; DECC, 2005b) and the species' preferred wet sclerophyll forest and rainforest habitat would also be sensitive to inappropriate fire regimes. Too frequent or extensive fire may result in a shift to more open dry sclerophyll vegetation types which would be unsuitable habitat.

Guidelines suggest that *Tylophora woollsii* should not be burnt more frequently than once every 25 years (NSW RFS, 2004 quoted in DEH, 2008).

Bushfire hazard reduction works may be undertaken in accordance with a Bush Fire Hazard Reduction Certificate issued under the *Rural Fires Act 1997* or a notification received under that Act, or in accordance with a Bush Fire Risk Management Plan that may apply to the land. Fire management at the site will aim to maintain the ecological integrity and complexity of native ecosystems in the offset site and especially threatened plant habitat through appropriate fire regimes and ensure that assets and persons are protected from bushfire.

There will be two components of purposeful fire management at offset sites: suppression of wildfire and exclusion of fire from occupied habitat; and fuel reduction in adjoining vegetation to reduce the likelihood and intensity of accidental fire. This fire management regime will help maintain the vegetation structure and microclimate in occupied habitat (i.e. fire sensitive wet sclerophyll forest and rainforest) and reduce the risk of harm to individual plants and populations.

Pest fauna control

Pest fauna will be managed through a trapping and shooting program and in accordance with the *NPWS North Coast Regional Pest Management Strategy: 2012-2016* (OEH, 2012). Pest fauna populations will be monitored in consultation with the Local Land Services control officer using techniques such as setting of camera traps, setting up of sand pits with bait stations and free feed and coordination with ongoing control programs as appropriate. Pest fauna control programs will be developed in response to monitoring and in consultation with the Local Land Services and will be consistent with the regional strategy (OEH, 2012). Coordination with group control programs that include pest fauna control on the site and adjoining properties is likely to increase the effectiveness of pest fauna control (Thorman, M., local land services, pers. comm.)

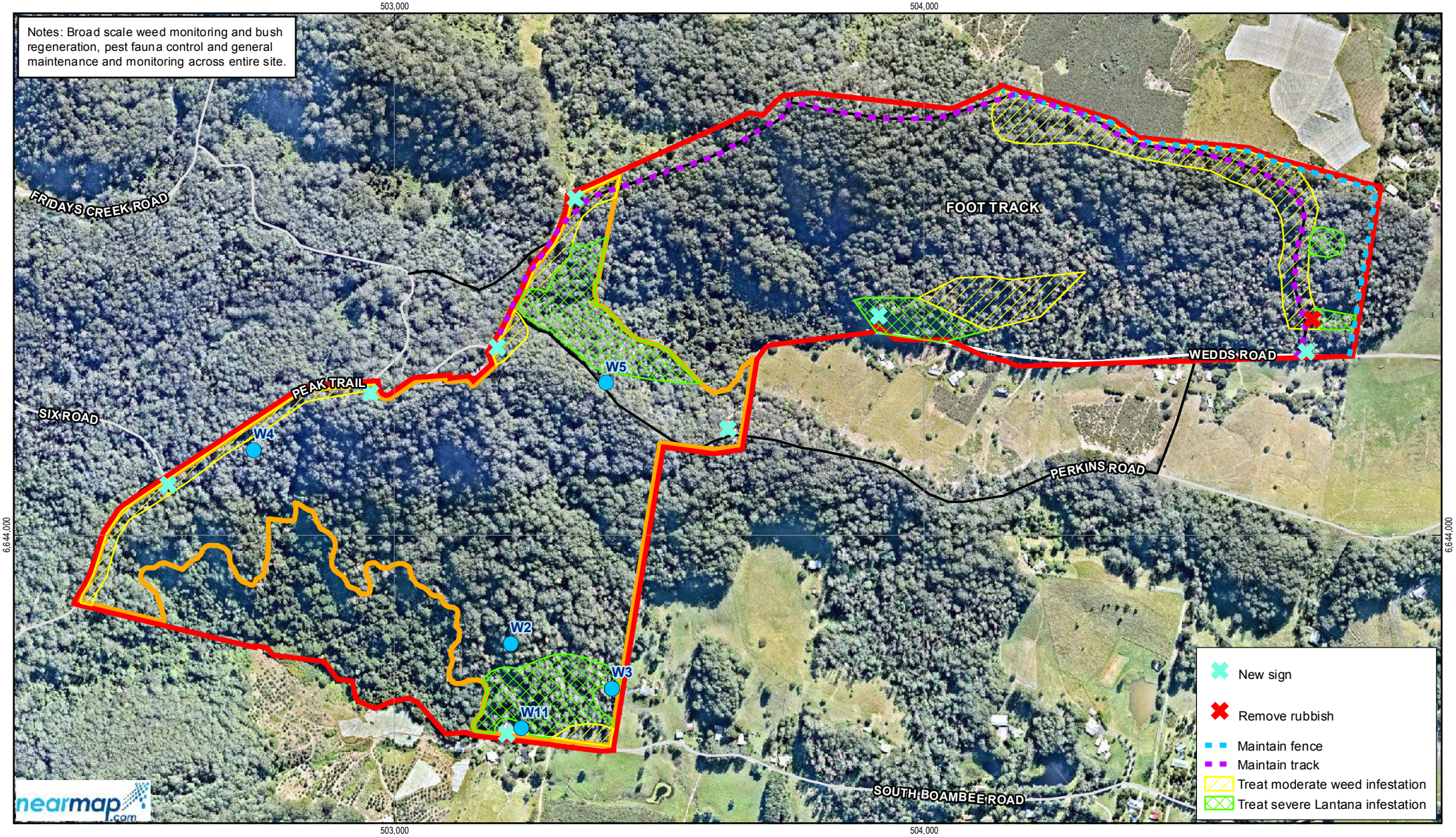
Dog attacks are recognised as a significant threat to Koalas that is managed by preventing domestic dogs from roaming and control of feral dogs (KSC, 2011). Dog, fox and feral cat attack and/or competition comprise a threat to the Spotted-tailed Quoll (Long and Nelson, 2009). Direct evidence of feral dogs was observed during the field survey of the Boambee SF site and foxes and cats are also likely to occur.

Feral dogs, cats and foxes will be monitored and managed through a trapping and shooting program in consultation with the Local Land Services control officer using techniques such as setting of camera traps, setting up of sand pits with bait stations and free feed and coordination with ongoing control programs as appropriate. Pest fauna control programs will be developed in response to monitoring and in consultation with the Local Land Services wild dog officer and will be consistent with the regional strategy (OEH, 2012). Poison baiting is the least preferred control option at the Boambee SF offset site because of the risk of harm to the Spotted-tailed Quoll (Long and Nelson, 2009).

Any baiting should preferably be conducted using Canid Pest Ejectors (CPEs). CPEs have been shown to achieve a high level of target specificity and involve minimal risk to Spotted-tailed Quolls because they require a firm pulling action to trigger poison delivery, which is easily achieved by foxes and wild dogs, but much less so by most non-target species (Hunt, 2010) (see Section 6.2.1 for more detail). If quolls are monitored near baiting sites, baiting will be ceased. Coordination with group control programs that include pest fauna control on the site and adjoining properties is likely to increase the effectiveness of pest fauna control (Thorman, M., local land services, pers. comm.). Roads and Maritime will provide funding to undertake this activity for 20 years.

Feral pigs and exotic herbivores such as feral cattle, deer or rabbits will be controlled as required based on the results of the biodiversity monitoring and consultation with the Local Land

Services control office. No specific evidence of any of these species, or environmental degradation as a result of their presence, was noted during field surveys. Active management of these pest fauna would commence if they are recorded at the site. Control methods are likely to include: active trapping; shooting from the ground; and/or strategic baiting. As above, the type and method of baiting will need to consider the presence of native fauna and their feeding habits, especially the Spotted-tailed Quoll.



Paper Size A4

0 75 150 300

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Boambee SF offset site
- WC2NH Boambee SF offset area
- Photo point
- Four wheel drive track
- Unsealed road
- Public road

Roads and Maritime Services
Pacific Highway Upgrade
Warrell Creek to Nambucca Heads
Biodiversity Offset Package

Boambee SF offset site property action plan

Job Number 21-24927
Revision A
Date 15 Sep 2016

Figure 13

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Level 15, 133 Castlereagh Street Sydney NSW 2000 T 61 2 9239 7100 F 61 2 9239 7199 E sydmail@ghd.com.au W www.ghd.com.au

Data Source: NSW Department of Lands: Cadastre - Jan 2011; Geoscience Australia: 250k Data - Jan 2011, Aerial imagery - ESRI 2016 and Nearmap 2016 (image extracted 17/18/2016, image taken 05/05/2016).mking3

7.2.2 Management actions plan

Table 15 presents the specific actions required to implement the strategies described above, including specifications, standards, objectives and timeframes for delivery. Property management actions are illustrated on Figure 13. FCNSW have provided in-principle agreement for management funding, to be provided by Roads and Maritime. FCNSW will manage the WC2NH offset area as part of a Flora Reserve within the State forest estate in line with the FMZ manual (State Forests NSW 2000) this offset package and other relevant legislative requirements.

Table 15 Boambee SF offset site management actions plan

	Activity	Quantity	Activity details	Performance target	Corrective actions	Timeframe
1	Sign installation and maintenance	Signs as shown on Figure 13.	Installation, monitoring, repair and maintenance of the signs shown on Figure 13 to prevent unauthorised public access. Signs to be clear and legible. Signs must be permanent and clearly identify the name of the site, that it is a Flora reserve, that unauthorised public access is prohibited, that rubbish dumping and domestic animal access is prohibited and that activities like weed spraying, baiting or shooting may occur on site.	Signs to be legible. Exclusion of unauthorised public access and damaging activities.	Maintenance and/or replacement of signs.	Installation by mid 2017. Maintenance ongoing as required.
2	Maintenance of fences	Fence lines shown on Figure 13.	Annual (as a minimum) dedicated monitoring and routine inspection of perimeter fences, gates and signs to prevent public or stock access. Repair and maintenance as required to correct issues identified during monitoring. To be done in partnership with neighbours.	Fences to be fully functional. Exclusion of livestock.	Maintenance and/or replacement of fence lines. To be done in partnership with neighbours.	Annual dedicated monitoring and routine inspection during other activities. Maintenance ongoing as required.

	Activity	Quantity	Activity details	Performance target	Corrective actions	Timeframe
3	Rubbish removal	At the locations shown on Figure 13. Entire site as required	Rubbish at the location shown on Figure 13 to be characterised by an appropriately qualified specialist and a safe and sustainable plan for its removal prepared. The removal plan is to include due consideration of any hazardous materials (e.g. asbestos sheeting). Identify dumping hotspots. Install signs. Use cameras to identify and prosecute offenders. Remove illegally dumped materials using staff and/or specialised contractors during Clean-up Australia Day if appropriate.	Safe and sustainable removal of all rubbish at the location shown on Figure 13.	Characterisation and removal of rubbish as required.	Completion of removal of rubbish shown on Figure 5 by June 30 2017. Bi-annual camera monitoring, annual clean-up Australia day. As required for identified hazardous materials.
4	Track upgrade and maintenance	Tracks shown on Figure 13	All tracks shown on Figure 13 to be maintained if deemed necessary for management purposes such as fire management. Roads not required are to be closed. Roads are to be maintained to FCNSW Fire management standards as single-lane, gravel or dirt tracks along with appropriate surface water and sediment controls where required.	Maintenance of access for management and fire control activities.	Quarterly monitoring. Entire perimeter and strategic internal trails open and ready prior to each fire season.	At least annually, prior to each fire season. Additional maintenance as required to achieve performance targets.
5	Treatment of noxious weeds	Moderate and severe infestations shown on Figure 13	Treatment of noxious weeds is to be undertaken in accordance with the regional and forest management strategies. No weed spraying undertaken in the vicinity (5 m radius) of identified stems of *Marsdenia longiloba* and *Tylophora woollsii.*	Eradication of noxious weeds and control of environmental weeds in the areas indicated on Figure 13.	Additional control rounds as required to achieve performance targets.	Two control rounds, in spring or autumn, completed by end 2018. Additional control rounds as required to achieve performance targets.

	Activity	Quantity	Activity details	Performance target	Corrective actions	Timeframe
6	Targeted threatened plant monitoring and bush regeneration of occupied habitat	Occupied habitat in the vicinity of threatened plants shown on Figure 8 and any additional threatened plants identified during monitoring rounds.	Targeted treatment of weeds in the immediate vicinity (2 m radius) of identified stems of *Marsdenia longiloba* and *Tylophora woollsii.* Hand weeding or targeted herbicide application (cut and paint, stem scrape etc.) only. This activity will be coordinated with the monitoring program outlined in Section 7.3.	Confirmation that the threatened plant populations shown on Figure 7 are being maintained or improved. Confirmation of stem densities and health of plants. Suppression of weeds in occupied habitat.	Additional weed control rounds as required to achieve performance targets. Additional research and consultation as required to identify causes of any observed decline in plant health or abundance and to identify appropriate management responses.	Five annual monitoring / control rounds, in Summer, completed by end 2021. Additional monitoring and control rounds as required to achieve performance targets.
7	Broad scale weed monitoring and bush regeneration	Entire site	Monitoring of native vegetation throughout the offset site. Treatment of noxious and environmental weeds is to be undertaken in accordance with the regional and park management pest management strategies. No weed spraying undertaken in the vicinity of identified stems of *Marsdenia longiloba* and *Tylophora woollsii*.	FCNSW is expected to make a reasonable effort to eradicate noxious weeds and control environmental weeds in the site. Weed management activities are to be undertaken by suitably qualified operators. Operators are to provide report of works undertaken, which includes mapping of area treated, primary species treated and photo monitoring points.	Additional control rounds as required to achieve performance targets.	Once yearly (spring), for a minimum of 20 years.

	Activity	Quantity	Activity details	Performance target	Corrective actions	Timeframe
8	Pest fauna control	Entire site	Ongoing evaluation of pest herbivore populations (e.g. goats, pigs, rabbits) in consultation with the Local land services control officer and including techniques such as setting of camera traps, setting up of sand pits with bait stations and free feed and coordination with ongoing control programs as appropriate. Pest fauna control at least every two years undertaken by appropriately licensed and qualified staff where possible. Control programs to be developed in consultation with the Local Land Services officer and to be consistent with regional plans and programs. Ongoing evaluation of pest carnivore populations in consultation with the Local land services control officer and including techniques such as setting of camera traps, setting up of sand pits with bait stations and free feed and coordination with ongoing control programs as appropriate. Pest fauna control at least every two years, principally targeting wild dogs and foxes, using soft-jaw trapping undertaken by appropriately licensed and qualified staff where possible. Any baiting undertaken will be conducted according to best practice standards (refer to NPWS Best Practice Guidelines – fox control). If quolls are monitored near baiting sites, baiting will be ceased. Control programs to be developed in consultation with the Local Land Services wild dog officer and to be consistent with regional plans and programs.	FCNSW must make a reasonable effort to control pest fauna in the Flora Reserve. Monitoring and the level of local activity (presence of neighbourhood baiting programs etc.) will help inform the level of effort necessary. FCNSW must monitor the site at least once every two years. Group control programs to be coordinated with adjoining properties	Pest control and monitoring to be reviewed annually. Adjustments implemented and documented.	Monitoring, followed by a pest fauna control round, at least once every two years or as required, for a minimum of 20 years.

	Activity	Quantity	Activity details	Performance target	Corrective actions	Timeframe
9	Wildfire suppression	1-2 per annum (on average)	Suppress wildfires as necessary quickly and efficiently.	Fires kept small and/or cool. Fire not allowed to spread into occupied threatened plant habitat or from State forest to other tenure, where possible.	Review fuel management strategy if frequency or intensity of wildfires increases.	Ongoing as required.
10	Fuel management	Entire site. Coordinated with management programs in surrounding State forests	Identification of fuel management strategies including formal lodgement of Asset Protection Zones and Strategic Fire Advantage Zones (APZ/SFAZ) with the regional Bush Fire Management Committee	Formal lodgement of FCNSW strategies into the regional Bush Fire Risk Management Plan.	Fuel management activities to be reviewed annually. Adjustments implemented and documented.	Ongoing as specified in the regional Bush Fire Risk Management Plan
11	General conservation, maintenance and monitoring.	Entire site	Facilitate and monitor natural regeneration and development of habitat resources in accordance with the monitoring program (see Section 7.3). Identify and monitor threats and impacts to biodiversity values (e.g. wildfire, erosion, harmful activities on adjoining properties) and undertake appropriate corrective actions.	FCNSW must comply with their management plan and provide monitoring results for: - vegetation and habitat condition - weed control - pest fauna control - any identified threats and impacts to biodiversity values that are not covered in this plan and appropriate corrective actions - any specific management actions for the reporting year.	Management activities and monitoring results to be reviewed annually. Adjustments implemented and documented.	Yearly monitoring report for a minimum of 20 years.

	Activity	Quantity	Activity details	Performance target	Corrective actions	Timeframe
12	Exclusion of timber harvesting and harmful activities	Entire site. Coordinated with harvest planning and management programs in surrounding State forest.	Exclude activities that will result in impacts on habitat for the affected threatened flora, including timber harvesting, vehicle based camping, domestic animal access, apiary or uncontrolled public access. Clear delineation of the Flora Reserve via signs and mapping. Consideration in harvest planning and management programs in surrounding State forest. Monitoring by FCNSW staff during all operations in the broader Boambee SF.	Exclusion of all timber harvesting, grazing and other harmful activities.	Immediate halting of timber harvesting, grazing or any other harmful activities if detected in the Flora Reserve.	Ongoing, in perpetuity.

7.2.3 Management actions program

Table 16 Boambee SF offset site management actions program

Activity	Works timing (periods for actions to be completed by FCNSW)												Timeframe
	2017				2018				Ongoing				
	Jan-Mar	Apr-Jun	July-Sep	Oct-Dec	Jan-Mar	Apr-Jun	July-Sep	Oct-Dec	Jan-Mar	Apr-Jun	July-Sep	Oct-Dec	
Gate and sign installation													Ongoing as required.
Rubbish removal													Completion of removal of rubbish shown on Figure 5 by June 30 2017. Ongoing as required.
Track maintenance													Ongoing as required.
Treatment of noxious weeds													Two control rounds, in spring or autumn, completion by end 2018
Targeted threatened plant monitoring and bush regeneration of occupied habitat													Once yearly in Summer, ideally in January or February, for a minimum of five years.
Broad scale weed monitoring and bush regeneration													Once yearly in spring, for a minimum of 20 years.
Pest fauna control													Monitoring and pest fauna control rounds two-yearly or as required for a minimum of 20 years.
General conservation, maintenance and monitoring													Yearly monitoring reports for a minimum of 20 years.

7.3 Monitoring program

7.3.1 Overview

The FCNSW will monitor biodiversity values at the Boambee SF offset site as part of their management of the State forest. Monitoring will include an annual assessment of the general extent and quality of habitat for the affected threatened flora and the effectiveness of management actions for a minimum of 20 years. The following monitoring programs and reports will apply to the Offset site:

- Threatened flora population monitoring, comprising an annual monitoring program to be completed by FCNSW ecologists or a suitably qualified subcontractor, for a minimum of five years.
- Vegetation and habitat monitoring, comprising a monitoring program to be completed by the FCNSW annually, for a minimum of 20 years and including preparation of annual overviews of the condition of vegetation and habitat.
- A targeted threatened species survey at year five to further confirm the presence and condition of occupied habitat for the affected threatened biota.
- Pest fauna control monitoring, involving documenting of control activities for a minimum of 20 years.

These monitoring programs and reports are described below.

7.3.2 Threatened flora populations

Targeted threatened flora population monitoring will be completed by FCNSW ecologists or a suitably qualified subcontractor, annually in Summer, ideally in January or February, for a minimum of five years. Surveys will be timed to coincide with the species' flowering times: *Tylophora woolsii* flowers in summer and autumn, usually between January and March; *Marsdenia longiloba* flowers in Summer. The team of specialists responsible for this management action will need to have strong field plant identification skills, demonstrated experience at identifying *Marsdenia longiloba* and *Tylophora woollsii* and bush regeneration skills.

Monitoring of threatened flora populations will comprise:

- Targeted searches for threatened plants with reference to the known locations of clusters of threatened plants and occupied habitat shown on Figure 7 and listed in Appendix B.
- Confirmation of the presence of the known clusters of threatened plants shown on Figure 7 and listed in Appendix B and identification of any additional clusters and documentation of the number of stems, apparent health of stems, evidence of fruiting or flowering and presence of weed infestation or other threats.
- Targeted treatment of weeds as required in the immediate vicinity of identified stems of *Marsdenia longiloba* and *Tylophora woollsii*. This will comprise hand weeding or targeted herbicide application (cut and paint, stem scrape etc.) only.
- Documentation of any additional weed control rounds or other corrective actions that are recommended to respond to observed threats to the threatened plant populations.

Table 17 Boambee SF offset site monitoring program

Monitoring program	Report	Dates for monitoring reports to be submitted by Landholder																					Timeframe
		2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037 on	
Threatened flora population monitoring	Updated mapping and summary tables of threatened flora populations		■	■	■	■	■																	Annual summary reports until 2021
Vegetation and habitat monitoring	'Vegetation and habitat monitoring' reports prepared by a qualified ecologist	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		Annual summary reports, until 2036
Year 5 targeted threatened species survey							■																	One off report. Completed by end 2021
Pest fauna control	Biennial 'Pest fauna monitoring and control' summary reports prepared by pest control contractor as appropriate.		■		■		■		■		■		■		■		■		■		■			Biennial summary reports, until at least 2036.
FCNSW monitoring and auditing																							■	Ongoing review of Flora reserve monitoring reports, inspections, auditing and additional stewardship as required.

7.3.3 Vegetation and habitat

FCNSW will monitor biodiversity values at the WC2NH offset area as part of their management of the Flora Reserve. A vegetation and habitat monitoring program will be completed by FCNSW annually, for a minimum of 20 years. A vegetation and habitat condition report will be prepared annually.

The annual monitoring of vegetation and habitat condition by the FCNSW will comprise:

- Monitoring of the five photo points to record the condition of habitat and the effectiveness of management actions. Photo point locations have been way pointed using a GPS and marked with star pickets to facilitate locating during subsequent monitoring events and consistent photo capture (see Table 18). A photo will be taken and notes taken on general vegetation condition, extent of weed infestation, ground cover, any management issues such as erosion or dieback, disturbance by pest fauna and any observed change since the last monitoring round.
- General observations of vegetation condition, degree of weed infestation, any management issues such as erosion or dieback and any observed change since the last monitoring round across the entire site.
- Description of any observed management problems or threats and proposed remedial action as required.
- Preparation of 'Vegetation and habitat monitoring' reports, including photo point data and comparisons with previous survey rounds and benchmark values, photos, assessment of vegetation condition and regeneration, assessment of the quality and extent of habitat resources, description of any observed management problems or threats and proposed remedial action as required.

7.3.4 Targeted threatened species survey

A targeted threatened species survey of the WC2NH Boambee SF offset area will be conducted five years after the offset site is formally established to further confirm the presence and condition of occupied habitat for the affected threatened biota, the link between the proposed management actions and habitat quality and the security of threatened species. Five years is the 'Offset calculator – Time horizon – Time until ecological benefit' value that was entered in the Offset assessment guide calculations and so this is the critical period after which it is necessary to confirm that the biodiversity offset has been delivered as planned.

The targeted threatened species survey will comprise the following techniques:

- The year five 'vegetation and habitat monitoring' survey described above.
- Collection of BioBanking plot/transect data at four permanent locations where baseline data was collected in the GHD field surveys. Survey locations are listed in Table 18.
- Habitat assessments, focussing on the extent and quality of specific habitat resources of relevance to the affected threatened species, including:
  - Food tree species for the Koala.
  - Vegetation type and structure, presence and quality of woody debris, caves rock outcrops and other potential den sites for the Spotted-tailed Quoll.
  - Critical foraging habitat for the Grey-headed Flying-fox.
- Sampling of four 'Canopy plots' nested in four BioBanking plot/transects, comprising counts of every tree in the 50 m x 20 m plot along with its height, species, canopy cover and any evidence of fauna activity. Each tree species will then be cross referenced to lists

of food tree species for the Koala and Grey-headed Flying-fox to calculate the cover of food tree species.

- Four Koala SAT searches for scats and evidence of Koala activity with reference to Phillips and Callaghan (2011).
- Nocturnal surveys targeting the Koala, Spotted-tailed Quoll and Grey-headed Flying-fox over two sets of four person-hour survey rounds on two separate nights, including walked spotlighting transects, quiet listening periods and call playback.
- At least four motion sensing camera traps targeting the Koala and Spotted-tailed Quoll and placed for as long as is possible, split between the main habitat types and targeting potential fauna movement corridors such as fire trails and drainage lines.
- Preparation of a 'Targeted threatened species monitoring' report, including survey results, plot/transect data and comparisons with the baseline survey round and benchmark values, photos, assessment of vegetation condition and regeneration, assessment of the quality and extent of habitat resources, description of any observed management problems or threats and proposed remedial action as required.

7.3.5 Pest fauna control

FCNSW will conduct dedicated monitoring of pest fauna populations and prepare summary reports every two years. The monitoring program will be developed in consultation with the Local Land Services control officer and include techniques such as setting of camera traps, setting up of sand pits with bait stations and free feed and coordination with ongoing control programs as appropriate. Each monitoring round will be followed by a round of pest fauna control undertaken by appropriately licensed and qualified staff where possible. Any baiting undertaken will be conducted according to best practice standards. Control programs will be developed in consultation with the Local Land Services officer and will be consistent with regional plans and programs.

The monitoring program will be developed in consultation with the Local Land Services control officer and include techniques such as setting of camera traps, setting up of sand pits with bait stations and free feed, predator scat analysis and coordination with ongoing control programs as appropriate. Each monitoring round will be followed by a round of pest fauna control using soft-jaw trapping and/or shooting undertaken by appropriately licensed and qualified staff where possible. Any baiting undertaken will be conducted according to best practice standards (refer to NPWS Best Practice Guidelines – fox control). If quolls are identified near baiting sites, baiting will be ceased. Control programs will be developed in consultation with the Local Land Services wild dog officer and will be consistent with regional plans and programs.

A brief pest fauna control report will be prepared following each monitoring round comprising:

- Dates and locations of monitoring activities.
- Numbers and species of animals recorded during monitoring.
- Dates and locations of pest fauna control activities.
- A brief description of group control programs encompassing the site or other relevant programs coordinated by Local Land Services and related to the pest control activities on site.
- Numbers and species of animals captured or killed during pest fauna control activities.
- Incidental observations of native animals.
- A summary of general observations of pest fauna abundance and activity throughout the preceding 24 months.

Table 18 Monitoring locations in the WC2NH Boambee SF offset area

Photo point	Plot/ transect ID	NSW Vegetation Type	NSW Veg. ID	Condition	Habitat type	Notes	Eastings	Northings
W2	W2	Hinterland and Escarpment Tallowwood - Blackbutt - Blue Gum Wet Ferny Forest	NR120	Moderate/good	Wet sclerophyll forest	Threatened plant habitat with moderate weed infestation.	503220	6643795
W3	W3	Coast and Hinterland Riparian Flooded Gum Bangalow Wet Forest	NR159	Moderate/good	Wet sclerophyll forest	Moderate weed infestation.	503411	6643711
W4	W4	Northern Escarpment Blackbutt - Apple Wet Ferny Forest	NR120	Moderate/good	Wet sclerophyll forest	Abundant Koala food trees.	502734	6644161
W5	W5	Foothills Grey Gum - Ironbark - Mahogany Dry Forest	NR263	Moderate/good	Dry sclerophyll forest	Moderate weed infestation.	503400	6644288
W11	n/a	n/a	n/a	Moderate/good	Exotic vegetation	Severe weed infestation.	503240	6643635

7.1 Responsibilities

Table 19 outlines the management roles and the standard of qualifications and experience required for the parties who will be implementing the management actions at the Boambee SF offset site in accordance with Condition f) viii. for the Project.

Table 19 Parties responsible for implementing this offset package at the WC2NH Boambee SF offset area

Role / management actions	Responsible party	Qualifications / experience
Site manager / supervising the implementation of this offset package and the MAP.	Forestry Corporation NSW (FCNSW) Flora reserve manager.	Tertiary qualifications in environmental science, forestry or ecology / demonstrated senior professional experience in site management role.
EPBC Act offset package auditor / ensuring compliance with this offset package and the Flora reserve plan of management.	FCNSW Flora reserve manager.	Tertiary qualifications in environmental science, forestry or ecology / demonstrated senior professional experience in site management role.
Ecologist / Annual vegetation and habitat monitoring until 2036	FCNSW ecologist.	Tertiary qualifications in environmental science or ecology / demonstrated professional experience in ecological survey and assessment.
Botanist / threatened flora population monitoring	FCNSW botanist or consultant botanist engaged by FCNSW.	Tertiary qualifications in botany or ecology / demonstrated professional experience in botanical survey and assessment including experience with the affected threatened plants.
Ecologist / targeted threatened species survey in year five.	FCNSW ecologist or consultant ecologist engaged by FCNSW.	Tertiary qualifications in environmental science or ecology / demonstrated professional experience in ecological survey and assessment.
Site maintenance contractor / installation and maintenance of fences, signs and tracks. Fence strand and rubbish removal as required.	Appropriately qualified and experienced contractors engaged by FCNSW.	Trade qualifications appropriate to the individual task / demonstrated professional experience in the individual task.
Bush regenerator / Treatment of mapped weed infestations, ongoing broad scale weed monitoring and bush regeneration. Targeted treatment of weeds in the vicinity of populations of the affected threatened flora in consultation with the botanist.	Appropriately qualified and experienced FCNSW personnel or bush regeneration contractors engaged by FCNSW.	Certificate III Conservation & Land Management (or interstate equivalent) / minimum one year full-time equivalent experience as a bush regenerator.

Role / management actions	Responsible party	Qualifications / experience
Pest fauna controller / pest fauna monitoring, control and reporting.	Appropriately qualified and experienced contractor engaged by FCNSW. Control programs to be developed in consultation with the Local Land Services wild dog officer and to be consistent with regional plans and programs	Endorsement of Local Land Services wild dog officer / demonstrated professional experience.

8. Management of the xxxxx offset site

8.1 Conservation mechanism and funding arrangements

The xxxxx offset site will be conserved under three BioBanking agreements under the TSC Act. Further information about Biobanking is provided in Section 6.1.

A BioBanking agreement is the strongest covenant available on private lands and extinguishes all land uses other than conservation unless the BioBanking agreement is varied or terminated by the NSW Minister for the Environment to permit alternative uses. Certain mining rights may be granted over a biobank site, and certain development can be carried out by public authorities on a biobank site, but any impacts from these activities must be offset again as an addition to any offsetting activities required by a given project in its own right. Therefore, the risk of loss of the offset sites with the BioBanking agreement in place has been assessed as 3 per cent for the purposes of the offset assessment guide calculations.

The three biobanks that will be established at the xxxxx offset site will include additional land outside the 'WC2NH xxxxx offset area' shown on Figure 9. The WC2NH xxxxx offset area that is the subject of this offset package will be entirely located within one biobank site. Roads and Maritime will purchase and retire the biodiversity credits associated with the 'WC2NH xxxxx offset area' to ensure that this land is secured for conservation and the offset area will not be used to compensate for the impacts of another development.

8.2 Management plan

8.2.1 Management strategies

The following broad management strategies and related actions at the xxxxx offset site will improve the value and extent of habitat for the Giant Barred Frog:

- Exclusion of domestic grazing and management of human disturbance.
- Property maintenance, through:
  - Establishment and maintenance of appropriate fences, gates and signs.
  - Removal of rubbish.
  - Maintenance of tracks.
  - Maintenance of easements.
- Conservation and improvement of habitat, through:
  - Bush regeneration and facilitated improvement in the condition of native vegetation.
  - Natural regeneration of cleared or degraded land.
  - Weed control.
  - Retention of dead timber, rocks and other habitat resources.
- Fire management.
- Pest fauna control.

An overview of these management strategies and how they relate to the site and to the population of the Giant Barred Frog is provided below. The following sections provide specific detail of the management actions that will be performed including a plan for their delivery, a works program and the minimum standards and objectives that will be achieved. Property management actions are illustrated on Figure 13.

The management strategies and actions will be implemented across the xxxxx biobanks under overarching MAPs prepared in accordance with the BioBanking assessment methodology, this offset package and any other relevant plans. The implementation of management strategies and actions in accordance with the MAPs for the biobanks will be funded by Roads and Maritime through the purchase of biodiversity credits associated with the xxxxx offset area.

Exclusion of grazing and other harmful activities

The xxxxx offset site is currently a rural residential landholding and is available for grazing, timber harvesting and other activities that are likely to harm the local population of the Giant Barred Frog and/or reduce the quality of habitat. Permitted activities include clearing of vegetation for more intensive agricultural activities such as blueberry cultivation that would be economic and have been considered by the landowner (xxxxx. pers. comm.). These activities will not be permitted in the xxxxx biobank sites. The BioBanking agreements are highly unlikely to be ever overturned to permit grazing, clearing of vegetation for blueberry cultivation or other damaging activities. This scenario supports the 'risk of loss' calculations that are included in the Offset assessment guide calculations.

Exclusion of grazing, timber harvesting and unauthorised access will avoid direct impacts such as removal or degradation of habitat and vehicle strike of threatened fauna. Exclusion of harmful activities will also help avert secondary impacts such as erosion and sedimentation and introduction or spread of disease. Grazing results in disturbance of soil and vegetation and movement of vehicles and livestock throughout patches of habitat and would comprise a significant vector for transmission of disease. Under the proposed management of the site there will be minimal disturbance of soil or vegetation, stock will be excluded from the biobank, vehicles will be restricted to tracks and there will be occasional foot traffic through patches of habitat. This will substantially reduce the risk of erosion, sedimentation or transmission of disease.

The xxxxx offset area within the proposed biobanks includes 5 hectares of habitat for the Giant Barred Frog that has been included in Offset assessment guide calculations in this offset package. Conservation and management of the biobanks will improve the quality of habitat for the Giant Barred Frog.

Property maintenance

The xxxxx offset site is currently a rural residential landholding and comprises remnant and regenerating native vegetation with small areas of cleared or degraded land. The biobanks will be maintained as native vegetation. Infrastructure such as signs and access tracks will be maintained to support these land uses as shown on Figure 14. This infrastructure is important to clearly define the conservation area, exclude harmful activities and facilitate efficient management.

There is an existing network of access tracks across the broader xxxxx property (see Figure 14). These tracks are likely to be adequate for weed management, fire management, monitoring and other activities. These tracks will be maintained in their current state as single lane, dirt or gravel tracks. Track maintenance will occur within the entire xxxxx site and from the site boundary to the nearest junction with a public road.

The majority of the perimeter of the xxxxx offset site adjoins intact native vegetation. Given the impacts associated with fence construction, the risk of injury to native fauna from fences and the surrounding land uses, no perimeter fence construction is proposed where the biobank adjoins native vegetation. Fences will be constructed and maintained where the biobank site adjoins agricultural land with livestock (see Figure 14). Annual inspection and maintenance of these fences is proposed to ensure exclusion of any neighbouring livestock. This activity will be undertaken in partnership with neighbours.

Conservation and improvement of habitat

Conservation and management of WC2NH offset area will improve the quality of habitat for the Giant Barred Frog and reduce the impact of threats.

The majority of the xxxxx offset site, and all of the WC2NH xxxxx offset area' contains near-intact vegetation or mature regeneration. There are small areas of low condition vegetation associated with previous clearing for agriculture (see Figure 10). Natural regeneration in these areas would be facilitated through the exclusion of grazing and the management of human disturbance.

Habitat resources such as stream geomorphology and mature, structurally complex vegetation would be retained and would continue to develop over time.

Weed control will be an important part of conserving habitat at the site and will comprise two main activities:

- Treatment of localised, severe noxious weed infestations, especially Lantana in the areas shown on Figure 14. Treatment of Lantana will be an important management action because this weed species can form particularly severe infestations in wet sclerophyll forest and rainforest habitat and are likely to decrease habitat suitability by suppressing the accumulation of suitable leaf litter and foraging substrate and physically impeding frogs (OEH, 2015; Hines et al. 2002; Lemkert, L., Niche, pers. comm.).This activity will be required in the first two years of the implementation of this plan in order to manage the current severe infestations currently present at the site. Additional control rounds will be performed as required to achieve performance targets.
- Broad-scale weed monitoring and bush regeneration activities throughout the entire site. This will include treatment of localised, minor infestations of weeds throughout the site This activity will be required throughout all native vegetation and will be funded in-perpetuity. More intensive weed management activities may be required from time to time if severe infestations are detected.

Weed control will be conducted with reference to the locations of weed infestations shown on the property action plan (see Figure 14). Additional detail will be included in the MAPs for the site. No weed spraying will be undertaken in the vicinity of aquatic habitat. Alternative weed control methods such as hand weeding or targeted herbicide application (cut and paint, stem scrape etc.) will be performed in these sensitive areas.

Fire management

The biobank site owners will actively manage fire at the xxxxx offset site to help maintain the structure and function of ecological communities. Ecological fire management will be coordinated with hazard reduction activities in accordance with the fire management plan included in Section 3 of the MAPs for the biobanks when they are prepared. These MAPs will have a similar structure and requirements as the Norton offset site MAP included as Appendix D of this offset package.

MAPs will be prepared for the three biobank sites that comprise the xxxxx offset site. The biobank sites will be split into management zones according to vegetation types and the locations of tracks and other firebreaks. The landowner will meet the ecological fire requirements of vegetation at the site by maintaining a fire interval appropriate to the vegetation within each management zone and avoiding successive fires of intensity sufficient to scorch or consume dominant tree crown. In accordance with the MAPs the landowner will:

- Carry out ecological burns for each management zone according to the method and frequency described in the 'Fire requirements for vegetation types and threatened species' table;

- Carry out the actions listed in the 'Ecological burning actions table' and the 'Other fire management activities' table.
- Undertake monitoring and inspections in accordance with the 'Fire management monitoring' table.

Ecological burns and bushfire hazard reduction works will be undertaken in accordance with a Bush Fire Hazard Reduction Certificate issued under the Rural Fires Act or a notification received under that Act, or in accordance with a Bush Fire Risk Management Plan that may apply to the land.

There will be two benefits of purposeful fire management in the WC2NH offset area proportion of the xxxxx biobank sites: suppression of wildfire and exclusion of fire from Giant Barred Frog habitat; and fuel reduction in adjoining vegetation to reduce the likelihood and intensity of accidental fire. This fire management regime will help maintain the vegetation structure and microclimate in occupied habitat (i.e. fire sensitive wet sclerophyll forest and rainforest) and reduce the risk of harm to individual frogs.

Pest fauna control

Pest fauna populations will be managed through a trapping, shooting and baiting program and in accordance with the *NPWS North Coast Regional Pest Management Strategy: 2012-2016* (OEH, 2012). Pest fauna control programs will be developed in response to monitoring and in consultation with the Local Land Services and will be consistent with the regional strategy (OEH, 2012). Coordination with group control programs that include pest fauna control on the site and adjoining properties is likely to increase the effectiveness of pest fauna control (Thorman, M., local land services, pers. comm.).

Dog, fox and feral cat attack and/or competition comprise a threat to the Koala, Spotted-tailed Quoll and many other native fauna species. Control of these exotic predators will be part of the management of the xxxxx offset site in order to benefit these threatened species and their habitats. Any baiting should preferably be conducted using Canid Pest Ejectors (CPEs). CPEs have been shown to achieve a high level of target specificity and involve minimal risk to Spotted-tailed Quolls because they require a firm pulling action to trigger poison delivery, which is easily achieved by foxes and wild dogs, but much less so by most non-target species (Hunt, 2010) (see Section 6.2.1 for more detail). Exotic predators are not recognised as a specific threat to Giant Barred Frogs (Hynes et. al., 2002; OEH, 2015), however they are likely to prey on Giant Barred Frogs and so their control is likely to benefit the species.

Feral pigs of are recognised as a specific threat to Giant Barred Frogs because they can degrade riparian habitat (Hynes et. al., 2002). Feral pigs and other large exotic herbivores such as feral cattle, deer or goats will be controlled as required based on the results of the biodiversity monitoring and consultation with the Local Land Services control office. No specific evidence of any of these species, or environmental degradation as a result of their presence, was noted during field surveys. Active management of these pest fauna would commence if they are recorded at the site. Control methods are likely to include: active trapping; shooting from the ground; and/or strategic baiting. The type and method of baiting will need to consider the presence of native fauna and their feeding habits, especially the Spotted-tailed Quoll.

8.2.2 Relationship with other documents

The xxxxx property will be managed in accordance with the following documents prepared in conjunction with the OEH:

- Three in perpetuity BioBanking agreements (one for each of the lots that make up the offset site because each has a separate owner) registered on the title of the property and tailored to suit the site.

- Three Management Action Plans which will be prepared with reference to this offset package, and which will set out the management strategies that must be applied at the site to manage the property in accordance with the BioBanking agreements.
- It is recommended that weed and pest fauna control is conducted with reference to the *NPWS North Coast Regional Pest Management Strategy (*OEH, 2012).

Figure 14 xxxxx offset property action plan (removed to protect privacy).

8.2.3 Management actions plan

Table 20 presents the specific actions required to implement the strategies described above, including specifications, standards, objectives and timeframes for delivery. The landowner will be responsible for implementing these actions in accordance with the MAP and this biodiversity offset package. OEH will be responsible for monitoring performance against the MAP. Property management actions are illustrated on Figure 14. Roads and Maritime are developing standard funding rates for management activities as part of the framework for delivering the Pacific Highway Biodiversity Offsets Covenant Program. Rates will be based on known vegetation types, topography and ground conditions and provide for costs based on the scale of the works proposed. Payments will be spread over a twenty-year period. After the works program is completed, and all payments made, landowners will be required to continue to manage the land in line with their BioBanking agreement and MAP and other relevant legislative requirements.

Table 20 xxxxx offset site management actions plan

Activity number	Activity	Quantity	Activity details	Performance target	Corrective actions	Timeframe
1	Gate and sign installation and maintenance	Signs and gates as shown on Figure 14.	Installation of gates and signs at the locations shown on Figure 14. Gates must be stock proof, lockable, considered permanent, and all materials used new or 'as new'. 10 metre wide fences in accordance with activity 1, or alternative vehicle barriers, are to be installed on either side of gates where no perimeter fence is present. Signs will clearly identify that the property is subject to a conservation covenant.	Permanent gates and signs on all entry points to the site. Minimise unauthorised access to the site and harmful activities.	Maintenance and/or replacement of signs.	Installation by end 2017. Maintenance ongoing as required.
2	Maintenance of fences	Fence lines shown on Figure 14.	Annual fence line inspection and maintenance to ensure exclusion of any neighbouring livestock. To be done in partnership with neighbours.	Fences to be fully functional. Exclusion of livestock.	Maintenance and/or replacement of fence lines. To be done in partnership with neighbours.	Maintenance ongoing as required.

Activity number	Activity	Quantity	Activity details	Performance target	Corrective actions	Timeframe
3	Track upgrade and maintenance	Tracks shown on Figure 14.	All tracks shown on Figure 14 to be maintained if deemed necessary for management purposes such as fire management. Roads not required are to be closed. Roads are to be maintained as single-lane, gravel or dirt tracks along with appropriate surface water and sediment controls where required.	Maintenance of access for management and fire control activities.	Quarterly monitoring. Entire perimeter and strategic internal trails open and ready prior to each fire season.	At least annually, prior to each fire season. Additional maintenance as required to achieve performance targets.
4	Treatment of Lantana infestations and woody weeds	Moderate and severe infestations shown on Figure 14. Additional scattered individuals throughout the site.	Treatment of woody weeds in accordance with best practice, including: • Manual removal in areas of Giant Barred Frog habitat and/or within 50 metres of drainage lines. • Spot spraying of isolated infestations. • Cut and paint/fill. • Drilling or frilling of Camphor Laurel and other large woody weeds. • Spot spraying of seedlings. Weed waste is to be left on site. Plants with a heavy fruit or seed load are to be piled, covered with black plastic and composted.	Control of noxious weeds and control of environmental weeds in the areas indicated on Figure 14. Weed control works will aim to achieve the following outcomes: • Lantana reduced to less than 20% of original distribution by the end of year 2. • Lantana reduced to less than 10% of original distribution by the end of year 5. • Lantana maintained at less than 10% of original distribution from year 6. • No mature Camphor Laurel or other large woody weeds from year 2.	Additional control rounds as required to achieve performance targets.	Lantana infestations: • 6 sessions per year during years 1* to 3. • 4 sessions per year during years 4 – 10. Scattered mature Camphor Laurel and other woody weeds: • 2 sessions per year in years 1 and 2. Additional control rounds as required to achieve performance targets. Follow up treatment and monitoring as required under activity 5 ‘broad scale weed monitoring and bush regeneration’.

Activity number	Activity	Quantity	Activity details	Performance target	Corrective actions	Timeframe
5	Broad scale weed monitoring and bush regeneration	Entire site	Monitoring of native vegetation throughout the offset site and treatment of noxious and environmental weeds in accordance with best practice. No weed spraying undertaken in areas of Giant Barred Frog habitat and/or within 50 metres of drainage lines.	Control of noxious and environment weeds in the biobank sites. Bush Regeneration activities to be undertaken by suitably qualified operators. Operators to provide report of works undertaken, which includes mapping of area treated, primary species treated and photo monitoring points.	Additional control rounds as required to achieve performance targets.	Years 1* to 10, coordinated with other weed control activities. Year 11 on, follow-up weed control, 6 sessions per year in perpetuity.
6	Pest fauna control	Entire site	Annual dedicated monitoring of pest fauna populations in consultation with the Local land services control officer and including techniques such as setting of camera traps, setting up of sand pits with bait stations and free feed and coordination with ongoing local/regional control programs as appropriate. Annual rounds of pest fauna control, principally targeting wild dogs, foxes and cats, using soft-jaw trapping and shooting undertaken by appropriately licensed and qualified staff. Control programs to be developed in consultation with the Local Land Services wild dog officer and to be consistent with regional plans and programs. Control programs to be targeted to pigs and other feral herbivores as appropriate if populations or impacts are detected during monitoring.	Pest control to be undertaken by appropriately licensed and qualified practitioners. Practitioners to provide a report of monitoring locations, presence/absence and control activities undertaken. The matters to be contained in the report are outlined in Section 8.3.5 of the offset package. Where activities are co-ordinated by landholders, landholders shall complete the landholder report in the Management Funding Contract, and include copies of any tax receipts associated with control activities.	Pest control and monitoring to be reviewed annually. Adjustments implemented and documented.	Annual monitoring; Annual pest fauna control rounds, or as required in response to monitoring or landholder observations, ongoing.

Activity number	Activity	Quantity	Activity details	Performance target	Corrective actions	Timeframe
7	Management of fire for conservation	Entire xxxx offset site	The landowner must implement, and at all relevant times, comply with the fire management plan included in Section 3 of the MAP for the biobank. The landowner must carry out ecological burns for each management zone according to the method and frequency described in the 'Fire requirements for vegetation types and threatened species' table in Section 3 of the MAP for the biobank. The landowner must also carry out the actions listed in the 'Ecological burning actions table' and the 'Other fire management activities' table in Section 3 of the MAP for the biobank Monitoring and inspections must be carried out in accordance with the 'Fire management monitoring' table in Section 3 of the MAP for the biobank (GHD, 2016).	Meet the ecological fire requirements of vegetation at the site by maintaining a fire interval of greater than 7 years and less than 25 years. Avoid successive fires of intensity sufficient to scorch or consume dominant tree crown.	In the event that wildfires did not occur for more than 25 years on the property, a prescribed ecological burn would be conducted. Fire management activities will be documented. Prescribed burn schedules The schedule will be adjusted in the event of a wildfire or activities undertaken under the *Rural Fires Act (RFA) 1997* to ensure the minimum frequencies between ecological burns.	Inter fire interval for individual cells greater than 7 years, less than 25 years. It is anticipated the first ecological burn will occur in Year 7 (ie 2023). Burns would be conducted in April/May and/or August/ September.
8	Exclusion of grazing and harmful activities	Entire xxxxx offset site, enforced by BioBanking agreement.	Exclude activities that will result in impacts on habitat for the affected threatened species, including grazing, vehicle based camping, domestic animal access, hunting, apiary or uncontrolled public access.	Exclusion of all grazing and other harmful activities.	Immediate halting of grazing or any other harmful activities if detected in the biobank site. Clear delineation of the biobank site via signs, fences and gates.	Ongoing, in perpetuity.

Note: * - it is assumed that 'year one' begins in the first quarter of 2017 for the purposes of weed control and implementation of the MAP. In practice management would commence upon finalisation of the BioBanking Agreement (expected by June 2017).

8.2.4 Management actions program

The xxxxx offset site was identified relatively late in the planning and delivery process for this offset package because a suitable area of occupied Giant Barred Frog habitat could not be secured at the Boambee SF offset site. The xxxxx offset site will be effectively secured as a biodiversity offset for the project upon approval of this offset package in late 2016. The landowners will exclude grazing and other harmful activities from the offset site immediately. However because of the additional time taken to complete a BioBanking assessment and obtain BioBanking agreements over the site it will not be formally secured under a conservation covenant and funded management actions will not commence until 2017.

Table 21 xxxxx offset site management actions program

Activity no.	Activity	Works timing (periods for actions to be completed by Landholder													Timeframe
		Jan-Jun 2017	July-Dec 2017	Jan-Jun 2018	July-Dec 2018	2019	2020	2021	2022	2023	2024	2025	2026	2027 –	
1	New gates and signs	■	■												Completion by June 30 2017.
2	Fence, gate and sign repair and maintenance		■	■	■	■	■	■	■	■	■	■	■	■	Completion by end 2017 when protected under a secure conservation mechanism.
3	Track upgrade and maintenance			■	■	■	■	■	■	■	■	■	■	■	Ongoing as required.
4	Treatment of woody weeds – Lantana infestations	■	■	■	■	■	■	■	■	■	■	■	■		6 sessions per year during years 1* to 3. 4 sessions per year during years 4 – 10.
	Scattered mature Camphor Laurel and other woody weeds	■	■	■	■										2 sessions per year in years 1 and 2.
5	Broad scale weed monitoring and bush regeneration	■	■	■	■	■	■	■	■	■	■	■	■	■	Coordinated with other weed control activities.
	Follow-up weed control													■	6 sessions per year in perpetuity.

Activity no.	Activity	Works timing (periods for actions to be completed by Landholder													Timeframe
		Jan-Jun 2017	July-Dec 2017	Jan-Jun 2018	July-Dec 2018	2019	2020	2021	2022	2023	2024	2025	2026	2027 –	
6	Pest fauna control														Annual monitoring; annual pest fauna control rounds, or as required ongoing
7	Management of fire for conservation														Inter fire interval for individual cells greater than 7 years, less than 25 years. It is anticipated the first ecological burn will occur in Year 7 (ie 2023). Burns would be conducted in April/May and/or August/ September.

Note: * - it is assumed that 'year one' begins in the first quarter of 2017 for the purposes of weed control and implementation of the MAP. In practice management would commence upon finalisation of BioBanking Agreement (expected by June 2017).

8.3 Monitoring program

8.3.1 Overview

The following monitoring programs and reports will apply to the xxxxx site:

- Management actions performance monitoring, from the approval of the Biobanking agreement. Annual reports will be prepared by the landowners and submitted to OEH.
- Vegetation and habitat monitoring and a targeted threatened species survey at year five to further confirm the presence and condition of occupied habitat for the Giant Barred Frog.
- Pest fauna control monitoring, comprising annual monitoring of pest fauna populations and documenting of control activities from the approval of this offset package until at least 2036. Reports are to be completed by suitably qualified practitioners and maintained by the landholder.
- OEH monitoring and auditing to be completed on an ongoing basis from approval of the BioBanking agreement.

These monitoring programs and reports are summarised in Table 22 and described below. Fixed monitoring locations are listed in Table 23.

Table 22 xxxxx offset site monitoring program

Monitoring program	Report	Dates for monitoring reports to be submitted by Landholder																						Timeframe
		2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038 on	
Management actions performance	Annual report prepared by biobank site owner and submitted to OEH																							Reports completed annually in perpetuity.
Year 5 vegetation & threatened species survey																								One off report. Completed by end 2021
Pest fauna control	Annual 'Pest fauna monitoring and control' summary reports prepared by pest control contractor as appropriate.																							Annual summary reports, until at least 2036.
OEH monitoring and auditing																								Ongoing review of annual monitoring reports, inspections, auditing and additional stewardship as required.

8.3.2 Management actions performance

The landowner will monitor and record the completion of management actions through each year through collection of receipts, performance reports from contractors, diaries etc. The landowner will complete an Annual Report in accordance with works program milestones and submit to the OEH in perpetuity. The report will be prepared in accordance with OEH's standard template and include a summary of the following topics:

- Fence maintenance.
- Feral animal presence.
- Feral animal control.
- Weed presence (including extent and severity of infestations and presence of any new infestations).
- Weed control.
- Description and proof of current reporting years' activities, including one-off or irregular events (fence replacement, fire management etc).

The OEH will confirm that activities have been completed in accordance with the MAP and/or recommend additional actions to achieve performance objectives (See Table 20).

Photo points will be maintained at two locations in the WC2NH offset area and at representative points in each vegetation zone in the broader biobank sites to monitor the condition of habitat and the effectiveness of management actions. Photo point locations have been waypointed using a GPS and marked with star pickets to facilitate locating during subsequent monitoring events and consistent photo capture (see Table 23). Photo point monitoring will be conducted annually. A photo illustrating vegetation condition and structure will be taken and notes taken on general vegetation condition, extent of weed infestation, ground cover, any management issues such as erosion or dieback and any observed change since the last monitoring round.

8.3.3 Vegetation, habitat monitoring and targeted threatened species survey

Vegetation and habitat monitoring and a targeted threatened species survey of the WC2NH xxxxx offset area will be conducted five years after the offset site is formally established to further confirm the presence and condition of occupied Giant barred Frog habitat, the link between the proposed management actions and habitat quality and the security of the species. Five years is the 'Offset calculator – Time horizon – Time until ecological benefit' value that was entered in the Offset assessment guide calculations and so this is the critical period after which it is necessary to confirm that the biodiversity offset has been delivered as planned.

The targeted threatened species survey will comprise the following techniques:

- The year five 'detailed vegetation and habitat monitoring' survey.
- Habitat assessments, focussing on the extent and quality riparian breeding habitat for the Giant Barred Frog.
- Targeted frog surveys over four person-hour survey rounds on two separate nights, including streamside searches, call playback and quiet listening periods. The targeted frog survey should be time to coincide with appropriate weather conditions during the species seasonal activity period as confirmed by checking of known reference populations.
- Preparation of a 'Targeted threatened species monitoring' report including survey results, plot/transect data and comparisons with the baseline survey round and benchmark values, photos, assessment of vegetation condition and regeneration, assessment of the

quality and extent of habitat resources, description of any observed management problems or threats and proposed remedial action as required.

8.3.4 Pest fauna control

The landowner will arrange annual dedicated monitoring of pest fauna populations. The monitoring program will be developed in consultation with the Local Land Services control officer and will be consistent with regional plans and programs.

Practitioners will be required to prepare an annual pest fauna control report comprising:

- Dates and locations of monitoring activities.
- Numbers and species of animals recorded during monitoring.
- A brief description of group control programs that encompass the site or other relevant programs coordinated by Local Land Services and related to the year's pest control activities.
- Dates and locations of pest fauna control activities.
- Numbers and species of animals captured or killed during pest fauna control activities.
- Incidental observations of native animals.
- A summary of general observations of pest fauna abundance and activity throughout year.

Table 23 Fixed monitoring locations in the WC2NH xxxxx offset area

Photo point	Plot/ transect ID	NSW Vegetation Type	NSW Veg. ID	Condition	Habitat type	Notes	Eastings	Northings
A	1	Flooded Gum - Brush Box moist forest	NR159	Moderate/good	Wet sclerophyll Forest	Giant Barred Frog habitat with moderate weed infestation.	511339	6679200
B	4	Flooded Gum - Brush Box moist forest	NR159	Moderate/good	Wet sclerophyll Forest	Giant Barred Frog habitat.	511157	6679190

8.4 Responsibilities

Table 24 outlines the management roles and the standard of qualifications and experience required for the parties who will be implementing the management actions at the xxxxx offset site in accordance with Condition f) viii. for the Project. There will be three biobank site owners each of whom is responsible for managing one of the three biobank sites that will collectively comprise the xxxxx offset site however the WC2NH xxxxx offset area that is the subject of this offset package will be entirely located within one biobank site.

Table 24 Parties responsible for implementing this offset package at the xxxxx offset site

Role / management actions	Responsible party	Qualifications / experience
Site manager / supervising the implementation of this offset package and the MAP.	Biobank site owner	Complies with OEH's 'fit and proper' person requirements. Signatory to the BioBanking agreement.
EPBC Act offset package auditor / ensuring compliance with this offset package.	Roads and Maritime offset site manager.	Tertiary qualifications in environmental science or ecology / demonstrated senior professional experience in an environmental management role.
Biobank site auditor / ensuring compliance with the BioBanking agreement and MAP.	NSW Office of Environment and Heritage (OEH)	Tertiary qualifications in environmental science or ecology / professional experience in BioBanking unit.
Ecologist / Detailed vegetation and habitat monitoring; targeted threatened species survey in year five.	Consultant ecologist engaged by Roads and Maritime	Tertiary qualifications in environmental science or ecology / demonstrated professional experience in ecological survey and assessment.
Site maintenance contractor / installation and maintenance of fences, signs and tracks. Fence strand and rubbish removal as required.	Appropriately qualified and experienced contractors engaged by the biobank site owner.	Trade qualifications appropriate to the individual task / demonstrated professional experience in the individual task.
Bush regeneration contractor / Treatment of mapped weed infestations, ongoing broad scale weed monitoring and bush regeneration.	Appropriately qualified and experienced bush regeneration contractors engaged by the biobank site owner.	Certificate III Conservation & Land Management (or interstate equivalent) / minimum one year full-time equivalent experience as a bush regenerator.
Pest fauna controller / pest fauna monitoring, control and reporting.	Appropriately qualified and experienced contractor engaged by the biobank site owner.	Endorsement of Local Land Services wild dog officer / demonstrated professional experience.

9. Risk assessment

Condition f) vii. for the Project states that this offset package must describe the potential risks to successful management and rehabilitation in the offset areas and provide a description of the contingency measures that would be implemented to mitigate these risks. The potential environmental risk associated with management of the offset areas has been assessed using the Commonwealth Department of Defence's Environment Risk Tool (ERT). Contingency measures would be implemented if issues of non-compliance, exceedance, or new information about the management of the offset areas becomes apparent.

The ERT is a recognised risk assessment tool that relies on a specific, measureable and repeatable methodology. A risk assessment for each of the proposed environmental management actions and risk controls (i.e. contingency measures) are provided in Table 27. The ERT includes the capability to assess financial, reputational or safety risks. For the purposes of this assessment, impacts have been assessed against the environment and heritage consequence descriptors only. The consequence and likelihood descriptors that apply to the risk assessment are listed in Table 25 and Table 26, and the complete risk assessment is located in Table 27.

Table 25 Consequence Descriptors

Likelihood of impact	Consequence of impact
Severe	Irreversible and extensive impact on a listed species; or damage to the values of a listed or indigenous heritage site.
Major	Irreversible and extensive damage to heritage, the environment or native fauna. OR Extensive and reversible or irreversible and localized impact on a listed species or damage to the values of a listed or indigenous heritage site. OR Extensive unnecessary production of waste or consumption of resources.
Moderate	Extensive and reversible or irreversible and localized damage to heritage, the environment or native fauna. OR Localized and reversible impact on a listed species or damage to the values of a listed or indigenous heritage site. OR Production of waste or consumption of resources substantially higher than necessary.
Minor	Localized and reversible damage to heritage, the environment or native fauna. OR Production of waste or consumption of resources that is slightly higher than necessary.
Negligible	Environmental or heritage impact, production of waste or consumption of resources that would not be of concern to a reasonable person.

Table 26 Likelihood Descriptors

Rating	Description
Almost Certain	Has occurred several times in the past year and in each of the previous 5 years OR has a > 90% chance of occurring before the risk assessment is reviewed (12 months) if the risk is not mitigated.
Likely	Has occurred at least once in the past year and in each of the previous 5 years OR has a 60-90% chance of occurring before the risk assessment is reviewed (12 months) if the risk is not mitigated.
Possible	Even probability of consequences occurring before the risk assessment is reviewed (12 months). OR Has occurred two or three times during the past 5 years OR has a 40-60% chance of occurring before the risk assessment is reviewed (12 months) if the risk is not mitigated.
Unlikely	Has occurred once in the last 5 years OR has a 10-30% chance of occurring in the future if the risk is not mitigated.
Rare	Has not occurred in the past 5 years OR may occur in exceptional circumstances, i.e. less than 10% chance of occurring in the next funding period if the risk is not mitigated.

Table 27 Risk assessment for the implementation of the proposed management actions

Activity number	Activity & Sub Activity	Risk source/potential incidents	Sensitive receptor	Impact Description	Consequence	Justification	Likelihood	Risk Band	Proposed risk control
Norton 1, 2 and 3; Boambee 1 and 2; xxxxx 1, 2	Fence, gate and sign installation, repair and maintenance	Weed invasion	Vegetation	Introduction of weed species to newly disturbed land.	Moderate	Moderate consequence – weed infestation localised and reversible. Likely likelihood - use of vehicles necessary.	Likely	Medium	Educate contractors about the type and location of sensitive receptors and the requirements of the offset package. Conduct works under an appropriate health, safety and environmental management plan (HSEMP) or equivalent.
Norton 1, 2 and 3; Boambee 1 and 2; xxxxx 1, 2	Fence, gate and sign installation, repair and maintenance	Erosion and soil compaction	Soil and remnant vegetation	Disturbance of soil around fencelines creating erosive conditions. Soil compaction resulting from excessive vehicle movements or heavy vehicle use.	Minor	Minor consequence - local and reversible damage to habitat / Possible likelihood - strict controls in place.	Possible	Medium	Educate contractors about the type and location of sensitive receptors and the requirements of the offset package. Conduct works under an appropriate health, safety and environmental management plan (HSEMP) or equivalent.

Activity number	Activity & Sub Activity	Risk source/potential incidents	Sensitive receptor	Impact Description	Consequence	Justification	Likelihood	Risk Band	Proposed risk control
Norton 4 and 5; Boambee 3	Rubbish and fence strand removal	Removal of fauna habitat	Fauna	Damage / removal of habitat or protected species	Minor	Minor consequence - local and reversible damage to habitat / threatened species. Unlikely likelihood - strict controls in place.	Unlikely	Low	Rubbish is to be characterised by an appropriately qualified specialist and a safe and sustainable plan for its removal prepared. Educate contractors about the type and location of sensitive receptors and the requirements of the offset package.
Norton 6; Boambee 4; xxxxx 3	Maintenance of tracks	Removal of regrowth vegetation	Regrowth vegetation	Disturbance to regrowth vegetation	Minor	Minor consequence - local and reversible damage to vegetation and habitat. Vegetation in track footprints has previously been disturbed and is of lower value. Almost certain likelihood - removal of regrowth vegetation necessary on tracks.	Almost certain	Medium	Appropriate surface water and sediment controls where required. Quarterly monitoring and supplementary maintenance as required.

Activity number	Activity & Sub Activity	Risk source/potential incidents	Sensitive receptor	Impact Description	Consequence	Justification	Likelihood	Risk Band	Proposed risk control
Norton 6; Boambee 4; xxxxx 3	Maintenance of tracks	Removal of threatened plants or important habitat	Threatened plants, habitat resources	Damage / removal of habitat or protected species	Major	Major consequence - Irreversible and localised damage to habitat / threatened species. Low likelihood - strict controls in place. Vegetation in track footprints has previously been disturbed and is unlikely to contain threatened species.	Rare	Medium	Educate contractors about the type and location of sensitive receptors, threatened plant identification and the requirements of the offset package.
Norton 7, 8 and 9; Boambee 5; xxxxx 4	Control of weeds	Spray drift causing accidental mortality of native flora, including threatened species	Remnant vegetation and threatened flora species	Decreased native species richness and potential mortality of threatened plants in localised patches	Major	Major consequence - irreversible and localized damage to habitat / threatened species. Possible likelihood - qualified contractors will be operating under strict controls and will be inspecting vegetation for threatened species and avoiding by-spray as far as practicable.	Unlikely	Medium	Weed management activities are to be undertaken by suitably qualified operators. Educate contractors about the type and location of sensitive receptors. No weed spraying undertaken in the vicinity (5 m radius) of identified stems of *Marsdenia longiloba* and *Tylophora woollsii*. Avoid spot spraying in high wind conditions.

Activity number	Activity & Sub Activity	Risk source/potential incidents	Sensitive receptor	Impact Description	Consequence	Justification	Likelihood	Risk Band	Proposed risk control
Norton 7, 8 and 9; Boambee 5; xxxxx 4	Control of weeds	Ineffective weed control causing further weed invasion	Remnant vegetation and threatened flora species	Reduction of habitat as exotic flora species outcompete native flora species. Spread of weeds from incorrect weed disposal	Major	Major consequence - Extensive and reversible damage to habitat / threatened species. Unlikely likelihood - qualified contractors will be operating under strict controls .	Unlikely	Medium	Ongoing monitoring and additional control rounds as required to achieve performance targets.
Boambee 6 and 7; xxxxx 5	Targeted threatened plant monitoring and bush regeneration of occupied habitat	Accidental removal or disturbance to native flora, including threatened species	Native vegetation, especially *Marsdenia longiloba* and *Tylophora woollsii* and other threatened plants	Decreased native species richness and death of Slender Marsdenia and Cryptic Forest Twiner in localised patches	Major	Major consequence - irreversible and localized damage to habitat / threatened species. Unlikely likelihood - qualified contractors will be operating under strict controls and will be aware of known threatened plant populations.	Possible	Medium	Targeted treatment of weeds in the immediate vicinity (2 m radius) of identified stems of *Marsdenia longiloba* and *Tylophora woollsii*. Hand weeding or targeted herbicide application (cut and paint, stem scrape etc.) only. This activity will be coordinated with the monitoring program

Activity number	Activity & Sub Activity	Risk source/potential incidents	Sensitive receptor	Impact Description	Consequence	Justification	Likelihood	Risk Band	Proposed risk control
Norton 10; xxxxx 6	Control of vertebrate pest fauna	Ineffective pest control. Continued impacts of pest fauna.	Native fauna and remnant vegetation	Reduced native fauna population	Moderate	Moderate consequence - Localized and reversible damage to habitat / threatened species. Possible likelihood - strict controls in place.	Possible	Medium	Pest control to be undertaken by appropriately licensed and qualified practitioners. Annual monitoring; Annual pest fauna control rounds, or as required in response to monitoring or landholder observations. Pest control and monitoring to be reviewed annually. Adjustments implemented and documented.

Activity number	Activity & Sub Activity	Risk source/potential incidents	Sensitive receptor	Impact Description	Consequence	Justification	Likelihood	Risk Band	Proposed risk control
Norton 10; Boambee 8; xxxxx 6	Control of vertebrate pest fauna	Accidental poisoning of non-target species and secondary poisoning of predator species	Native fauna	Reduced native fauna populations. Poisoning of Spotted-tailed Quoll or other threatened fauna species	Major	Major consequence - Irreversible and localized damage to habitat / threatened species. Possible likelihood - strict controls in place.	Possible	High	Pest control to be undertaken by appropriately licensed and qualified practitioners. Annual monitoring; Annual pest fauna control rounds, or as required in response to monitoring or landholder observations. Use of species specific bait stations and/or baiting techniques and/or alternative methods than poisoning e.g. shooting, den ripping.

Activity number	Activity & Sub Activity	Risk source/potential incidents	Sensitive receptor	Impact Description	Consequence	Justification	Likelihood	Risk Band	Proposed risk control
Boambee 9	Wildfire suppression and fuel management	Out of control wildfire or high fuel loads increasing risk of fire	Native flora and fauna	Reduced native fauna and flora populations	Major	Major consequence - Extensive and reversible damage to habitat / threatened species. Possible likelihood - strict controls in place.	Possible	High	Review fuel management strategy if frequency or intensity of wildfires increases. Fuel management activities to be reviewed annually. Adjustments implemented and documented. Controls as specified in the regional Bush Fire Risk Management Plan. Liaison with RFS.
Boambee 11; xxxxx 7	General conservation, maintenance and monitoring	Potential reduction in threatened species flora habitat	Native vegetation, especially Slender Marsdenia and Cryptic Forest Twiner and other threatened plants	Disturbance to regrowth vegetation and threatened flora species through an ongoing presence on-site	Minor	Minor consequence - Localised and reversible damage to habitat / threatened species. Low likelihood - strict controls in place.	Unlikely	Low	Management activities and monitoring results to be reviewed annually. Adjustments implemented and documented.

Activity number	Activity & Sub Activity	Risk source/potential incidents	Sensitive receptor	Impact Description	Consequence	Justification	Likelihood	Risk Band	Proposed risk control
Boambee 12; xxxxx 9	Exclusion of timber harvesting and harmful activities	Timber harvesting, grazing, vehicle based camping, domestic animal access, hunting, apiary or uncontrolled public access	Remnant vegetation	Removal or degradation of native vegetation and habitat, including occupied habitat for threatened species.	Major	Major consequence - Extensive and reversible damage to habitat / threatened species. Rare likelihood - conservation covenant, monitoring and strict controls in place.	Rare	Medium	Immediate halting of timber harvesting, grazing or any other harmful activities if detected in the Flora Reserve or BioBanking site. Clear delineation of the Flora Reserve and BioBanking site via signs and mapping.
Norton 11; xxxxx 8; Boambee 10	Management of fire for conservation	Out of control wildfire or high fuel loads increasing risk of fire	Native flora and fauna	Degradation of native vegetation and habitat, including occupied habitat for threatened species. Mortality of fire-sensitive threatened plants.	Major	Major consequence - Extensive and reversible damage to habitat / threatened species. Possible likelihood - strict controls in place.	Possible	High	Meet the ecological fire requirements of vegetation at the site by maintaining a fire interval of greater than 7 years and less than 25 years. Avoid successive fires of intensity sufficient to scorch or consume dominant tree crown.

Activity number	Activity & Sub Activity	Risk source/potential incidents	Sensitive receptor	Impact Description	Consequence	Justification	Likelihood	Risk Band	Proposed risk control
Norton 12; xxxxx 9; Boambee 12	Exclusion of grazing and harmful activities	Grazing, vehicle based camping, domestic animal access, hunting, apiary or uncontrolled public access	Remnant vegetation and threatened flora species	Removal or degradation of native vegetation and habitat, including occupied habitat for threatened species.	Major	Major consequence - Extensive and reversible damage to habitat / threatened species. Rare likelihood - conservation covenant, monitoring and strict controls in place.	Rare	Medium	Exclusion of all grazing and other harmful activities. Immediate halting of grazing or any other harmful activities if detected in the Flora Reserve and biobank sites. Clear delineation of the Flora Reserve and biobank sites via signs, fences and gates.

10. Quality of offset

10.1 Overview

This section provides detail about the quality of the biodiversity offset that is being presented to compensate for the Project's impacts on the affected threatened species. The DSEWPaC (2012a) policy requires a formal assessment of impacts and offset contributions using the 'Offsets assessment guide'. The Offsets assessment guide utilises a balance sheet approach to measure impacts and offsets. According to the offsets policy (DSEWPaC 2012), controlled actions requiring offsets must achieve a minimum 90 per cent 'direct offset'. Direct offsets are defined as 'those actions that provide a measurable conservation gain for an impacted protected matter'. A conservation gain for the protected matter may be achieved by measures such as:

- Improving existing habitat.
- Creating new habitat.
- Reducing threats.
- Averting the loss of a protected matter or its habitat that is under threat.

The offset package will include:

- Conservation of around 34 hectares of known habitat for *Marsdenia longiloba* and *Tylophora woollsii* to offset the removal of 17.8 hectares of habitat.
- Conservation of around 234 hectares of known habitat for the Koala to offset the removal of 106.6 hectares of habitat.
- Conservation of around 234 hectares of likely habitat for the Grey-headed Flying-fox to offset the removal of 106.6 hectares of habitat.
- Conservation of around 234 hectares of likely habitat for the Spotted-tailed Quoll to offset the removal of 114.1 hectares of habitat.
- Conservation of around 5 hectares of known habitat for the Giant Barred Frog to offset the removal of 0.7 hectares of habitat and offsets for an additional 0.18 ha.

These direct offsets will be delivered through conservation of appropriate areas of habitat in the WC2NH Norton, Boambee SF and xxxxx offset areas. Offset assessment guide calculations that demonstrate how these direct offsets will comply with the EPBC Act offset policy are included in Section 10.4.

A preliminary set of Offset assessment guide calculations was included in the offset strategy for the Project based on known impacts and potential conservation and management of candidate offset sites (BEM, 2014). The Project impact inputs to the final Offset assessment guide calculations included in Section 10.4 have been taken from the offset strategy.

The desktop assessments, field surveys, habitat assessments and management action plans presented in Sections 3 to 8 have been used to compile the data for the offset site component of the Offset assessment guide calculations. The following sections describe how a conservation gain for the affected threatened species will be achieved through the measures proposed and how this direct offset will be delivered in accordance with the policy.

10.2 Contribution of the conservation mechanism to the offset

The proposed conservation mechanism will achieve a conservation gain for the affected threatened species through the following measures specified in the policy:

- Reducing threats.
- Averting the loss of a protected matter or its habitat that is under threat (DSEWPaC 2012).

10.2.1 Norton Offset Site

The Norton site is currently unoccupied. Previous land uses include timber harvesting, low intensity grazing and stockpiling of timber, rubbish and fill. Adjacent land uses include a quarry and cleared land proposed for service centres, warehousing and light industrial land. Continuation of recent land uses and currently permissible activities such as grazing will result in deterioration in the quality of habitat at the site and the viability of fauna populations. Based on direct observations of recent and planned development in the near vicinity of the site there will also be a genuine risk of more intense land uses such as a quarry expansion, intensive agriculture, private forestry or industrial development over the 20 year 'risk related time horizon' nominated in the offset calculations. A 20% risk of loss without the offset site conservation mechanism in place has been entered in the Offset assessment guide calculations.

Long-term management and conservation of the property under an in-perpetuity conservation covenant will substantially reduce the risk to the affected threatened species and their habitat. The Norton site will be protected under a conservation covenant (see Section 6.1) that is highly unlikely to be overturned to permit damaging activities. A 3% residual risk of loss with the offset site conservation mechanism in place has been entered in the Offset assessment guide calculations. Protection of the WC2NH Norton offset area will see 185 hectares of habitat for the affected threatened species conserved which will otherwise be under threat of development in the next 20 years.

10.2.2 Boambee SF Offset Site

The WC2NH Boambee SF offset area is part of the Boambee SF and is under the management of FCNSW. Forest Management Zoning (FMZ) is a land classification system that sets out in a map format the way that FCNSW intends to manage forests across the State forests estate. The FMZ system clearly sets aside those areas that area set aside for conservation and those areas that are available for other activities, including timber harvesting (State Forests NSW 2000).

The majority of the WC2NH Boambee SF offset area is currently within FMZ 4 'General Management' and is available for timber harvesting and other activities (State Forests NSW 2000) that are likely to harm the affected threatened species and/or reduce the quality of habitat. The Boambee SF offset site contains high quality Blackbutt regrowth with considerable timber value (Williams J., FCNSW pers. comm.) and will be likely to be harvested within the 20 year 'risk related time horizon' nominated in the offset calculations.

Timber harvesting is likely to have a significant impact on populations of the affected threatened species and result in the long-term loss of occupied habitat for *Tylophora woollsii, Marsdenia longiloba*, the Koala, the Grey-headed Flying-fox and the Spotted-tailed Quoll. This conclusion is supported by:

- The inclusion of timber harvesting as a threat in the listing advice and recovery plans for the affected threatened flora (DECC 2005a; 2005b; Threatened Species Scientific Committee 2008a, 2008b) and the absence of these species from recently harvested State forests that were surveyed as candidate offset sites (GHD, 2016b). Timber

harvesting will directly harm individual plants and create an open, sunny microclimate that will not be suitable habitat.

- Food tree species for the Koala and the Grey-headed Flying Fox will be directly targeted by timber harvesting and the amount of foraging resources available will be significantly reduced. Timber harvesting may also harm or displace individual animals
- The recovery plan for the Spotted-tailed Quoll, which notes that the species has a limited ability to recolonise fragmented patches of habitat; many prey species rely on hollows for shelter and breeding and are limited by timber harvesting or other practices that reduce these resources. Quoll populations are limited to large, relatively intact patches of forest and are significantly prone to threatening processes that reduce, degrade and fragment such habitat (Long and Nelson, 2009). Timber harvesting will directly harm or displace individual quolls and prey species and create an open, immature forest structure that will not be suitable habitat.

The habitat affected by timber harvesting will not be permanently removed, however the key habitat resources that are important to populations of the affected threatened species will not regenerate within the 'Risk related time horizon' included in the calculations (20 years).

This scenario supports the 80% 'risk of loss' value that is included in the Offset assessment guide calculations for *Tylophora woollsii, Marsdenia longiloba*, the Koala, the Grey-headed Flying-fox and the Spotted-tailed Quoll.

The offset site will be changed to FMZ 1 'Special Protection' and protected as a Flora Reserve. Timber harvesting and other potentially damaging activities will be excluded. The land that is dedicated as a Flora Reserve will not be limited to exclude any land lying below the surface of the land pursuant to Section 16 (2) of the Forestry Act (i.e. mining will be prohibited within or below the Flora Reserve). This conservation mechanism is highly unlikely to be overturned to permit damaging activities; subject to the Forestry Act, a Flora Reserve cannot be revoked wholly or in part otherwise than by an Act of Parliament. This has been the case where several Flora Reserves previously declared in State forest are now within National Parks due to the surrounding forest being included in the National Park Estate.

There are currently 72 Flora Reserves declared on State forest in NSW. Areas within these zones are designed to meet the requirements of JANIS dedicated (formal) reserves in the National Forest Policy Statement and as such are equivalent to IUCN- Protected rea categories I, II, III or IV. The NSW OEH recognises that as a conservation mechanism, Flora Reserves offer a similar level of security and protection to biodiversity as National Parks and Nature Reserves (OEH, 2011).

The Flora Reserve that will encompass the Boambee SF offset site will be delimited by hard boundaries such as roads, drainage lines, fences and the State forest boundary will be readily identified and avoided in the planning and harvesting processes. FCNSW files have no records of a Flora Reserve being breached by any harvesting operations or management activities.

Gazettal of a Flora Reserve containing the WC2NH Boambee SF offset area will see 49 hectares of occupied habitat for the affected threatened species conserved which will otherwise be under threat of timber harvesting. A 3% residual risk of loss with the offset site conservation mechanism in place has been entered in the Offset assessment guide calculations.

10.2.3 xxxxx Offset Site

The xxxxx offset site is currently an occupied rural residential property that is subject to cattle and sheep grazing. Evidence of grazing as well as previous timber harvesting, track construction and partial clearing was noted during field surveys. Adjacent land uses include grazing and banana and blueberry plantations. Continuation of recent land uses and currently

permissible activities such as grazing will result in deterioration in the quality of habitat at the site and the viability of the Giant Barred Frog population. Based on direct observations of recent and planned development in the near vicinity of the site there will also be a genuine risk of more intense land uses. Permitted activities include clearing of vegetation for more intensive agricultural activities such as blueberry cultivation that would be economic and have been considered by the landowner (xxxxx. pers. comm.). In addition to the direct risk of removal of habitat upstream clearing, changes in water flow regimes and degradation of water quality are identified as threats to the Giant Barred Frog in the recovery plan for stream breeding frogs (Hines et al. 2002). A 20% risk of loss without the offset site conservation mechanism in place has been entered in the Offset assessment guide calculations.

The WC2NH xxxxx offset area will be protected and managed in perpetuity under an in-perpetuity conservation covenant (a BioBanking agreement). A BioBanking agreement is a secure conservation covenant that is supported by NSW legislation and OEH monitoring and enforcement and is highly unlikely to ever be overturned to permit grazing, clearing of vegetation for blueberry cultivation or other damaging activities. A 3% residual risk of loss with the offset site conservation mechanism in place has been entered in the Offset assessment guide calculations. Protection of the WC2NH xxxxx offset area will see five hectares of Giant Barred Frog habitat within an overall offset site of 97.4 hectares conserved which would otherwise be under threat of development in the next 20 years.

10.3 Contribution of management actions to the offset

The offset sites will be managed in perpetuity for biodiversity conservation and to protect the affected threatened species and their habitats. Specific management actions have been proposed that will improve the extent or quality of habitat for the affected threatened species and/or reduce threats. The field surveys and desktop assessments described above have confirmed that the offset sites contain habitat in moderate to good condition with some impacts from historical clearing, current land uses, weed infestation and edge effects. Current and potential threats to threatened fauna at the offset sites include pest fauna and degradation of habitat. These degrading factors and threats are likely to continue and in the case of edge effects, weed infestation and impacts of pest fauna will intensify without active management in the short term. The proposed management actions will help avoid a decrease in the current habitat quality at the offset sites and achieve a future increase in habitat quality. The specific relationships between proposed management actions, the type of conservation gain according to the policy (DSEWPaC 2012) and the likely effect on populations and/or habitat for the affected threatened species are presented in Table 28 and Table 30. These summary tables also state how current site quality and the predicted change were determined in this offset package and how the effectiveness of management actions will be monitored.

Condition of approval f) iii. states that “offset management must be consistent with threat abatement plans for threatened species”.

Table 29 and Table 31 to Table 34 include a summary of the threat abatement and recovery actions identified by DoEE for the affected threatened biota and how they have been addressed in specific management actions at each of the offset sites. This confirms that species-specific management actions will be implemented for each of the affected threatened biota (noting that the majority of the threat abatement and recovery actions identified by DoEE apply to conservation and management activities of Government agencies and not specific actions that could be undertaken at offset sites).

The summary of the likely benefits of management actions presented in this section supports the habitat quality calculations that were included in the Offset assessment guide calculations.

Further justification of the values that were entered for individual species is provided in Table 35 to Table 39.

Table 28 Contribution of proposed management actions to the conservation of the affected threatened plants

Management action	Type of conservation gain (DSEWPaC 2012)	Effect on *Marsdenia longiloba* and *Tylophora woollsii* habitat	Effect on *Marsdenia longiloba* and *Tylophora woollsii* populations	How surveyed / quantified in this offset package	How monitored
Property maintenance (establishment and maintenance of appropriate fences, gates and signs, removal of rubbish, maintenance of tracks).	Improving existing habitat. Reducing threats.	Maintenance and improvement of habitat. Facilitation of other management strategies. Reduced risk of impacts from inappropriate public access, rubbish dumping or grazing.	Reduced risk of harm to individual plants. In the longer term, potential increase in the extent or abundance of plants through facilitation of other management strategies.	General observations confirmed the presence of threats and of degraded habitat with scope for improvement.	Annual management actions and habitat monitoring and reporting.
Retention of regrowth and remnant native vegetation.	Improving existing habitat. Creating new habitat.	Maintenance and improvement of habitat. Potential increase in the area of habitat through succession of some dry sclerophyll forest vegetation in suitable landscape positions towards climax wet sclerophyll forest or rainforest communities.	Reduced risk of harm to individual plants. In the longer term, potential increase in the extent or abundance of plants.	Plot/transects and canopy plots confirmed the presence and quality of habitat resources for the affected threatened species.	Annual habitat monitoring and reporting, including photo points and sampling of selected plot/transects and canopy plots.
Regeneration of cleared or low condition vegetation.	Creating new habitat.	Improved quality and viability of retained habitat through reduced edge effects. In the longer term, increased extent of habitat.	In the longer term, potential increase in the extent or abundance of plants.	Mapping of cleared or degraded habitat with scope for improvement.	Annual habitat monitoring and reporting, including photo points and sampling of selected plot/transects and canopy plots.
Fire management (exclusion of fire from occupied habitat, fuel reduction in adjoining vegetation).	Improving existing habitat. Reducing threats.	Maintenance of natural vegetation structure and microclimate in occupied habitat (i.e. fire sensitive wet sclerophyll forest and rainforest). In the longer term, potential increase in the extent of habitat through succession towards climax rainforest communities.	Reduced risk of harm to individual plants. In the longer term, potential increase in the extent or abundance of plants.	Assessment and mapping of occupied threatened plant habitat. Desktop assessment confirmed that exclusion of fire necessary to maintain populations and habitat.	Annual management actions and habitat monitoring and reporting.

Management action	Type of conservation gain (DSEWPaC 2012)	Effect on *Marsdenia longiloba* and *Tylophora woollsii* habitat	Effect on *Marsdenia longiloba* and *Tylophora woollsii* populations	How surveyed / quantified in this offset package	How monitored
Weed control, especially control of Lantana.	Improving existing habitat. Reducing threats.	Maintenance and improvement in the quality of habitat by increasing the extent, health and productivity of native vegetation and restoring natural vegetation structure and microclimate.	Reduced competition for space, light, nutrients and water. Likely increase in the extent or abundance of plants.	Mapping of weed infestations.	Annual weed monitoring and reporting.
Exclusion of timber harvesting.	Reducing threats. Averted risk of loss.	Averted risk of loss of habitat. Improved health and productivity of native vegetation and restoration of natural vegetation structure and microclimate. Reduced risk of secondary impacts such as erosion and sedimentation and transmission of weeds or disease.	Averted risk of harm to individual plants. Likely increase in the extent or abundance of plants.	Observation of previous timber harvesting at the site. Consultation with FCNSW and review of plans to confirm current Forest Management Zoning and likelihood of timber harvesting.	Annual management actions and habitat monitoring and reporting.
Exclusion of domestic grazing and management of human disturbance.	Improving existing habitat. Reducing threats.	Improved health and productivity of native vegetation. Reduced risk of secondary impacts such as erosion and sedimentation and transmission of weeds or disease.	Reduced risk of harm to individual plants through herbivory or stock trampling. Likely increase in the extent or abundance of plants.	Observation of human activities at the site and surrounding land including presence of domestic livestock.	Annual management actions and habitat monitoring and reporting.
Control of pest fauna (deer, rabbits, pigs, feral cattle).	Improving existing habitat. Reducing threats.	Improved health and productivity of native vegetation. Reduced risk of secondary impacts such as erosion and sedimentation and transmission of weeds or disease.	Reduced risk of harm to individual plants through herbivory or trampling. Likely increase in the extent or abundance of plants.	Targeted fauna surveys. Desktop assessment.	Management actions monitoring and reporting.

Table 29 Consistency of proposed management actions with threat abatement and recovery of the affected threatened plants

Threat abatement (DECC, 2005a, 2005b; Threatened Species Scientific Committee, 2008a, DotE, 2015).	Management action at Boambee SF offset site
Monitoring known populations to identify key threats.	Targeted threatened flora population monitoring and documentation of any additional weed control rounds or other corrective actions that are recommended to respond to observed threats to the threatened plant populations (see Section 7.3).
Monitoring the progress of recovery, including the effectiveness of management actions and the need to adapt them if necessary.	11 - General conservation, maintenance and monitoring. Also, monitoring of all management actions against performance targets and implementation of corrective actions.
Ensuring road-widening, maintenance and forestry activities involving substrate or vegetation disturbance in areas where *Tylophora woollsii* or *Marsdenia longiloba* occurs do not adversely impact on known populations.	Exclusion of timber harvesting and other harmful activities when the site is set aside as a Flora Reserve to ensure maintenance of populations.
Avoid damaging wildfires or inappropriate fire regimes by developing and implementing a suitable fire management strategy; and providing maps of known occurrences to local and state Rural Fire Services and seeking inclusion of mitigation measures in bush fire risk management plan(s), risk register and/or operation maps.	9 – Wildfire suppression (exclusion of fire from occupied habitat). 10 – Fuel management (fuel reduction in adjoining vegetation). Incorporation of mapping of threatened plant populations and occupied habitat in fire planning. Exclusion of APZ/SFAZs from occupied habitat.
Avoid livestock impacts such as trampling, browsing or grazing.	8 - Pest fauna control (deer, rabbits, pigs, feral cattle). Also, exclusion of grazing and conservation of the offset site under the Flora Reserve to ensure maintenance of habitat.
Manage invasive weeds by developing and implementing a management plan for the control of invasive weeds in the region.	5 - Treatment of noxious weeds. 6 - Targeted threatened plant monitoring and bush regeneration of occupied habitat. This activity will be coordinated with the monitoring program outlined in Section 7.3. 7 - Broad scale weed monitoring and bush regeneration.

Threat abatement (DECC, 2005a, 2005b; Threatened Species Scientific Committee, 2008a, DotE, 2015).	Management action at Boambee SF offset site
Integrating weed control works on public lands into regional works programs, as appropriate. Ensuring chemicals or other mechanisms used to eradicate weeds do not have a significant adverse impact on the species	5 - Treatment of noxious weeds. No weed spraying undertaken in the vicinity (5 m radius) of identified stems of *Marsdenia longiloba* and *Tylophora woollsii.* 6 - Targeted threatened plant monitoring and bush regeneration of occupied habitat. Targeted treatment of weeds in the immediate vicinity (2 m radius) of identified stems of *Marsdenia longiloba* and *Tylophora woollsii.* Hand weeding or targeted herbicide application (cut and paint, stem scrape etc.) only. This activity will be coordinated with the monitoring program outlined in Section 7.3.

Table 30 Contribution of proposed management action to the conservation of the affected threatened fauna species

Management action	Type of conservation gain (DSEWPaC 2012)	Effect on populations and/or habitat for the affected threatened species	How surveyed / quantified in this offset package	How monitored
Retention of regrowth and remnant native vegetation.	Improving existing habitat. Creating new habitat.	Maintenance and improvement of shelter and foraging habitat. Regeneration and maturation of food tree species.	Plot/transects and canopy plots confirmed the presence and quality of habitat resources for the affected threatened species.	Annual habitat monitoring and reporting, including photo points and sampling of selected plot/transects and canopy plots.
Property maintenance (rubbish and fence strand removal, bush fire hazard management etc).	Improving existing habitat. Reducing threats.	Increased quality of shelter and foraging habitat. Reduced risk of injury from fences. Reduced risk and energy costs of movement between patches of habitat. Reduced risk of wildfire, erosion etc having an impact on the quality of habitat.	General observations confirmed the presence of threats and of degraded habitat with scope for improvement.	Annual management actions and habitat monitoring and reporting.

Management action	Type of conservation gain (DSEWPaC 2012)	Effect on populations and/or habitat for the affected threatened species	How surveyed / quantified in this offset package	How monitored
Regeneration of cleared land and low condition vegetation.	Creating new habitat.	Increased extent of shelter and foraging habitat. Improved connectivity of habitat. Regeneration and maturation of food tree species. Reduced risk and energy costs of movement between patches of habitat. Improved quality and viability of retained habitat through reduced edge effects.	Plot/transects and canopy plots confirmed the presence of degraded habitat with scope for improvement.	Annual habitat monitoring and reporting, including photo points and sampling of selected plot/transects and canopy plots.
Exclusion of timber harvesting.	Reducing threats. Averted risk of loss.	Averted risk of loss of habitat. Improved health and productivity of native vegetation and maintenance of natural vegetation structure and habitat resources. Reduced risk of secondary impacts such as erosion and sedimentation and transmission of weeds or disease.	Averted risk of harm to individual animals. Likely increase in the extent or abundance of populations.	Observation of previous timber harvesting at the site. Consultation with FCNSW and review of plans to confirm current Forest Management Zoning and likelihood of timber harvesting.
Weed control.	Improving existing habitat.	Maintenance and improvement in quality of foraging resources by increasing the extent, health and productivity of native vegetation containing food tree species.	Plot/transects and mapping of major weed infestations confirmed the presence of degraded habitat with scope for improvement.	Annual weed monitoring and reporting.
Exclusion of domestic grazing and management of human disturbance.	Improving existing habitat. Reducing threats. Averting the loss of a protected matter or its habitat that is under threat.	Maintenance and improvement in quality of foraging resources by increasing the health and productivity of native vegetation containing food tree species. Reduced risk, energy cost and/or stress of interactions with humans, pets or livestock.	General observations confirmed the presence of threats and of degraded habitat with scope for improvement.	Annual management actions and habitat monitoring and reporting.

Management action	Type of conservation gain (DSEWPaC 2012)	Effect on populations and/or habitat for the affected threatened species	How surveyed / quantified in this offset package	How monitored
Control of pest fauna.	Improving existing habitat. Reducing threats.	Reduced risk, energy cost and/or stress of interactions with feral dogs. Reduced risk of predation by feral carnivores and reduced risk of habitat degradation by feral herbivores. Maintenance and improvement in quality of foraging resources by reducing impacts of feral herbivores on surface soil and on native vegetation containing food tree species.	Spotlighting and camera traps confirmed the presence of feral dog populations at the Norton offset site. Dogs and feral herbivores are likely to be present at both sites and affect the threatened species through predation, competition and/or degradation of habitat.	Management actions monitoring and reporting.

Table 31 Consistency of proposed management actions with threat abatement and recovery of the Koala

Threat abatement action (TSCC 2012)	Norton offset site management actions	Boambee SF offset site management actions	xxxxx offset site management actions
Develop and implement a development planning protocol to be used in areas of Koala sub-populations or sub-population fragments to prevent loss of Koala sub-populations, habitat critical to the survival of the species and vital habitat connectivity.	Not applicable to this offset package.	Not applicable to this offset package.	Not applicable to this offset package.
Development plans should explicitly address ways to mitigate risk of vehicle strike when development occurs adjacent to, or within, Koala habitat.	Not applicable to this offset package. The risk of vehicle strike will be reduced through exclusion of harmful activities and restriction of access to the offset site.	Not applicable to this offset package. The risk of vehicle strike will be reduced through exclusion of timber harvesting and restriction of access to the offset site.	Not applicable to this offset package. The risk of vehicle strike will be reduced through exclusion of harmful activities and restriction of access to the offset site.
Develop and implement a management plan to control the adverse impacts of predation on Koalas by dogs in urban, peri-urban and rural environments.	10 - Pest fauna control	8 - Pest fauna control	6 - Pest fauna control

Threat abatement action (TSCC 2012)	Norton offset site management actions	Boambee SF offset site management actions	xxxxx offset site management actions
Monitor the progress of recovery, including the effectiveness of management actions and the need to adapt them, if necessary.	Monitoring in accordance with the MAP for the biobank site and the specific monitoring requirements outlined in Section 6.3. Also, monitoring of all management actions against performance targets and implementation of corrective actions.	11 - General conservation, maintenance and monitoring. Also, monitoring of all management actions against performance targets and implementation of corrective actions.	Monitoring in accordance with the MAP for the biobank site and the specific monitoring requirements outlined in Section 8.36.3. Also, monitoring of all management actions against performance targets and implementation of corrective actions.
Identify populations of high conservation priority.	Not applicable to this offset package.	Not applicable to this offset package.	Not applicable to this offset package.
Develop and implement options of vegetation recovery and re-connection in regions containing fragmented Koala populations, including inland regions in which Koala populations were diminished by drought and coastal regions where development pressures have isolated Koala populations.	7 - Treatment of woody weeds 8 - Treatment of exotic grasses and herbaceous weeds 9 - Broad scale weed monitoring and bush regeneration. 12 - Exclusion of grazing and harmful activities. Also, conservation of the offset site under a secure covenant to ensure maintenance of habitat.	7 - Broad scale weed monitoring and bush regeneration. Also, exclusion of timber harvesting and conservation of the offset site under a secure covenant to ensure maintenance of habitat.	4 - Treatment of noxious weeds 5 - Broad scale weed monitoring and bush regeneration. 9 - Exclusion of grazing and harmful activities. Also, conservation of the offset site under a secure covenant to ensure maintenance of habitat.
Investigate formal conservation arrangements, management agreements and covenants on private land, and, for both Crown and private land, investigate and/or secure inclusion of habitat critical to the survival of the Koala in reserve tenure, if possible.	A secure conservation covenant will be obtained over the offset site when it is set aside under a BioBanking agreement.	A secure conservation covenant will be obtained over the offset site when it is set aside as a Flora Reserve.	A secure conservation covenant will be obtained over the offset site when it is set aside under a BioBanking agreement.
Engage with private landholders and land managers responsible for the land on which populations occur and encourage these key stakeholders to contribute to the implementation of conservation management actions.	The private landowner will contribute to the implementation of conservation management actions through the implementation of this offset package and the BioBanking agreement.	FCNSW will contribute to the implementation of conservation management actions through the implementation of this offset package.	The private landowner will contribute to the implementation of conservation management actions through the implementation of this offset package and the BioBanking agreement.

Threat abatement action (TSCC 2012)	Norton offset site management actions	Boambee SF offset site management actions	xxxxx offset site management actions
Manage any other known, potential or emerging threats such as Bell Miner (*Manorina melanophrys*) Associated Dieback or Eucalyptus rust.	Monitoring in accordance with the MAP for the biobank site and the specific monitoring requirements outlined in Section 6.3. Potential or emerging threats would be detected by monitoring and managed accordingly.	11 - General conservation, maintenance and monitoring. Also, monitoring of all management actions against performance targets and implementation of corrective actions. Potential or emerging threats would be detected by monitoring and managed accordingly.	Monitoring in accordance with the MAP for the biobank site and the specific monitoring requirements outlined in Section 8.3. Potential or emerging threats would be detected by monitoring and managed accordingly.

Table 32 Consistency of proposed management actions with threat abatement and recovery of the Grey-headed Flying-fox

Threat abatement action	Norton offset site management actions	Boambee SF offset site management actions	xxxxx offset site management actions
The action plan for Australian bats (Duncan et al. 1999)			
Recovery objectives	Not applicable to this offset package.	Not applicable to this offset package.	Not applicable to this offset package.
Management and research actions required…	Not applicable to this offset package.	Not applicable to this offset package.	Not applicable to this offset package.
Seek funding from orchard industry and relevant government agencies to develop practical and cost effective non-destructive methods for on-crop control. Suggested scope of research could include…	Not applicable to this offset package.	Not applicable to this offset package.	Not applicable to this offset package.
Facilitate protection of existing camp sites and foraging habitat on private land. Considerations could include:	A secure conservation covenant will be obtained over foraging habitat at the offset site when it is set aside under a BioBanking agreement.	A secure conservation covenant will be obtained over foraging habitat at the offset site when it is set aside as a Flora Reserve.	A secure conservation covenant will be obtained over foraging habitat at the offset site when it is set aside under a BioBanking agreement.
identification of where camps occur and what land tenure exists at these sites	Not applicable to this offset package.	Not applicable to this offset package.	Not applicable to this offset package.

Threat abatement action	Norton offset site management actions	Boambee SF offset site management actions	xxxxx offset site management actions
development of conservation agreements with landowners	Conservation of the offset site under a secure covenant to ensure maintenance of habitat.	Conservation of the offset site under a secure covenant to ensure maintenance of habitat.	Conservation of the offset site under a secure covenant to ensure maintenance of habitat.
identification of alternative camp sites and encouragement of relocation to these sites, where necessary, in problem situations.	Not applicable to this offset package.	Not applicable to this offset package.	Not applicable to this offset package.
Draft National Recovery Plan for the Grey-headed Flying-fox *Pteropus poliocephalus* (DECCW, 2010)			
Action 1: Identify and protect foraging habitat critical to the survival of Grey-headed Flying-foxes across their range.	7 - Treatment of woody weeds 8 - Treatment of exotic grasses and herbaceous weeds 9 - Broad scale weed monitoring and bush regeneration. 12 - Exclusion of grazing and harmful activities. Also, conservation of the offset site under a secure covenant to ensure maintenance of habitat.	7 - Broad scale weed monitoring and bush regeneration. Also, exclusion of timber harvesting and conservation of the offset site under a secure covenant to ensure maintenance of habitat.	4 - Treatment of noxious weeds 5 - Broad scale weed monitoring and bush regeneration. 9 - Exclusion of grazing and harmful activities. Also, conservation of the offset site under a secure covenant to ensure maintenance of habitat.
Action 2: Enhance winter and spring foraging habitat for Grey-headed Flying-foxes.	7 - Treatment of woody weeds 8 - Treatment of exotic grasses and herbaceous weeds 9 - Broad scale weed monitoring and bush regeneration. 12 - Exclusion of grazing and harmful activities. Also, conservation of the offset site under a secure covenant to ensure maintenance of habitat.	7 - Broad scale weed monitoring and bush regeneration. Also, exclusion of timber harvesting and conservation of the offset site under a secure covenant to ensure maintenance of habitat.	4 - Treatment of noxious weeds 5 - Broad scale weed monitoring and bush regeneration. 9 - Exclusion of grazing and harmful activities. Also, conservation of the offset site under a secure covenant to ensure maintenance of habitat.

Threat abatement action	Norton offset site management actions	Boambee SF offset site management actions	xxxxx offset site management actions
Action 7: Monitor population trends for the Grey-headed Flying-fox	Monitoring in accordance with the MAP for the biobank site and the specific monitoring requirements outlined in Section 6.3. Potential or emerging threats would be detected by monitoring and managed accordingly.	11 - General conservation, maintenance and monitoring. Also, monitoring of all management actions against performance targets and implementation of corrective actions. Potential or emerging threats would be detected by monitoring and managed accordingly.	Monitoring in accordance with the MAP for the biobank site and the specific monitoring requirements outlined in Section 8.3. Potential or emerging threats would be detected by monitoring and managed accordingly.

Table 33 Consistency of proposed management actions with threat abatement and recovery of the Spotted-tailed Quoll

Threat abatement action	Norton offset site management actions	Boambee SF offset site management actions	xxxxx offset site management actions
Species profile and threats database (DotE, 2015)			
1080 baiting – reduce potential for impacts on quoll populations.	10 - Pest fauna control Pest fauna control will be undertaken using soft-jaw trapping and shooting undertaken by appropriately licensed and qualified staff.	8 - Pest fauna control Pest fauna control will be undertaken using soft-jaw trapping undertaken by appropriately licensed and qualified staff where possible. Any baiting undertaken will be conducted according to best practice standards. If quolls are monitored near baiting sites, baiting will be ceased.	6 - Pest fauna control Pest fauna control will be undertaken using soft-jaw trapping and shooting undertaken by appropriately licensed and qualified staff.
Habitat Management…rather than a reliance on public reserves, appropriate management and conservation is necessary for the south-east mainland population at a landscape-level.	A secure conservation covenant will be obtained over habitat at the offset site when it is set aside under a BioBanking agreement.	A secure conservation covenant will be obtained over habitat at the offset site when it is set aside as a Flora Reserve.	A secure conservation covenant will be obtained over habitat at the offset site when it is set aside under a BioBanking agreement.
Recovery Plan for the Spotted-tailed Quoll (Long and Nelson, 2009)			
Action 3.1 Target landholders in areas where Spotted-tailed Quolls are known to occur to protect and manage their land in a manner that is compatible with maintenance of Spotted-tailed Quoll habitat, through voluntary conservation agreements.	As above, a secure conservation covenant will be obtained over habitat at the offset site.	As above, a secure conservation covenant will be obtained over habitat at the offset site.	As above, a secure conservation covenant will be obtained over habitat at the offset site.

Threat abatement action	Norton offset site management actions	Boambee SF offset site management actions	xxxxx offset site management actions
Action 3.2 Maintain and restore habitat corridors on unprotected freehold land.	7 - Treatment of woody weeds 8 - Treatment of exotic grasses and herbaceous weeds 9 - Broad scale weed monitoring and bush regeneration. 12 - Exclusion of grazing and harmful activities. Also, conservation of the offset site under a secure covenant to ensure maintenance of habitat.	7 - Broad scale weed monitoring and bush regeneration. Also, exclusion of timber harvesting and conservation of the offset site under a secure covenant to ensure maintenance of habitat.	4 - Treatment of noxious weeds 5 - Broad scale weed monitoring and bush regeneration. 9 - Exclusion of grazing and harmful activities. Also, conservation of the offset site under a secure covenant to ensure maintenance of habitat.
Action 5.5 Investigate alternative livestock protection methods that have fewer impacts on non-target species.	10 - Pest fauna control Pest fauna control will be undertaken using soft-jaw trapping and shooting undertaken by appropriately licensed and qualified staff.	8 - Pest fauna control Pest fauna control will be undertaken using soft-jaw trapping undertaken by appropriately licensed and qualified staff where possible. Any baiting undertaken will be conducted according to best practice standards. If quolls are monitored near baiting sites, baiting will be ceased.	6 - Pest fauna control Pest fauna control will be undertaken using soft-jaw trapping and shooting undertaken by appropriately licensed and qualified staff.

Table 34 Consistency of proposed management actions with threat abatement and recovery of the Giant Barred Frog

Threat abatement action	xxxxx offset site management actions
Species profile and threats database (DotE, 2015)	
Revegetation should favour species that rapidly provide canopy cover and the use of dense groundcover species should be minimised.	No revegetation is proposed at the xxxxx offset site. The offset site contains only occupied Giant Barred Frog habitat in intact forest.
Recovery plan for Stream Frogs of South-east Queensland 2001–2005 (Hynes et. al., 2002)	
Action 2. Monitor populations.	Monitoring in accordance with the MAP for the biobank site and the specific monitoring requirements outlined in Section 8.36.3. Also, monitoring of all management actions against performance targets and implementation of corrective actions.

Threat abatement action	xxxxx offset site management actions
Action 4. Protect populations and manage habitat.	4 - Treatment of noxious weeds 5 - Broad scale weed monitoring and bush regeneration. 9 - Exclusion of grazing and harmful activities. Also, conservation of the offset site under a secure covenant to ensure maintenance of habitat.
Action 4.2. Control feral pigs.	6 - Pest fauna control Pest fauna control will be undertaken using soft-jaw trapping and shooting undertaken by appropriately licensed and qualified staff.

10.4 Offset assessment guide calculations

These direct offsets will be delivered through conservation of appropriate areas of habitat in the WC2NH Norton, Boambee SF and xxxxx offset areas. Offset assessment guide calculations that demonstrate how these direct offsets will comply with the EPBC Act offset policy have been performed and are summarised in Table 35 to Table 39 along with a summary of the justification for each of the attribute values entered. Separate sets of calculations were performed for the WC2NH Norton, Boambee SF and xxxxx offset areas based on the specific habitat types, conditions, proposed management actions and titling arrangements at each site.

Table 35 Attribute values entered in the Offset assessment guide calculations for *Marsdenia longiloba* and *Tylophora woollsii*

Offset assessment guide attribute	Boambee SF offset area	Justification
Impact Calculator - Quantum of impact - Area	17.8 hectares	The limitation on the area of removal of occupied habitat for the threatened plants under the EPBC Approval for the Project (EPBC 2013/7101) as documented in the approved offset strategy (BEM, 2014).
Impact Calculator - Quantum of impact – Quality	6/10	The quality of the habitat impacted as documented in the approved offset strategy (BEM, 2014).
Offset calculator – Time horizon –Risk related time horizon	20 years	The WC2NH Boambee SF offset area will be protected and managed in perpetuity as a Flora Reserve. 20 years is the maximum timeframe for averting loss in the guide.
Offset calculator – Time horizon – Time until ecological benefit	5 years	The WC2NH Boambee SF offset area contains native vegetation in moderate to good condition that will be managed through exclusion of timber harvesting, treatment of severe noxious weed infestations in the first five years and ongoing bush regeneration and treatment of pest fauna. Ecological benefits will be achieved in the short term, nominally five years. Conversely, a tangible reduction in the quality of habitat through timber harvesting, increased weed infestation and edge effects, human impacts or fire is likely within five years.
Offset calculator -Future area and quality without offset – Risk of loss without offset	80 %	The majority of the WC2NH Boambee SF offset area is currently within FMZ 4 ‘General Management’ and is available for timber harvesting and other activities that are likely to harm the affected threatened plants and/or reduce the quality of habitat. The offset area contains high quality regrowth with considerable timber value (Williams J., FCNSW pers. comm.) and would be likely to be harvested in the short to medium term.

Offset assessment guide attribute	Boambee SF offset area	Justification
Offset calculator -Future area and quality with offset – Risk of loss with offset	3 %	The WC2NH Boambee SF offset area will be protected and managed in perpetuity as a Flora Reserve. The Flora Reserve that will encompass the Boambee SF offset site will be delimited by hard boundaries such as roads, drainage lines, fences and the State forest boundary and as such will be readily identified and avoided in the planning and harvesting processes. FCNSW files include no records of a Flora Reserve being breached by any harvesting operations or management activities. The NSW OEH recognises that as a conservation mechanism, Flora Reserves offer a similar level of security and protection to biodiversity as National Parks and Nature Reserves (OEH, 2011).
Confidence in result – averted loss of offset	95 %	A Flora Reserve is one of the strongest conservation covenants available in NSW and will be supported by implementation of the Forestry Management Zoning system and a reserve specific works plan to exclude harmful activities (see Section 7.1 and 10.2.2).
Offset calculator – Start area and quality – Area	34 hectares	The 34 hectares of occupied habitat within the WC2NH offset area that is included in offset calculations is mapped on Figure 7. The area of habitat at the WC2NH Boambee SF offset area was confirmed through detailed field surveys, including targeted searches for threatened plants and mapping of vegetation type and condition (see Section 4.4.1). Occupied and potential habitat was mapped in consultation with Dr Benwell (a known specialist) and based on observed threatened plant locations, vegetation type and topographic position (see Section 4.5.1).
Offset calculator – Start area and quality – Start quality	7/10	The offset site contains occupied habitat, as part of a large patch of vegetation that is in good condition with some impacts from timber harvesting, weed infestation and edge effects. The quality of habitat is supported by the number of individuals of the threatened plants observed and condition of vegetation and habitat as confirmed by BioBanking plot/transect data included in Appendix A.
Offset calculator -Future area and quality without offset – Future quality without offset (1-10)	7/10	Habitat in the WC2NH Boambee SF offset area will continue to deteriorate through impacts from weed infestation, edge effects, pest fauna, inappropriate fire regimes etc. if not set aside for conservation. These impacts will probably not be sufficient to drop site quality an entire point. These incremental impacts are distinct from the removal of habitat associated with a timber harvesting event at the WC2NH offset area, which is assessed under 'risk of loss of offset'.
Offset calculator -Future area and quality with offset – Future quality with offset (1-10)	8/10	Habitat in the WC2NH Boambee SF offset area will be managed as described in Section 7. A tangible improvement in the quality of habitat and viability of plant populations will be achieved as described in Table 28.

Offset assessment guide attribute	Boambee SF offset area	Justification
Confidence in result – change in quality	75 %	A modest increase in site quality is predicted. The link between the predicted improvement in the quality of habitat and viability of fauna populations through management actions is described in Table 28. The site will be managed under a plan that includes performance criteria and corrective actions to help ensure that targets are achieved. A risk assessment has been performed which demonstrates that risks are manageable and that there is a low or moderate residual likelihood of the prescribed management actions not succeeding. 75% is a reasonable level of confidence in the effectiveness of the proposed environmental management actions.
Percentage of impact offset	**151.26%**	

Based on the offset assessment guide calculations summarised above the 34 hectares of habitat in the WC2NH Boambee SF offset area could offset 151.26% of the Project's impacts on *Marsdenia longiloba* and *Tylophora woollsii*.

Table 36 Attribute values entered in the Offset assessment guide calculations for the Koala

Offset assessment guide attribute	Norton offset area	Justification	Boambee SF offset area	Justification
Impact Calculator - Quantum of impact - Area	106.6 hectares	The area of removal of Koala habitat as documented in the approved offset strategy (BEM, 2014).	106.6 hectares	The limitation on the area of removal of Koala habitat under the EPBC Approval for the Project (EPBC 2013/7101) as documented in the approved offset strategy (BEM, 2014).
Impact Calculator - Quantum of impact – Quality	7/10	The quality of the habitat impacted as documented in the approved offset strategy (BEM, 2014).	7/10	The quality of the habitat impacted as documented in the approved offset strategy (BEM, 2014).
Offset calculator – Time horizon – Risk related time horizon	20 years	The Norton offset area will be protected and managed in perpetuity under a conservation covenant. 20 years is the maximum timeframe for averting loss in the guide.	20 years	The Boambee SF offset area will be protected and managed in perpetuity as a Flora Reserve. 20 years is the maximum timeframe for averting loss in the guide.
Offset calculator – Time horizon – Time until ecological benefit	5 years	The Norton offset area contains habitat in moderate to good condition that will be managed through exclusion of damaging human activities, treatment of severe noxious weed infestations in the first five years and ongoing bush regeneration and treatment of pest fauna. Ecological benefits will be achieved in the short term, nominally five years. Conversely, a tangible reduction in the quality of habitat through increased weed infestation and edge effects, human impacts or uncontrolled wildfire is likely within five years.	5 years	The Boambee SF offset area contains habitat in good condition that will be managed through exclusion of timber harvesting, treatment of severe noxious weed infestations in the first five years and ongoing bush regeneration and treatment of pest fauna. Ecological benefits will be achieved in the short term, nominally five years. Conversely, a tangible reduction in the quality of habitat through timber harvesting, increased weed infestation and edge effects, human impacts or uncontrolled wildfire is likely within five years.
Offset calculator - Future area and quality without offset – Risk of loss without offset	20%	Based on direct observations of recent and planned development in the near vicinity of the site there is a genuine risk of damaging land uses such as a quarry expansion, intensive agriculture, private forestry or industrial development.	80 %	The majority of the Boambee SF offset area is currently within FMZ 4 ‘General Management’ and is available for timber harvesting and other activities that are likely to harm Koala populations and/or remove habitat. The WC2NH offset area contains high quality regrowth with considerable timber value (Williams J., FCNSW pers. comm.) and will be likely to be harvested in the short to medium term.

Offset assessment guide attribute	Norton offset area	Justification	Boambee SF offset area	Justification
Offset calculator - Future area and quality with offset – Risk of loss with offset	3%	The Norton offset area will be protected and managed in perpetuity under a conservation covenant (a BioBanking agreement). A BioBanking agreement is a secure conservation covenant that is supported by NSW legislation and OEH monitoring and enforcement and is highly unlikely to ever be overturned.	3 %	The WC2NH Boambee SF offset area will be protected and managed in perpetuity as a Flora Reserve. The Flora Reserve that will encompass the Boambee SF offset site will be delimited by hard boundaries such as roads, drainage lines, fences and the State forest boundary and as such will be readily identified and avoided in the planning and harvesting processes. FCNSW files include no records of a Flora Reserve being breached by any harvesting operations or management activities. The NSW OEH recognises that as a conservation mechanism, Flora Reserves offer a similar level of security and protection to biodiversity as National Parks and Nature Reserves (OEH, 2011).
Confidence in result – averted loss of offset	95%	A BioBanking agreement is a secure conservation covenant that is supported by: NSW legislation; implementation of the site specific MAP to exclude harmful activities; and OEH monitoring and enforcement (see Section 6.1 and 10.2.1).	95 %	A Flora Reserve is a secure conservation covenants supported by NSW legislation as well as implementation of the Forestry Management Zoning system and a reserve specific works plan to exclude harmful activities (see Section 7.1 and 10.2.2).
Offset calculator – Start area and quality – Area	185 hectares	The area of habitat comprises the 'Dry Sclerophyll Forest' and 'Wet Sclerophyll Forest' habitat within the WC2NH offset area mapped on Figure 4. The area of habitat at the Norton offset area was confirmed through detailed field surveys, including targeted surveys for Koalas, quantification of the amount and quality of food resources available and mapping of vegetation type and condition (see Section 3.4.1). Occupied habitat was confirmed through direct observations of Koalas and their scats (see Section 3.5.1).	49.1 hectares	The area of habitat comprises the 'Dry Sclerophyll Forest' and 'Wet Sclerophyll Forest' habitat within the WC2NH offset area mapped on Figure 8. The area of habitat at the Boambee SF offset area was confirmed through detailed field surveys, including targeted surveys for Koalas, quantification of the amount and quality of food resources available and mapping of vegetation type and condition (see Section 4.4.2). Occupied habitat was confirmed through direct observations of Koalas and their scats (see Section 4.5.2).

Offset assessment guide attribute	Norton offset area	Justification	Boambee SF offset area	Justification
Offset calculator – Start area and quality – Start quality	7/10	The offset area contains occupied habitat with moderate cover of food tree species identified in management plans, as part of a large patch of vegetation that is in good condition with some impacts from clearing, rubbish dumping, weed infestation, edge effects and the presence of dogs. The habitat quality score is supported by: observations of the species at the site; the presence of high cover of food tree species in the canopy plots (see Table 4); and the good condition of vegetation and habitat as confirmed by Biobanking plot/transect data included in Appendix A.	8/10	The offset area contains occupied habitat with high cover of primary food tree species identified in management plans, as part of a large patch of vegetation that is in good condition with some impacts from timber harvesting, weed infestation, edge effects and the probable presence of dogs. The habitat quality score is supported by: observations of the species at the site; the presence of high cover of food tree species in the canopy plots (see Table 7); and the good condition of vegetation and habitat as confirmed by Biobanking plot/transect data included in Appendix B
Offset calculator - Future area and quality without offset – Future quality without offset (1-10)	6/10	Habitat in the Norton offset area will continue to deteriorate through impacts from weed infestation, edge effects, inappropriate fire regimes, predation by dogs etc. if not set aside for conservation.	7/10	Habitat in the Boambee SF offset area will continue to deteriorate through impacts from weed infestation, edge effects, pest fauna, inappropriate fire regimes, the probable presence of dogs etc. if not set aside for conservation. These incremental impacts are distinct from the removal of habitat associated with a timber harvesting event at the WC2NH offset area, which is assessed under 'risk of loss of offset'.
Offset calculator - Future area and quality with offset – Future quality with offset (1-10)	8/10	Habitat at the Norton offset area will be managed as described in Section 5. A tangible improvement in the quality of habitat will be achieved as described in Table 30 especially through the increased health and productivity of food tree species and reduced risk of predation by dogs.	9/10	Habitat at the Boambee SF offset area will be managed as described in Section 7. A tangible improvement in the quality of habitat will be achieved as described in Table 30, especially through the increased health and productivity of food tree species and reduced risk of predation by dogs.

Offset assessment guide attribute	Norton offset area	Justification	Boambee SF offset area	Justification
Confidence in result – change in quality	75 %	A modest increase in site quality is predicted. The link between the predicted improvement in the quality of habitat and viability of fauna populations through management actions is described in Table 30. The site will be managed under a plan that includes performance criteria and corrective actions to help ensure that targets are achieved. A risk assessment has been performed which demonstrates that risks are manageable and that there is a low or moderate residual likelihood of the prescribed management actions not succeeding. 75% is a reasonable level of confidence in the effectiveness of the proposed environmental management actions.	75 %	A modest increase in site quality is predicted. The link between the predicted improvement in the quality of habitat and viability of fauna populations through management actions is described in Table 30. The site will be managed under a plan that includes performance criteria and corrective actions to help ensure that targets are achieved. A risk assessment has been performed which demonstrates that risks are manageable and that there is a low or moderate residual likelihood of the prescribed management actions not succeeding. 75% is a reasonable level of confidence in the effectiveness of the proposed environmental management actions.
Percentage of impact offset	**60.41%**		**48.59%**	

Based on the offset assessment guide calculations summarised above the 234.1 hectares of habitat in the WC2NH Norton and Boambee SF offset areas could offset 109% of the Project's impacts on the Koala.

Table 37 Attribute values entered in the Offset assessment guide calculations for the Grey-headed Flying-fox

Offset assessment guide attribute	Norton offset area	Justification	Boambee SF offset area	Justification
Impact Calculator - Quantum of impact - Area	106.6 hectares	The area of removal of Grey-headed Flying-fox habitat as documented in the approved offset strategy (BEM, 2014).	106.6 hectares	The limitation on the area of removal of Grey-headed Flying-fox habitat under the EPBC Approval for the Project (EPBC 2013/7101) as documented in the approved offset strategy (BEM, 2014).
Impact Calculator - Quantum of impact – Quality	7/10	The quality of the habitat impacted as documented in the approved offset strategy (BEM, 2014).	7/10	The quality of the habitat impacted as documented in the approved offset strategy (BEM, 2014).

Offset assessment guide attribute	Norton offset area	Justification	Boambee SF offset area	Justification
Offset calculator – Time horizon –Risk related time horizon	20 years	The Norton offset area will be protected and managed in perpetuity under a conservation covenant. 20 years is the maximum timeframe for averting loss in the guide.	20 years	The Boambee SF offset area will be protected and managed in perpetuity as a Flora Reserve. 20 years is the maximum timeframe for averting loss in the guide.
Offset calculator – Time horizon – Time until ecological benefit	5 years	The Norton offset area contains habitat in moderate to good condition that will be managed through exclusion of damaging human activities, treatment of severe noxious weed infestations in the first five years and ongoing bush regeneration and treatment of pest fauna. Ecological benefits will be achieved in the short term, nominally five years. Conversely a tangible reduction in the quality of habitat through increased weed infestation and edge effects, human impacts or uncontrolled wildfire is likely within five years.	5 years	The Boambee SF offset area contains habitat in good condition that will be managed through exclusion of timber harvesting, treatment of severe noxious weed infestations in the first five years and ongoing bush regeneration and treatment of pest fauna. Ecological benefits will be achieved in the short term, nominally five years. Conversely a tangible reduction in the quality of habitat through timber harvesting, increased weed infestation and edge effects, human impacts or uncontrolled wildfire is likely within five years.
Offset calculator - Future area and quality without offset – Risk of loss without offset	20%	Based on direct observations of recent and planned development in the near vicinity of the site there is a genuine risk of damaging land uses such as a quarry expansion, intensive agriculture, private forestry or industrial development.	80 %	The majority of the Boambee SF offset area is currently within FMZ 4 ‘General Management’ and is available for timber harvesting and other activities that will remove habitat. The WC2NH offset area contains high quality regrowth with considerable timber value (Williams J., FCNSW pers. comm.) and will be likely to be harvested in the short to medium term.

Offset assessment guide attribute	Norton offset area	Justification	Boambee SF offset area	Justification
Offset calculator - Future area and quality with offset – Risk of loss with offset	3%	The Norton offset area will be protected and managed in perpetuity under a conservation covenant (a BioBanking agreement). A BioBanking agreement is a secure conservation covenant that is supported by NSW legislation and OEH monitoring and enforcement and is highly unlikely to ever be overturned.	3 %	The WC2NH Boambee SF offset area will be protected and managed in perpetuity as a Flora Reserve. The Flora Reserve that will encompass the Boambee SF offset site will be delimited by hard boundaries such as roads, drainage lines, fences and the State forest boundary and as such will be readily identified and avoided in the planning and harvesting processes. FCNSW files include no records of a Flora Reserve being breached by any harvesting operations or management activities. The NSW OEH recognises that as a conservation mechanism, Flora Reserves offer a similar level of security and protection to biodiversity as National Parks and Nature Reserves (OEH, 2011).
Confidence in result – averted loss of offset	95%	A BioBanking agreement is a secure conservation covenant that is supported by: NSW legislation; implementation of the site specific MAP to exclude harmful activities; and OEH monitoring and enforcement (see Section 6.1 and 10.2.1).	95 %	A Flora Reserve is a secure conservation covenants supported by NSW legislation as well as implementation of the Forestry Management Zoning system and a reserve specific works plan to exclude harmful activities (see Section 7.1 and 10.2.2).
Offset calculator – Start area and quality – Area	185 hectares	The area of habitat comprises the 'Dry Sclerophyll Forest' and 'Wet Sclerophyll Forest' habitat within the WC2NH offset area mapped on Figure 4. The area of habitat at the Norton offset area was confirmed through detailed field surveys, including targeted surveys for nocturnal fauna, quantification of the amount and quality of food resources available and mapping of vegetation type and condition (see Section 3.4.2). Occupied habitat was confirmed through direct observations of the species in previous surveys (Lewis and James, 2010).	49.1 hectares	The area of habitat comprises the 'Dry Sclerophyll Forest' and 'Wet Sclerophyll Forest' habitat within the WC2NH offset area mapped on Figure 8. The area of habitat at the Boambee SF offset area was confirmed through detailed field surveys, including targeted surveys, quantification of the amount and quality of food resources available and mapping of vegetation type and condition (see Section 4.4.3). Occupied habitat was confirmed through direct observations of Grey-headed Flying-foxes in vegetation immediately adjoining the site during the present surveys (see Section 4.5.3).

Offset assessment guide attribute	Norton offset area	Justification	Boambee SF offset area	Justification
Offset calculator – Start area and quality – Start quality	7/10	The offset area contains occupied habitat with moderate cover of food tree species identified in management plans, as part of a large patch of vegetation that is in good condition with some impacts from clearing, rubbish dumping, weed infestation and edge effects. The habitat quality score was confirmed: through the presence of moderate to high cover of food tree species in the canopy plots (see Table 4) and the moderate to good condition of vegetation and habitat as confirmed by BioBanking plot/transect data included in Appendix A.	8/10	The offset area contains occupied habitat with high cover of primary food tree species identified in management plans, as part of a large patch of vegetation that is in good condition with some impacts from timber harvesting, weed infestation, edge effects and the probable presence of dogs. The habitat quality score was confirmed: through the presence of high cover of food tree species in the canopy plots (see Table 7) and the good condition of vegetation and habitat as confirmed by BioBanking plot/transect data included in Appendix B.
Offset calculator - Future area and quality without offset – Future quality without offset (1-10)	6/10	Habitat in the Norton offset area will continue to deteriorate through impacts from weed infestation, edge effects, inappropriate fire regimes, permissible grazing etc. if not set aside for conservation.	8/10	Habitat in the Boambee SF offset area will continue to deteriorate through impacts from weed infestation, edge effects, pest fauna, inappropriate fire regimes etc. if not set aside for conservation. This is not likely to be sufficient to drop habitat quality by an entire point. These incremental impacts are distinct from the removal of habitat associated with a timber harvesting event at the WC2NH offset area, which is assessed under 'risk of loss of offset'.
Offset calculator - Future area and quality with offset – Future quality with offset (1-10)	8/10	Habitat at the Norton offset area will be managed as described in Section 5. A tangible improvement in the quality of habitat will be achieved as described in Table 30 especially through the increased health and productivity of food tree species.	9/10	Habitat at the Boambee SF offset area will be managed as described in Section 7. A tangible improvement in the quality of habitat will be achieved as described in Table 30, especially through the increased health and productivity of food tree species.

Offset assessment guide attribute	Norton offset area	Justification	Boambee SF offset area	Justification
Confidence in result – change in quality	75 %	A modest increase in site quality is predicted. The link between the predicted improvement in the quality of habitat and viability of fauna populations through management actions is described in Table 30. The site will be managed under a plan that includes performance criteria and corrective actions to help ensure that targets are achieved. A risk assessment has been performed which demonstrates that risks are manageable and that there is a low or moderate residual likelihood of the prescribed management actions not succeeding. 75% is a reasonable level of confidence in the effectiveness of the proposed environmental management actions.	75 %	A modest increase in site quality is predicted. The link between the predicted improvement in the quality of habitat and viability of fauna populations through management actions is described in Table 30. The site will be managed under a plan that includes performance criteria and corrective actions to help ensure that targets are achieved. A risk assessment has been performed which demonstrates that risks are manageable and that there is a low or moderate residual likelihood of the prescribed management actions not succeeding. 75% is a reasonable level of confidence in the effectiveness of the proposed environmental management actions.
Percentage of impact offset	**60.41%**		**42.6%**	

Based on the offset assessment guide calculations summarised above the 234.1 hectares of habitat in the WC2NH Norton and Boambee SF offset areas could offset 103.1% of the Project's impacts on the Grey-headed Flying-fox.

Table 38 Attribute values entered in the Offset assessment guide calculations for the Spotted-tailed Quoll

Offset assessment guide attribute	Norton offset area	Justification	Boambee SF offset area	Justification
Impact Calculator - Quantum of impact - Area	114.1 hectares	The area of removal of Spotted-tailed Quoll habitat as documented in the approved offset strategy (BEM, 2014).	114.1 hectares	The limitation on the area of removal of Spotted-tailed Quoll habitat under the EPBC Approval for the Project (EPBC 2013/7101) as documented in the approved offset strategy (BEM, 2014).
Impact Calculator - Quantum of impact – Quality	5/10	The quality of the habitat impacted as documented in the approved offset strategy (BEM, 2014).	5/10	The quality of the habitat impacted as documented in the approved offset strategy (BEM, 2014).

Offset assessment guide attribute	Norton offset area	Justification	Boambee SF offset area	Justification
Offset calculator – Time horizon – Risk related time horizon	20 years	The Norton offset area will be protected and managed in perpetuity under a conservation covenant. 20 years is the maximum timeframe for averting loss in the guide.	20 years	The Boambee SF offset area will be protected and managed in perpetuity as a Flora Reserve. 20 years is the maximum timeframe for averting loss in the guide.
Offset calculator – Time horizon – Time until ecological benefit	5 years	The Norton offset area contains habitat in moderate to good condition that will be managed through exclusion of damaging human activities, treatment of severe noxious weed infestations in the first five years and ongoing bush regeneration and treatment of pest fauna. Ecological benefits will be achieved in the short term, nominally five years. Conversely a tangible reduction in the quality of habitat through increased weed infestation and edge effects, human impacts or uncontrolled wildfire is likely within five years.	5 years	The Boambee SF offset area contains habitat in good condition that will be managed through exclusion of timber harvesting, treatment of severe noxious weed infestations in the first five years and ongoing bush regeneration and treatment of pest fauna. Ecological benefits will be achieved in the short term, nominally five years. Conversely a tangible reduction in the quality of habitat through timber harvesting, increased weed infestation and edge effects, human impacts or uncontrolled wildfire is likely within five years.
Offset calculator - Future area and quality without offset – Risk of loss without offset	20%	Based on direct observations of recent and planned development in the near vicinity of the site there is a genuine risk of damaging land uses such as a quarry expansion, intensive agriculture, private forestry or industrial development.	80 %	The majority of the Boambee SF offset area is currently within FMZ 4 ‘General Management’ and is available for timber harvesting and other activities that are likely to harm Spotted-tailed Quoll populations and/or remove habitat. The WC2NH offset area contains high quality regrowth with considerable timber value (Williams J., FCNSW pers. comm.) and will be likely to be harvested in the short to medium term.

Offset assessment guide attribute	Norton offset area	Justification	Boambee SF offset area	Justification
Offset calculator - Future area and quality with offset – Risk of loss with offset	3%	The Norton offset area will be protected and managed in perpetuity under a conservation covenant (a BioBanking agreement). A BioBanking agreement is a secure conservation covenant that is supported by NSW legislation and OEH monitoring and enforcement and is highly unlikely to ever be overturned.	3 %	The WC2NH Boambee SF offset area will be protected and managed in perpetuity as a Flora Reserve. The Flora Reserve that will encompass the Boambee SF offset site will be delimited by hard boundaries such as roads, drainage lines, fences and the State forest boundary and as such will be readily identified and avoided in the planning and harvesting processes. FCNSW files include no records of a Flora Reserve being breached by any harvesting operations or management activities. The NSW OEH recognises that as a conservation mechanism, Flora Reserves offer a similar level of security and protection to biodiversity as National Parks and Nature Reserves (OEH, 2011).
Confidence in result – averted loss of offset	95%	A BioBanking agreement is a secure conservation covenant that is supported by: NSW legislation; implementation of the site specific MAP to exclude harmful activities; and OEH monitoring and enforcement (see Section 6.1 and 10.2.1).	95 %	A Flora Reserve is a secure conservation covenants supported by NSW legislation as well as implementation of the Forestry Management Zoning system and a reserve specific works plan to exclude harmful activities (see Section 7.1 and 10.2.2).
Offset calculator – Start area and quality – Area	185 hectares	The area of habitat comprises the 'Dry Sclerophyll Forest' and 'Wet Sclerophyll Forest' habitat within the WC2NH offset area mapped on Figure 4. The area of habitat at the Norton offset area was confirmed through detailed field surveys, including targeted surveys, quantification of the amount and quality of habitat resources available and mapping of vegetation type and condition (see Section 3.4.3).	49.1 hectares	The area of habitat comprises the 'Dry Sclerophyll Forest' and 'Wet Sclerophyll Forest' habitat within the WC2NH offset area mapped on Figure 8. The area of habitat at the Boambee SF offset area was confirmed through detailed field surveys, including targeted surveys, quantification of the amount and quality of food resources available and mapping of vegetation type and condition (see Section 4.4.4). There is a record of a Spotted-tailed Quoll at the site from 2005 (OEH, 2015b) (see Section 4.5.4).

Offset assessment guide attribute	Norton offset area	Justification	Boambee SF offset area	Justification
Offset calculator – Start area and quality – Start quality	7/10	The offset area contains vegetation in moderate to good condition, with resources such as dense understorey vegetation, hollow-bearing trees and woody debris, as part of a large patch of vegetation that is in good condition with some impacts from clearing, rubbish dumping, weed infestation, edge effects and the likely presence of dogs, foxes and cats. The habitat quality score is supported by the moderate to good condition of vegetation and habitat as confirmed by BioBanking plot/transect data included in Appendix A.	8/10	The offset area contains vegetation in good condition, with resources such as dense understorey vegetation, hollow-bearing trees and woody debris, as part of a large patch of vegetation that is in good condition with some impacts from timber harvesting, weed infestation, edge effects and the probable presence of dogs, foxes and cats. The habitat quality score is supported by the good condition of vegetation and habitat as confirmed by BioBanking plot/transect data included in Appendix A.
Offset calculator - Future area and quality without offset – Future quality without offset (1-10)	6/10	Habitat in the Norton offset area will continue to deteriorate through impacts from weed infestation, edge effects, inappropriate fire regimes, predation and competition by dogs etc. if not set aside for conservation.	7/10	Habitat in the Boambee SF offset area will continue to deteriorate through impacts from weed infestation, edge effects, pest fauna, inappropriate fire regimes, predation and competition by dogs, foxes and cats. etc. if not set aside for conservation. These incremental impacts are distinct from the removal of habitat associated with a timber harvesting event at the WC2NH offset area, which is assessed under 'risk of loss of offset'.
Offset calculator - Future area and quality with offset – Future quality with offset (1-10)	8/10	Habitat at the Norton offset area will be managed as described in Section 5. A tangible improvement in the quality of habitat will be achieved as described in Table 30 especially through the increased health and productivity of vegetation and prey species populations and reduced risk of predation or competition by dogs, foxes and cats.	9/10	Habitat at the Boambee SF offset area will be managed as described in Section 6. A tangible improvement in the quality of habitat will be achieved as described in Table 30, especially through the increased health and productivity of vegetation and prey species populations and reduced risk of predation or competition by dogs, foxes and cats.

Offset assessment guide attribute	Norton offset area	Justification	Boambee SF offset area	Justification
Confidence in result – change in quality	75 %	A modest increase in site quality is predicted. The link between the predicted improvement in the quality of habitat and viability of fauna populations through management actions is described in Table 30. The site will be managed under a plan that includes performance criteria and corrective actions to help ensure that targets are achieved. A risk assessment has been performed which demonstrates that risks are manageable and that there is a low or moderate residual likelihood of the prescribed management actions not succeeding. 75% is a reasonable level of confidence in the effectiveness of the proposed environmental management actions.	75 %	A modest increase in site quality is predicted. The link between the predicted improvement in the quality of habitat and viability of fauna populations through management actions is described in Table 30. The site will be managed under a plan that includes performance criteria and corrective actions to help ensure that targets are achieved. A risk assessment has been performed which demonstrates that risks are manageable and that there is a low or moderate residual likelihood of the prescribed management actions not succeeding. 75% is a reasonable level of confidence in the effectiveness of the proposed environmental management actions.
Percentage of impact offset	**69.66%**		**47.07%**	

Based on the offset assessment guide calculations summarised above the 234.1 hectares of habitat in the WC2NH Norton and Boambee SF offset areas could offset 116.73% of the Project's impacts on the Spotted-tailed Quoll.

Table 39 Attribute values entered in the Offset assessment guide calculations for the Giant Barred Frog

Offset assessment guide attribute	Value	Justification
Impact Calculator - Quantum of impact - Area	0.88 hectares	The limitation on the area of removal of 0.7 hectares of occupied habitat for the Giant barred Frog under the EPBC Approval for the Project (EPBC 2013/7101) as documented in the approved offset strategy (BEM, 2014) plus a committment to offset an additional 0.18 hectares of habitat associated with an unexpected find process in October 2015.
Impact Calculator - Quantum of impact – Quality	8/10	The quality of the habitat impacted as documented in the approved offset strategy (BEM, 2014).
Offset calculator – Time horizon –Risk related time horizon	20 years	The WC2NH xxxxx offset area will be protected and managed in perpetuity as a biobank. 20 years is the maximum timeframe for averting loss in the guide.

Offset assessment guide attribute	Value	Justification
Offset calculator – Time horizon – Time until ecological benefit	5 years	The WC2NH xxxxx offset area contains native vegetation in moderate to good condition that will be managed through exclusion of grazing, treatment of noxious weed infestations and ongoing bush regeneration and treatment of pest fauna. Ecological benefits will be achieved in the short term, nominally five years. Conversely a tangible reduction in the quality of habitat through grazing, increased weed infestation and edge effects, human impacts or fire is likely within five years.
Offset calculator -Future area and quality without offset – Risk of loss without offset	20 %	The WC2NH xxxxx offset area is currently rural residential land and is available for grazing and other activities that are likely to harm frog populations and/or reduce the quality of habitat. Permitted activities include clearing of vegetation for more intensive agricultural activities such as blueberry cultivation that would be economic and have been considered by the landowner (xxxxx. pers. comm.).
Offset calculator -Future area and quality with offset – Risk of loss with offset	3 %	The WC2NH xxxxx offset area will be protected and managed in perpetuity under a conservation covenant (a BioBanking agreement). A BioBanking agreement is a secure conservation covenant that is supported by NSW legislation and OEH monitoring and enforcement and is highly unlikely to ever be overturned to permit grazing, clearing of vegetation for blueberry cultivation or other damaging activities.
Confidence in result – averted loss of offset	95 %	A BioBanking agreement is a secure conservation covenant that is supported by: NSW legislation; implementation of the site specific MAP to exclude harmful activities; and OEH monitoring and enforcement (see Section 6.1 and 10.2.1).
Offset calculator – Start area and quality – Area	5 hectares	The area of habitat comprises the 'Giant Barred Frog habitat' within the WC2NH xxxxx offset area mapped on Figure 11. The area of occupied habitat was confirmed through detailed field surveys, including targeted searches for frogs and mapping of vegetation type and condition. xxxxx Creek runs through the centre of the frog habitat within the site and features the specific hydrological, geomorphic and vegetation characteristics associated with Giant Barred Frog breeding habitat (see Section 5.4). Occupied habitat was confirmed through direct observations of Giant Barred Frogs (see Section 5.5).
Offset calculator – Start area and quality – Start quality	8/10	The offset site contains occupied habitat, including stream habitat in xxxxx Creek that features the specific hydrological, geomorphic and vegetation characteristics associated with Giant Barred Frog breeding habitat (see Section 5.4). This habitat is contained within a large patch of vegetation that is in good condition with some impacts from grazing, weed infestation and edge effects. The habitat quality score is supported by the good condition of vegetation and habitat as confirmed by BioBanking plot/transect data included in Appendix C.

Offset assessment guide attribute	Value	Justification
Offset calculator -Future area and quality without offset – Future quality without offset (1-10)	8/10	Habitat in the WC2NH xxxxx offset area will continue to deteriorate through impacts from weed infestation, edge effects, pest fauna, inappropriate fire regimes etc. if not set aside for conservation. These impacts will probably not be sufficient to drop site quality an entire point given the species' observed ability to persist in disturbed or weed-infested environments. These incremental impacts are distinct from the removal of habitat associated with vegetation clearing and intensification of agricultural activities at the site, which is assessed under 'risk of loss of offset'.
Offset calculator - Future area and quality with offset – Future quality with offset (1-10)	9/10	Habitat in the WC2NH xxxxx offset area will be managed as described in Section 8. A tangible improvement in the quality of habitat and viability of frog populations will be achieved as described in Table 30, by improving the condition of riparian vegetation and especially by reducing the impact of human activities, grazing or pest fauna on breeding habitat.
Confidence in result – change in quality	75 %	A modest increase in site quality is predicted. The link between the predicted improvement in the quality of habitat and viability of fauna populations through management actions is described in Table 30. The site will be managed under a plan that includes performance criteria and corrective actions to help ensure that targets are achieved. A risk assessment has been performed which demonstrates that risks are manageable and that there is a low or moderate residual likelihood of the prescribed management actions not succeeding. 75% is a reasonable level of confidence in the effectiveness of the proposed environmental management actions.
Percentage of impact offset	**121.47%**	

Based on the offset assessment guide calculations summarised above the 5 hectares of habitat in the WC2NH xxxxx offset area could offset 121.47% of the Project's offset requirements for the Giant Barred Frog.

11. Conclusion

Roads and Maritime Services (Roads and Maritime) are upgrading a section of the Pacific Highway between Warrell Creek and Nambucca Heads (WC2NH) as part of the Pacific Highway upgrade program funded by the Federal and NSW Governments (the Project).

The Project will result in significant impacts on threatened species listed under the *Environment Protection and Biodiversity Conservation Act 1999 (*EPBC Act) (*Marsdenia longiloba, Tylophora woollsii*, the Koala, Grey-headed Flying-fox, Spotted-tailed Quoll and Giant Barred Frog). The EPBC Act conditions of approval for the Project state that to compensate for the loss of threatened species habitat Roads and Maritime must submit a Biodiversity Offset Package report (offset package).

The offset package outlines the approach to the delivery of biodiversity offsets for threatened species impacted by the Project by conservation and management of the Norton, Boambee SF and xxxxx offset sites, comprising:

- Background information about the affected threatened species to inform the assessment of the quality of habitat and appropriate management actions.
- A detailed description of the quality of the offset with reference to the ecology and habitat requirements of the affected threatened species and based on targeted field surveys of the sites.
- Description of the titling and management framework that will be adopted at the offset sites and how maintenance and enhancement of habitat will contribute to the conservation of the affected threatened species.
- Details of a monitoring program for determining the effectiveness of management actions.

Roads and Maritime will enter into a BioBanking agreement with the Office of Environment and Heritage to ensure the long-term protection of the biodiversity values at the Norton offset site. Roads and Maritime will assist the landowners to obtain BioBanking agreements over the xxxxx offset site. Substantial gains in biodiversity values will be achieved through improvement of moderate condition habitat, management of threats to populations and averted risk of loss of habitat at these offset sites through development, quarrying or intensive agriculture.

The Boambee SF offset site will be purposefully managed by Forestry Corporation of NSW (FCNSW) for conservation as a Flora Reserve. Substantial gains in biodiversity values will be achieved through maintenance or improvement of good condition habitat, management of threats to populations and significant averted risk of loss of habitat at the site through timber harvesting.

Offset assessment guide calculations have been performed to demonstrate how these direct offsets will comply with the EPBC act offset policy. The outcome of the Offset guide assessment for the Project is that:

- Conservation of around 34 hectares of known habitat for *Marsdenia longiloba* and *Tylophora woollsii* to compensate for the EPBC Approval for the Project (EPBC 2013/7101) to remove not more than 17.8 hectares of habitat will directly offset around 151% of the Project's potential impacts on these species.
- Conservation of around 234.1 hectares of known habitat for the Koala to compensate for the EPBC Approval for the Project (EPBC 2013/7101) to remove not more than 106.6 hectares of habitat will directly offset around 109% of the Project's potential impacts on the species.

- Conservation of around 234.1 hectares of likely habitat for the Grey-headed Flying-fox to compensate for the EPBC Approval for the Project (EPBC 2013/7101) to remove not more than 106.6 hectares of habitat will directly offset around 103% of the Project's potential impacts on the species.
- Conservation of around 234.1 hectares of likely habitat for the Spotted-tailed Quoll to compensate for the EPBC Approval for the Project (EPBC 2013/7101) to remove not more than 114.1 hectares of habitat will directly offset around 117% of the Project's potential impacts on the species.
- Conservation of around 5 hectares of known habitat for the Giant Barred Frog to compensate for the removal of 0.7 hectares of occupied habitat as per the EPBC Approval for the Project (EPBC 2013/7101) and the committment to offset an additional 0.18 hectares of potential habitat during an unexpected find process in October 2015, will directly offset around 121.47% of the Project's offset requirements on the species.

A detailed management actions plan and monitoring program has been prepared for each site to ensure that the extent and quality of habitat for the affected threatened species is improved and then maintained in perpetuity.

The conservation and management of the Norton, Boambee SF and xxxxx offset sites will meet the Project's direct offset requirements in accordance with the EPBC Act offset policy and conditions of approval and enhance the conservation of the affected threatened species.

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Appendices

Appendix A – Norton Offset Site Field survey results

Norton site summary of survey effort

Fauna habitat type	Survey ID	Survey techniques	Easting	Northing	Zone
Dry sclerophyll forest	1	BioBanking plot/transect	484162	6555807	56
	1	Plot/transect, canopy plot and Koala SAT	484146	6555809	56
	16	BioBanking plot/transect	484507	6554741	56
	16	Plot/transect, canopy plot and Koala SAT	484507	6554741	56
	19	BioBanking plot/transect	485241	6554277	56
	19	Plot/transect, canopy plot and Koala SAT	485241	6554277	56
	2	Plot/transect, canopy plot and Koala SAT	484302	6556577	56
	20	BioBanking plot/transect	484935	6556281	56
	20	Plot/transect, canopy plot and Koala SAT	484935	6556281	56
	21	BioBanking plot/transect	484803	6556324	56
	21	Plot/transect, canopy plot and Koala SAT	484803	6556324	56
	22	Plot/transect, canopy plot and Koala SAT	484447	6557709	56
	23	BioBanking plot/transect	484230	6557443	56
	23	Plot/transect, canopy plot and Koala SAT	484230	6557443	56
	24	BioBanking plot/transect	484527	6556899	56
	24	Plot/transect, canopy plot and Koala SAT	484527	6556899	56
	26	BioBanking plot/transect	484536	6557961	56
	3	BioBanking plot/transect	484161	6555892	56
	3	Plot/transect, canopy plot and Koala SAT	484161	6555892	56
	34	BioBanking plot/transect	485144	6555906	56
	35	BioBanking plot/transect	485343	6555859	56
	38	BioBanking plot/transect	484949	6555995	56
	39	BioBanking plot/transect	484838	6556515	56
	40	BioBanking plot/transect	484254	6556454	56

Fauna habitat type	Survey ID	Survey techniques	Easting	Northing	Zone
	41	BioBanking plot/transect	483557	6555694	56
	42	BioBanking plot/transect	483712	6555651	56
	44	BioBanking plot/transect	483940	6555015	56
	45	BioBanking plot/transect	484241.3506	6555305.358	56
	46	BioBanking plot/transect	483584	6555052	56
	47	BioBanking plot/transect	483570	6555859	56
	5	BioBanking plot/transect	484815	6555175	56
	5	Plot/transect, canopy plot and Koala SAT	484815	6555175	56
	51	BioBanking plot/transect	485598.0571	6553851.162	56
	6	BioBanking plot/transect	485202	6554907	56
	Camera 4	Camera trap	484803	6555197	56
	Camera 6	Camera trap	485310	6554457	56
	Camera 7	Camera trap	484844	6555430	56
	Camera 7b	Camera trap	485702	6554123	56
Dry sclerophyll forest in low condition	27	BioBanking plot/transect	484466	6557804	56
	28	BioBanking plot/transect	484310	6557831	56
Exotic vegetation	17	Plot/transect, canopy plot and Koala SAT	485094	6555334	56
Grassy woodland	48	BioBanking plot/transect	483476	6555230	56
	49	BioBanking plot/transect	483407	6555243	56
Wet sclerophyll forest	18	BioBanking plot/transect	485324	6555351	56
	18	Plot/transect, canopy plot and Koala SAT	485324	6555351	56
	25	BioBanking plot/transect	485475	6554973	56
	29	BioBanking plot/transect	484791	6555678	56
	30	BioBanking plot/transect	485187	6555625	56
	31	BioBanking plot/transect	485281	6555675	56
	32	BioBanking plot/transect	485193	6555505	56
	33	BioBanking plot/transect	485132	6555423	56
	36	BioBanking plot/transect	484893	6555840	56
	37	BioBanking plot/transect	484648	6555871	56

Fauna habitat type	Survey ID	Survey techniques	Easting	Northing	Zone
	4	BioBanking plot/transect	484621	6555662	56
	4	Plot/transect, canopy plot and Koala SAT	484621	6555662	56
	43	BioBanking plot/transect	484112	6555612	56
	50	BioBanking plot/transect	483517	6555412	56
	Camera 5	Camera trap	484847	6555749	56
	Camera 8	Camera trap	483253	6555098	56

WC2NH Norton offset area biometric plot/transect data

Fauna habitat type	Veg Type ID	Plot ID	Native plant species richness	Native over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Over storey regen.	Total length of fallen logs	Easting	Northing	Zone
Dry sclero-phyll forest	NR222	Bench-mark	44	15-50	10-40	5-50	5-40	5-70	0	0.1	1.0	> = 20			
		1	34	19.5	17.5	84	4	56	0	0	0.6	32	484146	6555808	56
		47	22	13.5	12.5	54	0	48	0	1	0.6	5	483570	6555859	56
	NR247	Bench-mark	37	15-40	10-50	5-60	5-60	5-40	0	1	1.0	> = 10			
		21	40	27.2	29	88	8	22	0	2	1	65	484803	6556324	56
		38	30	15	4.5	24	0	70	0	0	1.0	20	484949	6555995	56
		39	30	18.5	13.5	48	4	18	0	0	1.0	5	484838	6556515	56
	NR228	Bench-mark	35	15-50	5-70	5-70	5-60	5-80	0	1.5	1	> = 10			
		35	30	13	12	84	8	40	0	0	1	94	484506	6554741	56
	NR246	Bench-mark	37	20-50	10-60	10-60	5-60	10-50	0	1	1	10			
		20	37	43.5	46	46	22	34	0	1	0.6	46	484935	6556281	56
		23	32	30.2	28.1	62	8	44	0	1	0.6	32.5	484229	6557443	56
		24	30	19.5	23.2	82	30	24	0	0	0.6	95	484526	6556898	56
		40	23	11	10.5	78	0	40	0	0	0.6	36	484254	6556454	56
		3	24	18.5	51	74	20	28	0	0	0.6	5	484161	6555892	56
Wet sclero - phyll forest	NR119	Bench-mark	44	15-50	10-40	5-50	5-40	5-70	0	0.1	1	> = 20			56
		34	39	15	14.5	58	14	38	0	0	0.83	54	485144	6555906	56
	NR122	Bench-mark	49	20-90	15-90	0-50	10-70	5-90	0	10	1	> = 10			56

Fauna habitat type	Veg Type ID	Plot ID	Native plant species richness	Native over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Over storey regen.	Total length of fallen logs	Easting	Northing	Zone
		31	45	23	35	68	10	70	0	0	0.5	25	485281	6555675	56
		36	41	11	14.5	56	20	42	0	0	0.5	21	484893	6555840	56
	NR160	Bench-mark	49	20-50	15-90	0-50	10-70	5-90	0	10	1.0	0.1			
		30	36	34	32	74	38	78	0	0	0.0	12	485187	6555625	56
		32	22	24.5	20	36	36	52	0	0	0.0	18	485193	6555505	56
	NR117	Bench-mark	49	20-90	15-90	0-50	10-70	5-90	0	0.1	1	10			
		29	33	36	51	14	18	60	0	0	0.6	4	484791	6555678	56
		4	31	17.5	48.5	44	42	22	0	2	0.6	46	484621	6555662	56
		37	36	16	25.5	56	10	38	0	1	0.6	28	484621	6555662	56

NH2U Norton offset area biometric plot/transect data

Fauna habitat type	Veg Type ID	Plot ID	Native plant species richness	Native over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Over storey regen.	Total length of fallen logs	Easting	Northing	Zone
Dry sclero-phyll forest	NR222	Bench-mark	44	15-50	10-40	5-50	5-40	5-70	0	0.1	1.0	> = 20			
		41	29	11	20	72	6	4	0	0	0.6	16	483557	6555694	56
		42	27	12	9	24	4	64	0	0	0.6	5	483712	6555651	56
	NR228	Bench-mark	35	15-50	5-70	5-70	5-60	5-80	0	1.5	1	> = 10			
		6	30	18	44.5	24	10	16	0	1	1	17	485202	6554907	56
		16	33	21.7	34.5	80	16	18	0	3	1	94	484506	6554741	56
		5	34	22.2	0	44	6	2	0	2	1	300	484815	6555175	56
		19	35	7.8	19.1	90	8	22	0	0	1	142	485241	6554276	56
		51	36	18	20.5	66	8	28	0	0	1	18	485598	6553851	56
	NR246	Bench-mark	37	20-50	10-60	10-60	5-60	10-50	0	1	1	10			
		26	32	30.5	14.5	42	0	44	38	0	0.6	126	484536	6557961	56
Dry sclero-phyll forest in low condition	NR246	Bench mark	37	20-50	10-60	10-60	5-60	10-50	0	1	1.0	10			
		27	18	0	11	8	2	20	86	0	0.1	0	484466	6557804	56
		28	9	0	3	30	2	4	68	0	0.1	0	484310	6557831	56
Wet sclero-phyll forest	NR119	Bench-mark	44	15-50	10-40	5-50	5-40	5-70	0	0.1	1	> = 20			56

Fauna habitat type	Veg Type ID	Plot ID	Native plant species richness	Native over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Over storey regen.	Total length of fallen logs	Easting	Northing	Zone
		44	35	12.5	10.5	68	0	18	0	0	0.83	34	483940	6555015	56
		45	29	13	14.5	86	6	32	0	0	0.83	13	483134	6555782	56
		46	22	20.5	8.5	52	6	30	0	0	0.83	0	483570	6555859	56
	NR122	Bench-mark	49	20-90	15-90	0-50	10-70	5-90	0	10	1	> = 10			56
		18	44	30.5	55.5	64	28	40	0	1	0.5	76	485324	6255535 1	56
		25	42	38.5	30.5	24	22	20	0	0	0.5	82	485475	6554973	56
	NR160	Bench-mark	49	20-50	15-90	0-50	10-70	5-90	0	10	1.0	0.1			
		33	24	18.5	22.5	70	16	36	6	0	0.0	15	485132	6555423	56
	NR117	Bench-mark	49	20-90	15-90	0-50	10-70	5-90	0	0.1	1	10			
		43	42	15.5	21	54	18	36	0	1	0.6	40	484112	6555612	56
		50	35	14	18	60	38	8	0	0	0.6	9	483517	6555412	56
	NR161	Bench mark	27	10-35	5-30	10-60	0-10	5-25	0	1	1.0	5			
		48	36	9	18.5	54	6	28	2	0	1.0	0	483476	6555230	56
		49	28	6	20.5	50	16	54	0	0	1.0	18	483407	6555243	56

WC2NH Norton offset area flora species recorded in plots

Flora species within NR122 and NR222 (plots 1, 31, 36 and 47)

Family	Scientific Name	Common Name	Exotic	Plot 1 Cover	Plot 1 Abundance	Plot 31 Cover	Plot 31 Abundance	Plot 36 Cover	Plot 36 Abundance	Plot 47 Cover	Plot 47 Abundance
Acanthaceae	*Pseuderanthemum variabile*	Pastel Flower		1	20	1	100	1	200	1	4
Adiantaceae	*Adiantum aethiopicum*	Common Maidenhair						1	30		
Araceae	*Gymnostachys anceps*	Settler's Twine				1	30				
Asteliaceae	*Cordyline stricta*	Narrow-leaved Palm Lily						1	1		
Bignoniaceae	*Pandorea pandorana*	Wonga Wonga Vine						1	16		
Casuarinaceae	*Allocasuarina littoralis*	Black She-Oak		1	30					25	80
Casuarinaceae	*Allocasuarina torulosa*	Forest Oak				1	2	1	4		
Convolvulaceae	*Polymeria calycina*			1	2	1	20	1	8		
Cyperaceae	*Lepidosperma laterale*	Variable Sword-sedge		1	50			1	3	1	25
Cyperaceae	*Ptilothrix deusta*			2	200					1	2
Dennstaedtiaceae	*Pteridium esculentum*	Bracken				1	3	1	3		
Dicksoniaceae	*Calochlaena dubia*	Rainbow Fern				1	5	1	5		
Dilleniaceae	*Hibbertia aspera*	Rough Guinea Flower		1	10					1	3
Dilleniaceae	*Hibbertia scandens*	Climbing Guinea Flower				1	20	1	7		
Dioscoreaceae	*Dioscorea transversa*	Native Yam				1	3				
Dryopteridaceae	*Lastreopsis acuminata*	Shiny Shield Fern						1	10		
Eupomatiaceae	*Eupomatia laurina*	Bolwarra				1	1				
Fabaceae (Faboideae)	*Desmodium gunnii*	Slender Tick-trefoil				1	100	1	1		

Family	Scientific Name	Common Name	Exotic	Plot 1 Cover	Plot 1 Abundance	Plot 31 Cover	Plot 31 Abundance	Plot 36 Cover	Plot 36 Abundance	Plot 47 Cover	Plot 47 Abundance
Fabaceae (Faboideae)	*Desmodium varians*	Slender Tick-trefoil				1	1	1	1		
Fabaceae (Faboideae)	*Glycine clandestina*	Twining glycine								1	1
Fabaceae (Faboideae)	*Glycine* sp.					1	3	1	10		
Fabaceae (Faboideae)	*Hardenbergia violacea*	False Sarsaparilla		1	2						
Fabaceae (Faboideae)	*Jacksonia scoparia*	Dogwood		1	8						
Fabaceae (Faboideae)	*Pultenaea myrtoides*			1	1					1	1
Fabaceae (Mimosoideae)	*Acacia binervata*	Two-veined Hickory				1	1				
Fabaceae (Mimosoideae)	*Acacia concurrens*	Curracabah		1	2						
Fabaceae (Mimosoideae)	*Acacia falcata*			1	2						
Fabaceae (Mimosoideae)	*Acacia floribunda*	White Sally				1	2	1	8		
Fabaceae (Mimosoideae)	*Acacia irrorata*	Green Wattle						1	3		
Goodeniaceae	*Dampiera sylvestris*									1	8
Goodeniaceae	*Goodenia ovata*	Hop Goodenia		1	20						
Haloragaceae	*Gonocarpus tetragynus*	Poverty Raspwort		1	2						
Lamiaceae	*Clerodendrum floribundum* var. *floribundum*					1	1				
Lauraceae	*Cassytha* sp.			1	4						
Lauraceae	*Cinnamomum camphora*	Camphor Laurel	*					1	1		
Lauraceae	*Cryptocarya microneura*	Murrogun								1	1

Family	Scientific Name	Common Name	Exotic	Plot 1 Cover	Plot 1 Abundance	Plot 31 Cover	Plot 31 Abundance	Plot 36 Cover	Plot 36 Abundance	Plot 47 Cover	Plot 47 Abundance
Lindsaeaceae	*Lindsaea microphylla*	Lacy Wedge Fern		1	4						
Lobeliaceae	*Pratia purpurascens*	Whiteroot		1	5	1	3	1	3		
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush		5	100	1	2	1	13	1	4
Luzuriagaceae	*Eustrephus latifolius*	Wombat Berry				1	1	1	15		
Meliaceae	*Synoum glandulosum subsp. glandulosum*	Scentless Rosewood				1	2				
Myrsinaceae	*Myrsine howittiana*	Brush Muttonwood				1	1				
Myrsinaceae	*Myrsine variabilis*					1	3				
Myrtaceae	*Acmena smithii*	Lilly Pilly				1	1				
Myrtaceae	*Callistemon salignus*	Willow Bottlebrush		1	2	1	4	1	4	1	7
Myrtaceae	*Corymbia gummifera*	Red Bloodwood		2	2	10	3			5	2
Myrtaceae	*Eucalyptus cameronii*	Diehard Stringybark						3	2	15	4
Myrtaceae	*Eucalyptus carnea*	Thick-leaved Mahogany		30	12						
Myrtaceae	*Eucalyptus microcorys*	Tallowwood				1	1	5	3		
Myrtaceae	*Eucalyptus pilularis*	Blackbutt				30	4	30	4	5	1
Myrtaceae	*Eucalyptus resinifera*	Red Mahogany								15	1
Myrtaceae	*Eucalyptus seeana*	Narrow-leaved Red Gum		3	3						
Myrtaceae	*Eucalyptus siderophloia*	Grey Ironbark		1	1			1	1		
Myrtaceae	*Leptospermum polygalifolium*	Tantoon				1	2	1	7		
Myrtaceae	*Lophostemon confertus*	Brush Box				15	12	1	6		
Myrtaceae	*Melaleuca nodosa*			1	5					1	1
Myrtaceae	*Melaleuca styphelioides*	Prickly-leaved Tea Tree				1	1	1	1		
Myrtaceae	*Sannantha angusta*			1	1	1	3	1	1		

Family	Scientific Name	Common Name	Exotic	Plot 1 Cover	Plot 1 Abundance	Plot 31 Cover	Plot 31 Abundance	Plot 36 Cover	Plot 36 Abundance	Plot 47 Cover	Plot 47 Abundance
Myrtaceae	*Syncarpia glomulifera*	Turpentine		1	3	20	16	40	200		
Orchidaceae	*Pterostylis* sp.	Greenhood				1	3				
Orchidaceae	*Themeda australis*	Kangaroo Grass		1	50						
Oxalidaceae	*Oxalis* sp.			1	1						
Phormiaceae	*Dianella caerulea*	Blue Flax-lily		1	50						
Phormiaceae	*Dianella revoluta*	Blueberry Lily						1	12		
Phormiaceae	*Dianella* sp.					1	4				
Phyllanthaceae	*Breynia oblongifolia*	Coffee Bush				1	2	1	3		
Phyllanthaceae	*Glochidion ferdinandi*	Cheese Tree						1	5		
Pittosporaceae	*Billardiera scandens*	Hairy Apple Berry		1	3	1	1	1	5	1	3
Poaceae	*Aristida vagans*	Threeawn Speargrass		1	6						
Poaceae	*Digitaria diffusa*	Open Summer-grass				1	3				
Poaceae	*Digitaria parviflora*	Small-flowered Finger Grass		1	2						
Poaceae	*Echinopogon* sp.	A Hedgehog Grass		1	2						
Poaceae	*Entolasia marginata*	Bordered Panic				1	1				
Poaceae	*Entolasia stricta*	Wiry Panic		70	1000	20	1000	2	200	70	100
Poaceae	*Imperata cylindrica*	Blady Grass		1	10	1	50	1	50	1	1
Poaceae	*Oplismenus imbecillis*					3	100	1	100		
Poaceae	*Ottochloa gracillima*					1	1				
Poaceae	*Panicum simile*	Two-colour Panic								1	1
Poaceae	*Austrostipa pubescens*									1	9
Proteaceae	*Persoonia stradbrokensis*					1	5	1	2		
Sapindaceae	*Dodonaea triquetra*	Large-leaf Hop-bush				1	2	1	5		
Smilacaceae	*Smilax australis*	Lawyer Vine				1	1	1	1		

Family	Scientific Name	Common Name	Exotic	Plot 1 Cover	Plot 1 Abundance	Plot 31 Cover	Plot 31 Abundance	Plot 36 Cover	Plot 36 Abundance	Plot 47 Cover	Plot 47 Abundance
Violaceae	*Hybanthus stellarioides*							1	2		
Xanthorrhoeaceae	*Xanthorrhoea* sp.									15	100

Notes: Cover – visual estimate of foliage projective cover within the plot, recorded from 1–5% and then to the nearest 5%.

Abundance - relative number of individuals or shoots of a species within the plot. Based on the following intervals: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 20, 50, 100, 500, 1000. Counts above 20 are estimates only

Flora species within NR247 (plots 21, 38 and 39)

Family	Scientific Name	Common Name	Exotic	Plot 21 Cover	Plot 21 Abundance	Plot 38 Cover	Plot 38 Abundance	Plot 39 Cover	Plot 39 Abundance
Acanthaceae	*Pseuderanthemum variabile*	Pastel Flower		1	50	1	50	1	40
Adiantaceae	*Cheilanthes sieberi*	Rock Fern		1	1				
Adiantaceae	*Cheilanthes* sp.	Cloak Fern, Mulga Fern, Rock Fern				1	15	1	4
Apiaceae	*Centella asiatica*	Indian Pennywort		1	1				
Apocynaceae	*Marsdenia* sp.			1	1				
Asteraceae	*Ozothamnus diosmifolius*	White Dogwood				1	6		
Asteraceae	*Vernonia cinerea*			1	30	1	100	1	1
Casuarinaceae	*Allocasuarina littoralis*	Black She-Oak		25	20			3	10
Casuarinaceae	*Allocasuarina torulosa*	Forest Oak				1	5	2	4
Convolvulaceae	*Polymeria calycina*			1	30	1	3		
Cyperaceae	*Cyperus* sp.			1	1				
Cyperaceae	*Fimbristylis dichotoma*	Common Fringe-sedge				1	2		
Cyperaceae	*Lepidosperma laterale*	Variable Sword-sedge		2	50	2	50	1	50
Fabaceae (Faboideae)	*Desmodium gunnii*	Slender Tick-trefoil						1	1
Fabaceae (Faboideae)	*Desmodium varians*	Slender Tick-trefoil						1	3
Fabaceae (Faboideae)	*Glycine microphylla*	Small-leaf Glycine		2	50				
Fabaceae (Faboideae)	*Glycine* sp.					1	3	1	7
Fabaceae (Faboideae)	*Jacksonia scoparia*	Dogwood						1	1
Fabaceae (Faboideae)	*Pultenaea retusa*					1	1		
Fabaceae (Mimosoideae)	*Acacia concurrens*	Curracabah		10	20	1	4	10	50

Family	Scientific Name	Common Name	Exotic	Plot 21 Cover	Plot 21 Abundance	Plot 38 Cover	Plot 38 Abundance	Plot 39 Cover	Plot 39 Abundance
Fabaceae (Mimosoideae)	*Acacia floribunda*	White Sally				1	2		
Goodeniaceae	*Goodenia ovata*	Hop Goodenia				1	5	1	1
Goodeniaceae	*Goodenia rotundifolia*			1	20				
Haloragaceae	*Gonocarpus* sp.	Raspwort		1	10				
Haloragaceae	*Gonocarpus tetragynus*	Poverty Raspwort				1	2		
Lauraceae	*Cassytha* sp.			1	2				
Lobeliaceae	*Pratia purpurascens*	Whiteroot		1	20			1	1
Lomandraceae	*Lomandra filiformis*	Wattle Matt-rush				1	100		
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush		10	50	30	400	1	2
Myrtaceae	*Callistemon salignus*	Willow Bottlebrush				1	2		
Myrtaceae	*Corymbia variegata*			10	1	20	7	20	5
Myrtaceae	*Eucalyptus cameronii*	Diehard Stringybark		5	1				
Myrtaceae	*Eucalyptus carnea*	Thick-leaved Mahogany				20	9	15	5
Myrtaceae	*Eucalyptus microcorys*	Tallowwood		20	2				
Myrtaceae	*Eucalyptus propinqua*	Small-fruited Grey Gum		20	10				
Myrtaceae	*Eucalyptus siderophloia*	Grey Ironbark		10	1	2	2	5	3
Myrtaceae	*Lophostemon confertus*	Brush Box		10	20			1	1
Myrtaceae	*Sannantha angusta*							1	2
Myrtaceae	*Sannantha pluriflora*			10	30				
Oxalidaceae	*Oxalis* sp.			1	1	1	1		
Phormiaceae	*Dianella caerulea*	Blue Flax-lily						1	2
Phormiaceae	*Dianella longifolia*	Blueberry Lily		1	5				
Phormiaceae	*Dianella revoluta*	Blueberry Lily				1	1		
Phyllanthaceae	*Breynia oblongifolia*	Coffee Bush		1	1				
Phyllanthaceae	*Glochidion ferdinandi*	Cheese Tree		1	5				
Poaceae	*Andropogon virginicus*	Whisky Grass	*			1	5		

Family	Scientific Name	Common Name	Exotic	Plot 21 Cover	Plot 21 Abundance	Plot 38 Cover	Plot 38 Abundance	Plot 39 Cover	Plot 39 Abundance
Poaceae	*Aristida vagans*	Threeawn Speargrass		2	50	1	20	1	3
Poaceae	*Cymbopogon refractus*	Barbed Wire Grass		1	10	1	2	1	1
Poaceae	*Dichelachne* sp.	A Plumegrass						1	1
Poaceae	*Digitaria diffusa*	Open Summer-grass		2	30	1	2	1	2
Poaceae	*Digitaria parviflora*	Small-flowered Finger Grass		3	50	1	4	1	3
Poaceae	*Echinopogon* sp.	A Hedgehog Grass		1	20	1	1		
Poaceae	*Entolasia marginata*	Bordered Panic		15	100				
Poaceae	*Entolasia stricta*	Wiry Panic		30	500	30	1000	20	1000
Poaceae	*Eragrostis brownii*	Brown's Lovegrass		1	20				
Poaceae	*Eragrostis* sp.	A Lovegrass	*			1	10	1	1
Poaceae	*Imperata cylindrica*	Blady Grass		5	50			2	100
Poaceae	*Panicum simile*	Two-colour Panic		1	20	1	12	1	3
Poaceae	*Sporobolus fertilis*	Giant Parramatta Grass	*			1	1		
Poaceae	*Themeda australis*	Kangaroo Grass		1	5			1	2
Proteaceae	*Persoonia stradbrokensis*			1	1	1	5		
Rubiaceae	*Pomax Umbellata*	Pomax						1	1
Verbenaceae	*Lantana camara*	Lantana	*					1	1
Violaceae	*Hybanthus stellarioides*			1	2				

Notes: Cover – visual estimate of foliage projective cover within the plot, recorded from 1–5% and then to the nearest 5%.

Abundance - relative number of individuals or shoots of a species within the plot. Based on the following intervals: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 20, 50, 100, 500, 1000. Counts above 20 are estimates only

Flora species within NR160, NR228 and NR119 (plots 30, 32, 34 and 35)

Family	Scientific Name	Common Name	Exotic	Plot 30 Cover	Plot 30 Abundance	Plot 32 Cover	Plot 32 Abundance	Plot 34 Cover	Plot 34 Abundance	Plot 35 Cover	Plot 35 Abundance
Acanthaceae	*Pseuderanthemum variabile*	Pastel Flower		1	50			1	10	1	30
Apiaceae	*Centella asiatica*	Indian Pennywort		1	10						
Apocynaceae	*Parsonsia straminea*	Common Silkpod				1	1				
Apocynaceae	*Tabernaemontana pandacaqui*	Banana Bush		1	2						
Araceae	*Gymnostachys anceps*	Settler's Twine		1	1						
Araliaceae	*Polyscias sambucifolia*	Elderberry Panax						1	2		
Asteliaceae	*Cordyline stricta*	Narrow-leaved Palm Lily		1	2						
Asteraceae	*Vernonia cinerea*							1	2		
Bignoniaceae	*Pandorea pandorana*	Wonga Wonga Vine						1	2		
Casuarinaceae	*Allocasuarina littoralis*	Black She-Oak								15	25
Casuarinaceae	*Allocasuarina torulosa*	Forest Oak						2	15		
Convolvulaceae	*Polymeria calycina*			1	10	1	2	1	5		
Cyperaceae	*Carex appressa*	Tall Sedge		1	2						
Cyperaceae	*Carex fascicularis*	Tassel Sedge				1	2				
Cyperaceae	*Carex maculata*			1	25	1	6				
Cyperaceae	*Gahnia sieberiana*	Red-fruit Saw-sedge				1	3				
Cyperaceae	*Gahnia* sp.			1	5						
Cyperaceae	*Lepidosperma laterale*	Variable Sword-sedge						1	1	5	200
Dennstaedtiaceae	*Hypolepis muelleri*	Harsh Ground Fern		5	100						

Family	Scientific Name	Common Name	Exotic	Plot 30 Cover	Plot 30 Abundance	Plot 32 Cover	Plot 32 Abundance	Plot 34 Cover	Plot 34 Abundance	Plot 35 Cover	Plot 35 Abundance
Dennstaedtiaceae	*Pteridium esculentum*	Bracken		3	50						
Dicksoniaceae	*Calochlaena dubia*	Rainbow Fern		1	5						
Dilleniaceae	*Hibbertia aspera*	Rough Guinea Flower						1	100	1	7
Dilleniaceae	*Hibbertia diffusa*	Wedge Guinea Flower						1	50		
Dilleniaceae	*Hibbertia scandens*	Climbing Guinea Flower		1	1						
Dioscoreaceae	*Dioscorea transversa*	Native Yam		1	20						
Ericaceae	*Monotoca scoparia*							1	4		
Fabaceae (Faboideae)	*Bossiaea rhombifolia*							1	4		
Fabaceae (Faboideae)	*Desmodium varians*	Slender Tick-trefoil				1	1	1	2	1	1
Fabaceae (Faboideae)	*Glycine clandestina*	Twining glycine						1	50		
Fabaceae (Faboideae)	*Glycine* sp.			1	1			1	50		
Fabaceae (Faboideae)	*Gompholobium pinnatum*	Pinnate Wedge Pea								1	1
Fabaceae (Faboideae)	*Pultenaea myrtoides*									1	1
Fabaceae (Faboideae)	*Pultenaea retusa*							1	3		
Fabaceae (Mimosoideae)	*Acacia binervata*	Two-veined Hickory				1	1				
Fabaceae (Mimosoideae)	*Acacia concurrens*	Curracabah						1	6	1	1
Fabaceae (Mimosoideae)	*Acacia floribunda*	White Sally		1	2	5	50	1	1	1	2
Fabaceae (Mimosoideae)	*Acacia irrorata*	Green Wattle						1	2	1	2
Goodeniaceae	*Dampiera sylvestris*									1	1

Family	Scientific Name	Common Name	Exotic	Plot 30 Cover	Plot 30 Abundance	Plot 32 Cover	Plot 32 Abundance	Plot 34 Cover	Plot 34 Abundance	Plot 35 Cover	Plot 35 Abundance
Goodeniaceae	*Goodenia rotundifolia*									1	4
Haloragaceae	*Gonocarpus tetragynus*	Poverty Raspwort		1	1			1	3		
Juncaceae	*Juncus* sp.	A Rush				1	10				
Lauraceae	*Cinnamomum camphora*	Camphor Laurel	*			1	1	1	1	1	1
Lauraceae	*Cryptocarya microneura*	Murrogun				1	2				
Lindsaeaceae	*Lindsaea microphylla*	Lacy Wedge Fern						1	2	1	50
Lobeliaceae	*Pratia purpurascens*	Whiteroot		1	10					1	3
Lomandraceae	*Lomandra filiformis*	Wattle Matt-rush						1	2		
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush						3	50	2	50
Lomandraceae	*Lomandra multiflora* subsp. *multiflora*	Many-flowered Mat-rush						1	1	1	5
Luzuriagaceae	*Eustrephus latifolius*	Wombat Berry				1	1	1	2		
Meliaceae	*Synoum glandulosum subsp. glandulosum*	Scentless Rosewood		1	1						
Myrtaceae	*Acmena smithii*	Lilly Pilly		1	1						
Myrtaceae	*Callistemon salignus*	Willow Bottlebrush		1	2	3	4	1	1	1	5
Myrtaceae	*Corymbia gummifera*	Red Bloodwood								2	2
Myrtaceae	*Eucalyptus cameronii*	Diehard Stringybark		25	3	1	1	2	1	25	4
Myrtaceae	*Eucalyptus grandis*	Flooded Gum		25	3	25	9				
Myrtaceae	*Eucalyptus microcorys*	Tallowwood						5	1		
Myrtaceae	*Eucalyptus pilularis*	Blackbutt						20	2		
Myrtaceae	*Eucalyptus resinifera*	Red Mahogany						5	1		
Myrtaceae	*Eucalyptus siderophloia*	Grey Ironbark								2	1
Myrtaceae	*Eucalyptus signata*	Scribbly Gum				2	2			15	3

Family	Scientific Name	Common Name	Exotic	Plot 30 Cover	Plot 30 Abundance	Plot 32 Cover	Plot 32 Abundance	Plot 34 Cover	Plot 34 Abundance	Plot 35 Cover	Plot 35 Abundance
Myrtaceae	*Leptospermum polygalifolium*	Tantoon				5	50				
Myrtaceae	*Lophostemon confertus*	Brush Box						1	5		
Myrtaceae	*Melaleuca linariifolia*	Flax-leaved Paperbark		10	9	5	11				
Myrtaceae	*Melaleuca styphelioides*	Prickly-leaved Tea Tree								1	2
Myrtaceae	*Sannantha angusta*			10	50	60	500			15	100
Myrtaceae	*Syncarpia glomulifera*	Turpentine		7	2			2	9		
Oleaceae	*Notelaea ovata*									1	1
Orchidaceae	*Pterostylis* sp.	Greenhood								1	1
Phormiaceae	*Dianella caerulea*	Blue Flax-lily						1	10	1	20
Phormiaceae	*Dianella revoluta*	Blueberry Lily		1	20						
Phyllanthaceae	*Glochidion ferdinandi*	Cheese Tree		1	2						
Pittosporaceae	*Billardiera scandens*	Hairy Apple Berry		1	6	1	20	1	1	1	1
Pittosporaceae	*Pittosporum revolutum*	Rough Fruit Pittosporum								1	2
Poaceae	*Cymbopogon refractus*	Barbed Wire Grass						1	10		
Poaceae	*Digitaria diffusa*	Open Summer-grass						1	1		
Poaceae	*Entolasia marginata*	Bordered Panic		5	1000	1	50				
Poaceae	*Entolasia stricta*	Wiry Panic		1	100	1	100	5	200	30	1000
Poaceae	*Imperata cylindrica*	Blady Grass						20	1000		
Poaceae	*Oplismenus imbecillis*			5	1000						
Poaceae	*Ottochloa gracillima*			30	1000						
Proteaceae	*Lomatia silaifolia*	Crinkle Bush						1	4		
Proteaceae	*Persoonia stradbrokensis*							1	1	1	4
Rubiaceae	*Morinda jasminoides*	Sweet Morinda				1	2				

Family	Scientific Name	Common Name	Exotic	Plot 30 Cover	Plot 30 Abundance	Plot 32 Cover	Plot 32 Abundance	Plot 34 Cover	Plot 34 Abundance	Plot 35 Cover	Plot 35 Abundance
Rutaceae	*Acronychia oblongifolia*	White Aspen		1	1						
Violaceae	*Viola hederacea*	Ivy-leaved Violet		1	10						

Notes: Cover – visual estimate of foliage projective cover within the plot, recorded from 1–5% and then to the nearest 5%.

Abundance - relative number of individuals or shoots of a species within the plot. Based on the following intervals: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 20, 50, 100, 500, 1000. Counts above 20 are estimates only

Flora species within NR117 (plots 4, 29 and 37)

Family	Scientific Name	Common Name	Exotic	Plot 4 Cover	Plot 4 Abundance	Plot 29 Cover	Plot 29 Abundance	Plot 37 Cover	Plot 37 Abundance
Acanthaceae	*Pseuderanthemum variabile*	Pastel Flower		1	50	1	200	1	50
Apiaceae	*Centella asiatica*	Indian Pennywort				1	1		
Apocynaceae	*Parsonsia straminea*	Common Silkpod		1	1	1	1		
Araceae	*Gymnostachys anceps*	Settler's Twine		1	1				
Araliaceae	*Polyscias sambucifolia*	Elderberry Panax		1	3				
Asteraceae	*Vernonia cinerea*			1	1				
Bignoniaceae	*Pandorea pandorana*	Wonga Wonga Vine						1	1
Casuarinaceae	*Allocasuarina littoralis*	Black She-Oak				2	2		
Casuarinaceae	*Allocasuarina torulosa*	Forest Oak						1	20
Convolvulaceae	*Polymeria calycina*					1	2		
Cyperaceae	*Lepidosperma laterale*	Variable Sword-sedge		1	50			2	100
Dennstaedtiaceae	*Pteridium esculentum*	Bracken		1	10	1	5	1	5
Dilleniaceae	*Hibbertia aspera*	Rough Guinea Flower		1	11				
Dilleniaceae	*Hibbertia scandens*	Climbing Guinea Flower				1	2		
Dilleniaceae	*Hibbertia vestita*							1	30
Fabaceae (Faboideae)	*Desmodium gunnii*	Slender Tick-trefoil				1	50		
Fabaceae (Faboideae)	*Desmodium varians*	Slender Tick-trefoil		1	1			1	3
Fabaceae (Faboideae)	*Glycine* sp.			1	6	1	2	1	10
Fabaceae (Mimosoideae)	*Acacia binervata*	Two-veined Hickory		1	2	1	2		
Fabaceae (Mimosoideae)	*Acacia floribunda*	White Sally		1	2	5	4	1	13
Fabaceae (Mimosoideae)	*Acacia irrorata*	Green Wattle		1	1	5	4	1	5

Family	Scientific Name	Common Name	Exotic	Plot 4 Cover	Plot 4 Abundance	Plot 29 Cover	Plot 29 Abundance	Plot 37 Cover	Plot 37 Abundance
Goodeniaceae	*Dampiera sylvestris*							1	11
Goodeniaceae	*Goodenia rotundifolia*							1	8
Haloragaceae	*Gonocarpus tetragynus*	Poverty Raspwort						1	1
Iridaceae	*Patersonia sericea*	Silky Purple-Flag						1	5
Lauraceae	*Cassytha sp.*					1	10		
Lauraceae	*Cinnamomum camphora*	Camphor Laurel	*	1	3				
Lauraceae	*Cryptocarya microneura*	Murrogun				1	10		
Lindsaeaceae	*Lindsaea microphylla*	Lacy Wedge Fern						1	5
Lobeliaceae	*Pratia purpurascens*	Whiteroot		1	1				
Lomandraceae	*Lomandra filiformis*	Wattle Matt-rush						1	2
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush		1	5	5	200	2	50
Luzuriagaceae	*Eustrephus latifolius*	Wombat Berry		1	25	1	3	1	3
Meliaceae	*Synoum glandulosum subsp. glandulosum*	Scentless Rosewood				1	1		
Myrtaceae	*Callistemon salignus*	Willow Bottlebrush		1	3	1	5	1	20
Myrtaceae	*Corymbia intermedia*	Pink Bloodwood		1	2			1	1
Myrtaceae	*Eucalyptus cameronii*	Diehard Stringybark				15	3		
Myrtaceae	*Eucalyptus microcorys*	Tallowwood		10	2	1	1		
Myrtaceae	*Eucalyptus pilularis*	Blackbutt		30	2	15	2	30	3
Myrtaceae	*Eucalyptus resinifera*	Red Mahogany				1	1		
Myrtaceae	*Leptospermum polygalifolium*	Tantoon		1	10	10	100	2	20
Myrtaceae	*Leptospermum trinervium*	Slender Tea-tree						1	3
Myrtaceae	*Lophostemon confertus*	Brush Box						1	4
Myrtaceae	*Melaleuca styphelioides*	Prickly-leaved Tea Tree						1	3
Myrtaceae	*Sannantha angusta*			1	20	10	100	15	100
Myrtaceae	*Syncarpia glomulifera*	Turpentine		20	70			20	100

Family	Scientific Name	Common Name	Exotic	Plot 4 Cover	Plot 4 Abundance	Plot 29 Cover	Plot 29 Abundance	Plot 37 Cover	Plot 37 Abundance
Orchidaceae	*Pterostylis sp.*	Greenhood						1	1
Phormiaceae	*Dianella caerulea*	Blue Flax-lily		1	1				
Phormiaceae	*Dianella revoluta*	Blueberry Lily				1	100		
Pittosporaceae	*Billardiera scandens*	Hairy Apple Berry		1	5	1	4	1	6
Poaceae	*Digitaria diffusa*	Open Summer-grass				1	1		
Poaceae	*Entolasia marginata*	Bordered Panic				1	50		
Poaceae	*Entolasia stricta*	Wiry Panic		2	100	5	500	10	1000
Poaceae	*Imperata cylindrica*	Blady Grass		2	200	1	50	1	20
Poaceae	*Oplismenus aemulus*			1	2	1	100		
Poaceae	*Oplismenus imbecillis*							1	50
Poaceae	*Paspalidium distans*					1	10		
Poaceae	*Themeda australis*	Kangaroo Grass						1	1
Proteaceae	*Persoonia stradbrokensis*			1	5			1	3
Rubiaceae	*Pomax Umbellata*	Pomax		1	1			1	5
Violaceae	*Hybanthus stellarioides*					1	10		
Xanthorrhoeaceae	*Xanthorrhoea sp.*							1	1

Notes: Cover – visual estimate of foliage projective cover within the plot, recorded from 1–5% and then to the nearest 5%.

Abundance - relative number of individuals or shoots of a species within the plot. Based on the following intervals: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 20, 50, 100, 500, 1000. Counts above 20 are estimates only

Flora species within NR246 (plots 3, 20, 23, 24 and 40)

Family	Scientific Name	Common Name	Exotic	Plot 3 Cover	Plot 3 Abundance	Plot 20 Cover	Plot 20 Abundance	Plot 23 Cover	Plot 23 Abundance	Plot 24 Cover	Plot 24 Abundance	Plot 40 Cover	Plot 40 Abundance
Acanthaceae	*Pseuderanthemum variabile*	Pastel Flower		1	20	1	20	1	20	1	100	1	4
Araliaceae	*Polyscias sambucifolia*	Elderberry Panax				1	4	1	6				
Asteraceae	*Vernonia cinerea*					1	3						
Bignoniaceae	*Pandorea pandorana*	Wonga Wonga Vine				1	1			1	2		
Casuarinaceae	*Allocasuarina littoralis*	Black She-Oak		20	70	1	3			4	18	20	400
Casuarinaceae	*Allocasuarina torulosa*	Forest Oak				2	8	3	20				
Convolvulaceae	*Polymeria calycina*					1	10			1	100	1	50
Cyperaceae	*Carex maculata*					1	1						
Cyperaceae	*Lepidosperma laterale*	Variable Sword-sedge		1	50	1	100	2	100	2	50	2	100
Dilleniaceae	*Hibbertia aspera*	Rough Guinea Flower		1	3	1	20	1	1	1	1	1	2
Dilleniaceae	*Hibbertia diffusa*	Wedge Guinea Flower						1	20				
Fabaceae (Faboideae)	*Desmodium gunnii*	Slender Tick-trefoil						1	3				
Fabaceae (Faboideae)	*Desmodium varians*	Slender Tick-trefoil						1	6				
Fabaceae (Faboideae)	*Glycine clandestina*	Twining glycine				1	5	1	6	1	1	1	2
Fabaceae (Faboideae)	*Hardenbergia violacea*	False Sarsaparilla				1	1						
Fabaceae (Faboideae)	*Jacksonia scoparia*	Dogwood						1	3				
Fabaceae (Faboideae)	*Pultenaea retusa*			1	1			1	2				

Family	Scientific Name	Common Name	Exotic	Plot 3 Cover	Plot 3 Abundance	Plot 20 Cover	Plot 20 Abundance	Plot 23 Cover	Plot 23 Abundance	Plot 24 Cover	Plot 24 Abundance	Plot 40 Cover	Plot 40 Abundance
Fabaceae (Faboideae)	*Pultenaea villosa*	Hairy Bush-pea						1	1				
Fabaceae (Mimosoideae)	*Acacia concurrens*	Curracabah		1	1	1	6	3	13	1	15	1	11
Fabaceae (Mimosoideae)	*Acacia floribunda*	White Sally		1	3								
Goodeniaceae	*Goodenia ovata*	Hop Goodenia		1	2					1	3		
Goodeniaceae	*Goodenia rotundifolia*					1	2						
Haloragaceae	*Gonocarpus* sp.	Raspwort				1	1						
Haloragaceae	*Gonocarpus tetragynus*	Poverty Raspwort								1	1		
Lauraceae	*Cassytha* sp.									1	10		
Lauraceae	*Cinnamomum camphora*	Camphor Laurel	*					1	1				
Lindsaeaceae	*Lindsaea microphylla*	Lacy Wedge Fern				1	10						
Lobeliaceae	*Pratia purpurascens*	Whiteroot								1	1	1	1
Lomandraceae	*Lomandra filiformis*	Wattle Matt-rush				1	5			1	5	1	12
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush		1	3	2	100	5	100	30	400	1	1
Lomandraceae	*Lomandra multiflora subsp. multiflora*	Many-flowered Mat-rush		1	2	1	20			1	1		
Lomandraceae	*Lomandra* sp.	Mat-rush						1	20				
Luzuriagaceae	*Eustrephus latifolius*	Wombat Berry				1	6	1	5				
Myrtaceae	*Callistemon salignus*	Willow Bottlebrush		1	1					1	6		

Family	Scientific Name	Common Name	Exotic	Plot 3 Cover	Plot 3 Abundance	Plot 20 Cover	Plot 20 Abundance	Plot 23 Cover	Plot 23 Abundance	Plot 24 Cover	Plot 24 Abundance	Plot 40 Cover	Plot 40 Abundance
Myrtaceae	*Corymbia gummifera*	Red Bloodwood								10	4	2	3
Myrtaceae	*Corymbia intermedia*	Pink Bloodwood				3	2	1	3				
Myrtaceae	*Corymbia variegata*			10	3							3	1
Myrtaceae	*Eucalyptus cameronii*	Diehard Stringybark				4	2	2	1	5	3	1	1
Myrtaceae	*Eucalyptus carnea*	Thick-leaved Mahogany		1	2	4	2	10	4				
Myrtaceae	*Eucalyptus globoidea*	White Stringybark				2	1						
Myrtaceae	*Eucalyptus microcorys*	Tallowwood				10	2	10	1	1	1		
Myrtaceae	*Eucalyptus seeana*	Narrow-leaved Red Gum		5	4							6	4
Myrtaceae	*Eucalyptus siderophloia*	Grey Ironbark		3	5	7	2	5	3	10	2	3	2
Myrtaceae	*Leptospermum polygalifolium*	Tantoon				2	7						
Myrtaceae	*Lophostemon confertus*	Brush Box				5	20			3	8	1	7
Myrtaceae	*Melaleuca sieberi*			2	16								
Myrtaceae	*Melaleuca styphelioides*	Prickly-leaved Tea Tree								1	2		
Myrtaceae	*Sannantha angusta*			1	7	1	8			2	23	1	5
Myrtaceae	*Syncarpia glomulifera*	Turpentine						2	8				
Oleaceae	*Notelaea ovata*											1	1
Oxalidaceae	*Oxalis* sp.					1	5			1	1		
Phormiaceae	*Dianella caerulea*	Blue Flax-lily		1	1	1	50			1	50	1	5
Phyllanthaceae	*Breynia oblongifolia*	Coffee Bush								1	7		

Family	Scientific Name	Common Name	Exotic	Plot 3 Cover	Plot 3 Abundance	Plot 20 Cover	Plot 20 Abundance	Plot 23 Cover	Plot 23 Abundance	Plot 24 Cover	Plot 24 Abundance	Plot 40 Cover	Plot 40 Abundance
Pittosporaceae	*Billardiera scandens*	Hairy Apple Berry				1	2	1	3				
Poaceae	*Cymbopogon refractus*	Barbed Wire Grass				1	3						
Poaceae	*Digitaria diffusa*	Open Summer-grass						1	20			1	4
Poaceae	*Digitaria parviflora*	Small-flowered Finger Grass		1	5								
Poaceae	*Entolasia marginata*	Bordered Panic				1	100						
Poaceae	*Entolasia stricta*	Wiry Panic		50	1000	10	1000	10	1000	20	1000	60	1000
Poaceae	*Eragrostis leptostachya*	Paddock Lovegrass						1	3				
Poaceae	*Imperata cylindrica*	Blady Grass				1	100	1	100	1	20		
Poaceae	*Ischaemum australe*			1	2								
Poaceae	*Microlaena stipoides*	Weeping Grass		1	5								
Poaceae	*Panicum simile*	Two-colour Panic		1	1	1	10	1	5			1	1
Poaceae	*Themeda australis*	Kangaroo Grass		1	1								
Proteaceae	*Lomatia silaifolia*	Crinkle Bush						1	10				
Proteaceae	*Persoonia stradbrokensis*							1	1	1	1		
Rubiaceae	*Pomax umbellata*	Pomax						1	30				
Sapindaceae	*Dodonaea triquetra*	Large-leaf Hop-bush								1	8		
Violaceae	*Hybanthus stellarioides*											1	1
Xanthorrhoeaceae	*Xanthorrhoea macronema*							2	30				

Notes: Cover – visual estimate of foliage projective cover within the plot, recorded from 1–5% and then to the nearest 5%.

Abundance - relative number of individuals or shoots of a species within the plot. Based on the following intervals: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 20, 50, 100, 500, 1000. Counts above 20 are estimates only

NH2U Norton offset area BioBanking plot/transect data

Fauna habitat type	Veg Type ID	Plot ID	Native plant species richness	Native over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Over storey regen.	Total length of fallen logs	Easting	Northing	Zone
Dry sclero-phyll forest	NR222	Bench-mark	44	15-50	10-40	5-50	5-40	5-70	0	0.1	1.0	> = 20			
		41	29	11	20	72	6	4	0	0	0.6	16	483557	6555694	56
		42	27	12	9	24	4	64	0	0	0.6	5	483712	6555651	56
	NR228	Bench-mark	35	15-50	5-70	5-70	5-60	5-80	0	1.5	1	> = 10			
		6	30	18	44.5	24	10	16	0	1	1	17	485202	6554907	56
		16	33	21.7	34.5	80	16	18	0	3	1	94	484506	6554741	56
		5	34	22.2	0	44	6	2	0	2	1	300	484815	6555175	56
		19	35	7.8	19.1	90	8	22	0	0	1	142	485241	6554276	56
		51	36	18	20.5	66	8	28	0	0	1	18	485598	6553851	56
	NR246	Bench-mark	37	20-50	10-60	10-60	5-60	10-50	0	1	1	10			
		26	32	30.5	14.5	42	0	44	38	0	0.6	126	484536	6557961	56
Dry sclero-phyll forest in low condition	NR246	Bench mark	37	20-50	10-60	10-60	5-60	10-50	0	1	1.0	10			
	Low	27	18	0	11	8	2	20	86	0	0.1	0	484466	6557804	56
		28	9	0	3	30	2	4	68	0	0.1	0	484310	6557831	56
Wet sclero - phyll forest	NR119	Bench-mark	44	15-50	10-40	5-50	5-40	5-70	0	0.1	1	> = 20			56

Fauna habitat type	Veg Type ID	Plot ID	Native plant species richness	Native over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Over storey regen.	Total length of fallen logs	Easting	Northing	Zone
		44	35	12.5	10.5	68	0	18	0	0	0.83	34	483940	6555015	56
		45	29	13	14.5	86	6	32	0	0	0.83	13	483134	6555782	56
		46	22	20.5	8.5	52	6	30	0	0	0.83	0	483570	6555859	56
	NR122	Bench-mark	49	20-90	15-90	0-50	10-70	5-90	0	10	1	> = 10			56
		18	44	30.5	55.5	64	28	40	0	1	0.5	76	485324	62555351	56
		25	42	38.5	30.5	24	22	20	0	0	0.5	82	485475	6554973	56
	NR160	Bench-mark	49	20-50	15-90	0-50	10-70	5-90	0	10	1.0	0.1			
		33	24	18.5	22.5	70	16	36	6	0	0.0	15	485132	6555423	56
	NR117	Bench-mark	49	20-90	15-90	0-50	10-70	5-90	0	0.1	1	10			
		43	42	15.5	21	54	18	36	0	1	0.6	40	484112	6555612	56
		50	35	14	18	60	38	8	0	0	0.6	9	483517	6555412	56
Grassy Woodland	NR161	Bench mark	27	10-35	5-30	10-60	0-10	5-25	0	1	1.0	5			
		48	36	9	18.5	54	6	28	2	0	1.0	0	483476	6555230	56
		49	28	6	20.5	50	16	54	0	0	1.0	18	483407	6555243	56

Norton offset site fauna observations

Common Name	Scientific Name	Exotic	NSW Status	EPBC Status	Observation Type
Amphibia					
Bibron's Toadlet	*Pseudophryne bibronii*				W
Bleating Tree Frog	*Litoria dentata*				W
Brown-striped Frog	*Limnodynastes peronii*				W
Common Eastern Froglet	*Crinia signifera*				W
Dusky Toadlet	*Uperoleia fusca*				W
Eastern Dwarf Tree Frog	*Litoria fallax*				W
Giant Barred Frog	*Mixophyes iteratus*		E	E	W
Haswell's Froglet	*Paracrinia haswelli*				W
Lesueur's Frog	*Litoria lesueuri*				O
Peron's Tree Frog	*Litoria peronii*				O
Red-backed Toadlet	*Pseudophryne coriacea*				W
Revealed Frog	*Litoria revelata*				W
Tyler's Tree Frog	*Litoria tyleri*				W
Aves					
Australian Magpie	*Cracticus tibicen*				O
Australian Owlet-nightjar	*Aegotheles cristatus*				W
Australian Raven	*Corvus coronoides*				OW
Australian Wood Duck	*Chenonetta jubata*				O
Bar-shouldered Dove	*Geopelia humeralis*				W
Bassian Thrush	*Zoothera lunulata*				W
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*				W
Brown Gerygone	*Gerygone mouki*				O
Brown Thornbill	*Acanthiza pusilla*				O
Brush Bronzewing	*Phaps elegans*				OW
Eastern Rosella	*Platycercus eximius*				O
Eastern Spinebill	*Acanthorhynchus tenuirostris*				O
Eastern Whipbird	*Psophodes olivaceus*				W
Eastern Yellow Robin	*Eopsaltria australis*				O
Fan-tailed Cuckoo	*Cacomantis flabelliformis*				W
Fuscous Honeyeater	*Lichenostomus fuscus*				O
Glossy Black-Cockatoo	*Calyptorhynchus lathami*		V		W
Golden Whistler	*Pachycephala pectoralis*				O
Grey Butcherbird	*Cracticus torquatus*				W
Grey Fantail	*Rhipidura albiscapa*				O

Common Name	Scientific Name	Exotic	NSW Status	EPBC Status	Observation Type
Grey Shrike-thrush	*Colluricincla harmonica*				W
Horsfield's Bronze-Cuckoo	*Chalcites basalis*				W
Indian Peafowl	*Pavo cristatus*	*			OW
Laughing Kookaburra	*Dacelo novaeguineae*				O
Leaden Flycatcher	*Myiagra rubecula*				OW
Lewin's Honeyeater	*Meliphaga lewinii*				O
Little Lorikeet	*Glossopsitta pusilla*		V		O
Little Raven	*Corvus mellori*				OW
Logrunner	*Orthonyx temminckii*				OW
Masked Lapwing	*Vanellus miles*				W
Mistletoebird	*Dicaeum hirundinaceum*				O
Musk Lorikeet	*Glossopsitta concinna*				W
New Holland Honeyeater	*Phylidonyris novaehollandiae*				W
Noisy Friarbird	*Philemon corniculatus*				O
Noisy Miner	*Manorina melanocephala*				OW
Olive-backed Oriole	*Oriolus sagittatus*				OW
Pacific Baza	*Aviceda subcristata*				W
Painted Button-quail	*Turnix varius*				O
Pallid Cuckoo	*Cacomantis pallidus*				W
Pied Butcherbird	*Cracticus nigrogularis*				OW
Pied Currawong	*Strepera graculina*				W
Rainbow Bee-eater	*Merops ornatus*			J	W
Rainbow Lorikeet	*Trichoglossus haematodus*				O
Red Wattlebird	*Anthochaera carunculata*				W
Red-browed Finch	*Neochmia temporalis*				O
Restless Flycatcher	*Myiagra inquieta*				W
Rose Robin	*Petroica rosea*				W
Rufous Whistler	*Pachycephala rufiventris*				W
Satin Bowerbird	*Ptilonorhynchus violaceus*				O
Shining Bronze-Cuckoo	*Chalcites lucidus*				O
Silvereye	*Zosterops lateralis*				OW
Spotted Pardalote	*Pardalotus punctatus*				W
Striated Thornbill	*Acanthiza lineata*		P		O
Superb Fairy-wren	*Malurus cyaneus*				W
Torresian Crow	*Corvus orru*				W
Varied Sittella	*Daphoenositta chrysoptera*		V		O

Common Name	Scientific Name	Exotic	NSW Status	EPBC Status	Observation Type
Variegated Fairy-wren	*Malurus lamberti*				O
Wedge-tailed Eagle	*Aquila audax*				O
Whistling Kite	*Haliastur sphenurus*				O
White-bellied Cuckoo-shrike	*Coracina papuensis*				O
White-browed Scrubwren	*Sericornis frontalis*				O
White-cheeked Honeyeater	*Phylidonyris niger*				O
White-naped Honeyeater	*Melithreptus lunatus*				O
White-throated Gerygone	*Gerygone olivacea*				W
White-throated Treecreeper	*Cormobates leucophaea*				W
Willie Wagtail	*Rhipidura leucophrys*				O
Yellow Thornbill	*Acanthiza nana*				OW
Yellow-faced Honeyeater	*Lichenostomus chrysops*				O
Yellow-tailed Black-cockatoo	*Calyptorhynchus funereus*				O
Yellow-throated Scrubwren	*Sericornis citreogularis*				O
Mammalia					
Common Brushtail Possum	*Trichosurus vulpecula*				O
Common Ringtail Possum	*Pseudocheirus peregrinus*				E
Dog	*Canis lupus familiaris*	*			F, Q
Eastern Grey Kangaroo	*Macropus giganteus*				O
European cattle	*Bos taurus*	*			O
Fox	*Vulpes vulpes*	*			F
Koala	*Phascolarctos cinereus*		V	V	O, P
Long-nosed Bandicoot	*Perameles nasuta*				W, Q
Red-necked Wallaby	*Macropus rufogriseus*				O
Sugar Glider	*Petaurus breviceps*				W
Swamp Wallaby	*Wallabia bicolor*				O, Q
White-striped Freetail-bat	*Tadarida australis*				W
Reptilia					
Copper-tailed Skink	*Ctenotus taeniolatus*				O
Eastern Water Dragon	*Intellagama lesueurii*				O
Lace Monitor	*Varanus varius*				O

Key: E – endangered, M – migratory, V – vulnerable. B – burrow; F – tracks, H – skin, K – dead, O – observed, P – scat, W – heard, Q – camera trap image.

Appendix B – Boambee SF Offset Site Field survey results

WC2NH Boambee SF offset site summary of survey effort

Fauna habitat type	Survey ID	Survey techniques	Easting	Northing	Zone
Dry sclerophyll forest	Camera 1	Camera trap	503368	6644314	56
	W5	BioBanking plot/transect, canopy plot and Koala SAT	503400	6644288	56
	W9	BioBanking plot/transect, canopy plot and Koala SAT	503595	6644194	56
Rainforest	Camera 4	Camera trap	504495	6644379	56
	W1	BioBanking plot/transect and canopy plot	503079	6643670	56
Wet sclerophyll forest	Camera 2	Camera trap	502493	6643940	56
	Camera 3	Camera trap	502819	6644133	56
	Camera 5	Camera trap	503368	6643673	56
	W10	BioBanking plot/transect, canopy plot and Koala SAT	502506	6643972	56
	W2	BioBanking plot/transect, canopy plot and Koala SAT	503220	6643795	56
	W3	BioBanking plot/transect, canopy plot and Koala SAT	503411	6643711	56
	W4	BioBanking plot/transect, canopy plot and Koala SAT	502734	6644161	56
	W6	BioBanking plot/transect, canopy plot and Koala SAT	503332	6644281	56
	W8	BioBanking plot/transect, canopy plot and Koala SAT	502997	6644170	56

Records of Marsdenia longiloba and Tylophora woollsii at the Boambee SF

Species	Stems	Sample ID	Eastings	Northings	Height (m)	Age class	Health	Offset area
Marsdenia longiloba	1	ML_B39	502380	6643927	0.05	Seedling	Apparently healthy	WC2NH offset area
Marsdenia longiloba	6	ML-13	502575	6644035	0.5 x 4, 0.6, 1	Adult	Apparently healthy	WC2NH offset area
Marsdenia longiloba	2	ML_B62	502638	6644211	0.3, 1.5	Adult	Apparently healthy	WC2NH offset area
Marsdenia longiloba	1	M_C2	502713.8	6644160	150	Adult	Apparently healthy	WC2NH offset area
Marsdenia longiloba	2	ML_16	502761	6644068	2, 0.8	Adult	Apparently healthy	WC2NH offset area
Marsdenia longiloba	1	ML-3	502832	6644180	0.1	Seedling	Apparently healthy	WC2NH offset area
Marsdenia longiloba	1	ML_B7	502858	6644161	0.5	Adult	Apparently healthy	WC2NH offset area
Marsdenia longiloba	1	ML-4	502866	6644150	0.2	Adult	Apparently healthy	WC2NH offset area
Marsdenia longiloba	3	ML-5	502940	6644115	0.3, 0.3, 0.7	Adult	Apparently healthy	WC2NH offset area
Marsdenia longiloba	3	ML-213	502943	6644136	<0.1x3	Seedling	Apparently healthy	WC2NH offset area
Marsdenia longiloba	2	ML-6	502981	6644125	0.2, 0.4	Adult	Apparently healthy	WC2NH offset area
Marsdenia longiloba	3	ML-8	502981	6644129	0.5 x 3	Adult	Apparently healthy	WC2NH offset area
Marsdenia longiloba	4	ML-7	502981	6644141	0.3 x 4, 0.6	Adult	Apparently healthy	WC2NH offset area
Marsdenia longiloba	5	ML_B48	502989	6644064	5x 0.05	Seedling	Apparently healthy	WC2NH offset area
Marsdenia longiloba	1	ML-212	502994	6644229	0.2	Adult	Apparently healthy	WC2NH offset area
Marsdenia longiloba	3	ML_B49	502995	6644063	3x0.05	Adult	Apparently healthy	WC2NH offset area
Marsdenia longiloba	1	ML_B50	503013	6644065	1.5	Adult	Apparently healthy	WC2NH offset area
Marsdenia longiloba	1	ML_B51	503030	6644069	0.4	Adult	Apparently healthy	WC2NH offset area
Marsdenia longiloba	4	ML_B46	503120	6644013	0.25, 3x 0.05	3 x seedings , 1 adult	Apparently healthy	WC2NH offset area
Marsdenia longiloba	1	ML_B40	503126	6644035	20.5	Adult	Apparently healthy	WC2NH offset area
Marsdenia longiloba	2	ML_B38	503128	6644104	0.3, 0.5	Adult	Apparently healthy	WC2NH offset area
Marsdenia longiloba	1	Mlb_45	503160	6643967	0.4	Adult	Apparently healthy	WC2NH offset area
Marsdenia longiloba	1	ML_B52	503202	6644014	0.8	Adult	Apparently healthy	WC2NH offset area
Marsdenia longiloba	4	ML_B62	503214	6643848	0.6, 0.3, 0.20, 1.5	Adult	Apparently healthy	WC2NH offset area
Marsdenia longiloba	2	ML_B37	503215	6644097	0.4, 0.7	Adult	Apparently healthy	WC2NH offset area
Marsdenia longiloba	3	ML_B53	503258	6644004	0.3, 0.3, 0.7	Adult	Apparently healthy	WC2NH offset area
Marsdenia longiloba	2	ML_B23	503290	6644220	0.4, 1.5	Adult	Apparently healthy	WC2NH offset area

Species	Stems	Sample ID	Eastings	Northings	Height (m)	Age class	Health	Offset area
Marsdenia longiloba	4	ML_B43	503357	6644127	0.1, 0.3, 0.1, 2	3x juveniles, 1 x adult	Apparently healthy	WC2NH offset area
Marsdenia longiloba	2	ML_B33	503395	6644193	0.1, 0.15	Seedling	Apparently healthy	WC2NH offset area
Marsdenia longiloba	2	ML_B54	503410	6644101	0.4, 0.15	Adult	Apparently healthy	WC2NH offset area
Marsdenia longiloba	5	ML_B55	503413	6644107	0.3, 0.3, 0.5,0.05, 0.3	Adult	Apparently healthy	WC2NH offset area
Marsdenia longiloba	1	ML_B32	503414	6644198	10.1	Adult	Apparently healthy	WC2NH offset area
Marsdenia longiloba	5	ML_B58	503421	6644030	120, 20, 5, 10, 0.4	Adult	Apparently healthy	WC2NH offset area
Marsdenia longiloba	1	ML_B57	503487	6644116	0.3	Adult	Apparently healthy	WC2NH offset area
Marsdenia longiloba	5	ML_B56	503497	6644150	0.05, 0.02, 0.5, 0.25, 0.20	2 x juveniles, 3 x adults	Apparently healthy	WC2NH offset area
Marsdenia longiloba	1	MLB6	502849.2	6644131.1	1	Adult	Apparently healthy	WC2NH offset area
Marsdenia longiloba	1	MLB10	502753.8	6644137.3	0.50	Adult	Apparently healthy	WC2NH offset area
Marsdenia longiloba	1	MLB18	503006.6	6644140.7	0.5	Adult	Apparently healthy	WC2NH offset area
Marsdenia longiloba	1	MLB5	502796.5	6644202.9	1	Adult	Apparently healthy	WC2NH offset area
Total in WC2NH offset area	**90**							
Marsdenia longiloba	2	ML_B47x	503499	6644483	0.3, 0.15	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-210	503526	6644597	2	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-209	503528	6644597	<0.1	Seedling	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-206	503534	6644586	<0.1	Seedling	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-207	503534	6644588	<0.1	Seedling	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-208	503534	6644588	<0.1	Seedling	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-205	503570	6644616	0.2	Seedling	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-202	503597	6644670	0.2	Seedling	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-203	503597	6644670	<0.1	Seedling	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-186	503615	6644681	0.2	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-187	503615	6644681	0.1	Seedling	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-188	503615	6644681	0.1	Seedling	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-189	503615	6644681	0.2	Adult	Apparently healthy	NH2U offset area

Species	Stems	Sample ID	Eastings	Northings	Height (m)	Age class	Health	Offset area
Marsdenia longiloba	1	ML-190	503615	6644681	0.1	Seedling	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-200	503619	6644671	0.2	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-201	503619	6644671	0.3	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-199	503620	6644670	0.2	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-198	503621	6644669	0.4	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-204	503629	6644669	<0.1	Seedling	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-193	503725	6644721	0.6	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	2	ML-191	503726	6644717	0.2x2	Seedling	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-192	503727	6644716	1	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	3	TW-120	503797	6644659	1.4, 0.4, 0.2	2 x adults, 1 seedling	Apparently healthy	NH2U offset area
Marsdenia longiloba	2	TW-119	503805	6644649	2.2, 1	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	3	TW-118	503807	6644678	3.8, 0.5, 0.4	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-122	503843	6644548	1.6	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	3	ML-115	503845	6644648	0.4, 0.2, 2.2	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-124	503869	6644541	1.5	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	2	ML-123	503880	6644526	1.2, 0.6	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	2	ML-125	503928	6644529	0.7, 6	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	2	ML-113	504047	6644610	2, <0.1	Seedling	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-114	504072	6644606	0.3	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-111	504072	6644614	0.9	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	3	ML-109	504078	6644624	0.3, 0.6, 0.4	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	5	ML-112	504080	6644610	<0.1x5	Seedling	Apparently healthy	NH2U offset area
Marsdenia longiloba	2	ML-110	504090	6644629	1.3, 0.2	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-108	504095	6644621	1.6	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	2	ML-107	504115	6644645	1.2, 1.0	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	4	ML-106	504126	6644619	0.2, 0.3x2, 0.4	3 x seedlings, 1 x adult.	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-99	504333	6644764	0.4	Adult	Apparently healthy	NH2U offset area

Species	Stems	Sample ID	Eastings	Northings	Height (m)	Age class	Health	Offset area
Marsdenia longiloba	1	ML-100	504357	6644714	0.3	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-101	504388	6644653	0.2	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-102	504426	6644634	0.4	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	3	ML-103	504527	6644601	0.2, 0.4, 0.6	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-174	504540	6644468	4	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-175	504549	6644479	1	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-173	504559	6644485	0.5	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-26	504568	6644588	0.6	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-24	504606	6644597	0.3	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-22	504616	6644612	0.3	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	2	ML-23	504617	6644582	0.5 x 2	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-21	504655	6644622	0.3	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	3	ML-29	504665	6644502	0.4 x 2, 0.2	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	2	ML-17	504697	6644521	0.1, 0.2	Seedling	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-137	504700	6644533	<0.1	Seedling	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-127	504700	6644546	1.4	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-136	504703	6644528	0.4	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-138	504704	6644532	0.4	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-139	504704	6644533	<0.1	Seedling	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-140	504704	6644533	0.7	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-20	504708	6644624	0.3	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-128	504709	6644544	1.6	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-141	504711	6644531	1.4	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-129	504711	6644544	<0.1	Seedling	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-130	504712	6644540	0.4	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-133	504713	6644539	0.3	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-134	504713	6644539	<0.1	Seedling	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-135	504713	6644539	<0.1	Seedling	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-144	504713	6644539	1.4	Adult	Apparently healthy	NH2U offset area

Species	Stems	Sample ID	Eastings	Northings	Height (m)	Age class	Health	Offset area
Marsdenia longiloba	1	ML-131	504713	6644540	0.3	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-132	504713	6644540	<0.1 scrambling	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-19	504715	6644554	0.3	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-143	504716	6644538	1	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	2	ML-18	504718	6644550	0.4, 0.6	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-145	504719	6644541	0.7	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-147	504721	6644544	0.4	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-148	504721	6644544	<0.1	Seedling	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-149	504721	6644544	<0.1	Seedling	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-150	504721	6644544	1.8	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-151	504721	6644544	<0.1	Seedling	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-152	504721	6644544	1.4	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-153	504722	6644535	2	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-142	504724	6644525	0.2	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-157	504725	6644526	0.7	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-146	504726	6644537	2	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-154	504729	6644529	0.5	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-156	504730	6644520	0.6	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-158	504735	6644537	<0.1	Seedling	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-159	504738	6644521	1.8	Adult	Apparently healthy	NH2U offset area
Marsdenia longiloba	1	ML-155	504750	6644523	<0.1	Seedling	Apparently healthy	NH2U offset area
Total in Boambee SF	**210**							
Tylophora woolsii	1	Tsp-9	502575	6644054	0.2	Adult	Apparently healthy	WC2NH offset area
Tylophora woolsii	1	TW_B13	502643	6644059	1.20, 0.6	Adult	Apparently healthy	WC2NH offset area
Tylophora woolsii	1	TW_B14	502664	6644065	0.2	Adult	Apparently healthy	WC2NH offset area
Tylophora woolsii	2	TW_15	502713	6644062	0.1, 0.5	Adult	Apparently healthy	WC2NH offset area
Tylophora woolsii	1	Tsp-1	502742	6644177	0.2	Adult	Apparently healthy	WC2NH offset area
Tylophora woolsii	1	Tsp-2	502770	6644187	0.2	Adult	Apparently healthy	WC2NH offset area

Species	Stems	Sample ID	Eastings	Northings	Height (m)	Age class	Health	Offset area
Tylophora woolsii	1	TW_9	502774	6644129	0.15	Adult	Apparently healthy	WC2NH offset area
Tylophora woolsii	2	TW_B8	502820	6644161	0.5, 0.1	Adult	Apparently healthy	WC2NH offset area
Tylophora woolsii	1	TW-214	502953	6644132	1.2	Adult	Apparently healthy	WC2NH offset area
Tylophora woolsii	1	TW-215	502959	6644132	0.5	Adult	Apparently healthy	WC2NH offset area
Tylophora woolsii	1	TW-216	502959	6644132	1	Adult	Apparently healthy	WC2NH offset area
Tylophora woolsii	1	775	502962	6644151	1	Adult	Apparently healthy	WC2NH offset area
Tylophora woolsii	1	TW-219	502972	6644199	0.5	Adult	Apparently healthy	WC2NH offset area
Tylophora woolsii	2	B1	502980	6644133	1.5, 0.20	Adult	Apparently healthy	WC2NH offset area
Tylophora woolsii	1	b2	502980	6644133	0.3	Adult	Apparently healthy	WC2NH offset area
Tylophora woolsii	1	TW-218	502985	6644133	0.5	Adult	Apparently healthy	WC2NH offset area
Tylophora woolsii	1	TW-217	502987	6644132	0.5	Adult	Apparently healthy	WC2NH offset area
Tylophora woolsii	1	b3	502994	6644141	1	Adult	Apparently healthy	WC2NH offset area
Tylophora woolsii	1	b4	503002	6644153	0.1	Seedling	Apparently healthy	WC2NH offset area
Tylophora woolsii	3	TW_B22	503056	6644219	2x0.1, 0.15	Seedling	Apparently healthy	WC2NH offset area
Tylophora woolsii	5	TW_B20	503065	6644257	4x0.1, 0.20	4 x seedlings, 1 x adult	Apparently healthy	WC2NH offset area
Tylophora woolsii	1	TW_B21	503069	6644240	0.1	Seedling	Apparently healthy	WC2NH offset area
Tylophora woolsii	2	TW_B19	503124	6644262	0.20, 0.6	Adult	Apparently healthy	WC2NH offset area
Tylophora woolsii	4	TW_B36	503217	6644100	2x0.05, 1.5, 2.2	2 x seedlings, 2 adults	Apparently healthy	WC2NH offset area
Tylophora woolsii	2	TW_B35	503226	6644107	0.05, 0.05	Seedling	Apparently healthy	WC2NH offset area
Tylophora woolsii	1	TW_b42	503255	6644027	2	Adult	Apparently healthy	WC2NH offset area
Tylophora woolsii	1	TW_C4	503314.9	6644262.5	0.3	Adult	Apparently healthy	WC2NH offset area
Tylophora woolsii	1	TW_B24	503344	6644254	0.05	Seedling	Apparently healthy	WC2NH offset area
Tylophora woolsii	1	TW-177	503344	6644292	1.3	Adult	Apparently healthy	WC2NH offset area
Tylophora woolsii	1	TW-178	503344	6644292	0.3	Adult	Apparently healthy	WC2NH offset area
Tylophora woolsii	1	TW-179	503344	6644292	0.3	Adult	Apparently healthy	WC2NH offset area
Tylophora woolsii	1	TW-180	503344	6644292	0.3	Adult	Apparently healthy	WC2NH offset area
Tylophora woolsii	1	TW-181	503344	6644292	0.3	Adult	Apparently healthy	WC2NH offset area

Species	Stems	Sample ID	Eastings	Northings	Height (m)	Age class	Health	Offset area
Tylophora woolsii	1	TW-182	503344	6644292	0.3	Adult	Apparently healthy	WC2NH offset area
Tylophora woolsii	1	TW-183	503349	6644289	0.3	Adult	Apparently healthy	WC2NH offset area
Tylophora woolsii	2	TW_C5	503353.4	6644276.1	0.3	Adult	Apparently healthy	WC2NH offset area
Tylophora woolsii	1	TW_B44	503360	6644136	1.4, 1	Adult	Apparently healthy	WC2NH offset area
Tylophora woolsii	1	TW-184	503360	6644300	0.2	Adult	Apparently healthy	WC2NH offset area
Tylophora woolsii	1	TWB_25	503373	6644266	0.20,	Adult	Apparently healthy	WC2NH offset area
Tylophora woolsii	1	TWB41	503228.1	6644006.6	1	Adult	Apparently healthy	WC2NH offset area
Tylophora woolsii	1	TWB12	502617	6644071	0.2	Adult	Apparently healthy	WC2NH offset area
Tylophora woolsii	1	MLB18	503006.5	6644140.7	0.15	Adult	Apparently healthy	WC2NH offset area
Total in WC2NH offset area	57							
Tylophora woolsii	1	TW-194	503746	6644816	0.8	Adult	Apparently healthy	NH2U offset area
Tylophora woolsii	1	TW-195	503746	6644816	<0.1	Seedling	Apparently healthy	NH2U offset area
Tylophora woolsii	1	TW-196	503746	6644816	<0.1	Seedling	Apparently healthy	NH2U offset area
Tylophora woolsii	1	TW-197	503746	6644816	<0.1	Seedling	Apparently healthy	NH2U offset area
Tylophora woolsii	1	TW-168	503779	6644797	0.5	Adult	Apparently healthy	NH2U offset area
Tylophora woolsii	1	TW-169	503779	6644797	0.4	Adult	Apparently healthy	NH2U offset area
Tylophora woolsii	1	TW-170	503779	6644797	<0.1	Seedling	Apparently healthy	NH2U offset area
Tylophora woolsii	1	TW-171	503779	6644797	0.2	Adult	Apparently healthy	NH2U offset area
Tylophora woolsii	1	TW-117	503825	6644656	2.2	Adult	Apparently healthy	NH2U offset area
Tylophora woolsii	4	TW-116	503858	6644649	1.1, 0.7, <0.1 x3	2 x adults, 2 x seedlings	Apparently healthy. 1.1m adult with seed pod.	NH2U offset area
Tylophora woolsii	1	ML-126	503938	6644449	1.2	Adult	Apparently healthy	NH2U offset area
Tylophora woolsii	1	TW-166	504192	6644801	1	Adult	Apparently healthy	NH2U offset area
Tylophora woolsii	1	TW-167	504194	6644799	1.2	Adult	Apparently healthy	NH2U offset area
Tylophora woolsii	1	TW-163	504200	6644799	0.6	Adult	Apparently healthy	NH2U offset area
Tylophora woolsii	2	TW-164	504200	6644799	0.8	Adult	Apparently healthy	NH2U offset area
Tylophora woolsii	3	TW-165	504200	6644799	1	Adult	Apparently healthy	NH2U offset area
Tylophora woolsii	1	745	504205	6644788	0.7	Adult	Apparently healthy	NH2U offset area

Species	Stems	Sample ID	Eastings	Northings	Height (m)	Age class	Health	Offset area
Tylophora woolsii	1	TW-162	504752	6644466	2	Adult	Apparently healthy	NH2U offset area
Tylophora woolsii	1	TW-161	504776	6644464	1	Adult	Apparently healthy	NH2U offset area
Tylophora woolsii	1	T_C3	502854.7	6644289	1.6	Adult	Very vigorous.	
Total in Boambee SF	**83**							

WC2NH Boambee SF offset area BioBanking plot/transect data

Coffs Harbour LGA Vegetation Community (OEH 2012)	Veg Type ID	Plot ID	Native plant species richness	Native over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Over storey regen.	Total length of fallen logs	Easting	Northing
Hinterland and Escarpment Tallowwood - Blackbutt - Blue Gum Wet Ferny Forest	NR120	Bench-mark	49	20-90	15-90	0-50	10-70	5-90	0	1	1	> = 10		
		W2	41	46	32.5	2	0	36	16	0	1	245	503220	6643795
Northern Escarpment Blackbutt - Apple Wet Ferny Forest	NR120	Bench mark	49	20-90	15-90	0-50	10-70	5-90	0	1	1	> = 10		
		W4	48	39.5	22	0	16	48	2	0	1	385	502734	6644161
		W6	51	39.5	20	6	14	44	4	0	1	95	503332	6644281
		W8	n/a	41.5	28	16	6	34	0	2	1	40	502997	6644170
Coast and Hinterland Riparian Flooded Gum Bangalow Wet Forest	NR159	Bench-mark	49	20-90	15-90	0-50	10-70	5-90	0	1	1	> = 10		
		W3	37	48.5	12	4	10	32	24	0	1	35	503411	6643711
		W10	n/a	24.5	64	0	10	32	0	2	1	85	502506	6643972
Foothills Grey Gum - Ironbark - Mahogany Dry Forest	NR263	Bench-mark	44	15-50	10-40	5-50	5-40	5-70	0	1	1	> = 20		
		W5	34	29	13.5	38	2	18	26	2	1	165	503400	6644288
		W9	n/a	41	21	68	0	4	4	2	1	65	503595	6644194

NH2U Boambee SF offset area BioBanking plot/transect data

Fauna habitat type	Coffs Harbour LGA Vegetation Community (OEH 2012)	Veg Type ID	Plot ID	Native plant species richness	Native over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Over storey regen.	Total length of fallen logs	Easting	Northing	Zone
Wet sclerophyll forest		NR120	Benchmark	49	20-90	15-90	0-50	10-70	5-90	0	1	1	> = 10			
	Hinterland and Escarpment Tallowwood - Blackbutt - Blue Gum Wet Ferny Forest		1	44	56	34	2	16	40	10	0	1	51	504705	6644542	56
	Northern Escarpment Blackbutt - Apple Wet Ferny Forest		2	40	51.5	10.2	4	4	74	10	0	1	222	504176	6644800	56
			5	44	38.5	30	4	24	36	8	0	1	120	503686	6644732	56
		NR159	Benchmark	49	20-90	15-90	0-50	10-70	5-90	0	1	1	> = 10			
	Coast and Hinterland Riparian Flooded Gum Bangalow Wet Forest		3	37	28.5	59.5	10	6	48	4	0	0	65	504493	6644492	56
			4	42	34	55	4	16	14	23	0	0	129	504067	6644387	56

WC2NH Boambee SF offset area flora species recorded in plots

Family	Scientific Name	Common Name	Exotic	W2	W3	W4	W5	W6
Acanthaceae	*Pseuderanthemum variabile*	Pastel Flower		1	2	1		1
Adiantaceae	*Adiantum atroviride*						2	
Adiantaceae	*Adiantum formosum*	Giant Maidenhair		2				1
Adiantaceae	*Adiantum hispidulum*	Rough Maidenhair					2	
Adiantaceae	*Pellaea paradoxa*						1	
Anacardiaceae	*Harpephyllum caffrum*		*		1			
Apiaceae	*Hydrocotyle laxiflora*	Stinking Pennywort						1
Apiaceae	*Hydrocotyle peduncularis*							1
Apocynaceae	*Gomphocarpus fruticosus*	Narrow-leaved Cotton Bush	*				1	
Apocynaceae	*Parsonsia straminea*	Common Silkpod						1
Apocynaceae	*Tabernaemontana pandacaqui*	Banana Bush			2	1		
Apocynaceae	*Tylophora woollsii*	Cryptic Forest Twiner						1
Araceae	*Alocasia brisbanensis*	Cunjevoi			1			
Araceae	*Gymnostachys anceps*	Settler's Twine				1		
Araliaceae	*Cephalaralia cephalobotrys*	Climbing Panax		1	2	1		
Araliaceae	*Polyscias elegans*	Celery Wood			1			
Araliaceae	*Polyscias sambucifolia*	Elderberry Panax		2			2	2
Arecaceae	*Archontophoenix cunninghamiana*	Bangalow Palm						1
Aspleniaceae	*Asplenium australasicum*	Bird's Nest Fern				1		
Aspleniaceae	*Asplenium flaccidum* subsp. *flaccidum*	Weeping Spleenwort				1		
Asteliaceae	*Cordyline petiolaris*	Broad-leaved Palm Lily		2	2	1		
Asteliaceae	*Cordyline stricta*	Narrow-leaved Palm Lily		2	2	2		1
Asteraceae	*Ageratina adenophora*	Crofton Weed	*				2	1
Asteraceae	*Ageratum houstonianum*		*	1				
Asteraceae	*Coronidium elatum*							1
Asteraceae	*Olearia nernstii*							1

Family	Scientific Name	Common Name	Exotic	W2	W3	W4	W5	W6
Asteraceae	*Sigesbeckia orientalis* subsp. *orientalis*	Indian Weed						2
Asteraceae	*Sonchus oleraceus*	Common Sowthistle	*					1
Bignoniaceae	*Pandorea pandorana*	Wonga Wonga Vine				1		
Blechnaceae	*Blechnum cartilagineum*	Gristle Fern		4	3	2		
Blechnaceae	*Doodia aspera*	Prickly Rasp Fern			3	2	2	3
Cardiopteridaceae	*Citronella moorei*				1			
Casuarinaceae	*Allocasuarina torulosa*	Forest Oak				3	3	3
Celastraceae	*Celastrus subspicata*	Large-leaved Staff Vine						1
Commelinaceae	*Aneilema acuminatum*						2	
Cyatheaceae	*Cyathea australis*	Rough Treefern		4		4		3
Cyperaceae	*Cyperus filipes*			2	2			
Cyperaceae	*Cyperus gracilis*	Slender Flat-sedge					1	
Cyperaceae	*Cyperus trinervis*						1	
Cyperaceae	*Lepidosperma laterale*	Variable Sword-sedge						1
Davalliaceae	*Davallia solida* var. *pyxidata*	Hare's Foot Fern				1		
Dicksoniaceae	*Calochlaena dubia*	Rainbow Fern				2		
Dilleniaceae	*Hibbertia dentata*	Twining Guinea Flower		1				1
Dilleniaceae	*Hibbertia scandens*	Climbing Guinea Flower				1		
Dioscoreaceae	*Dioscorea transversa*	Native Yam		1	2	2	2	2
Dryopteridaceae	*Lastreopsis microsora* subsp. *microsora*	Creeping Shield Fern		2	3	2		2
Elaeocarpaceae	*Elaeocarpus reticulatus*	Blueberry Ash				1		
Elaeocarpaceae	*Sloanea woollsii*	Yellow Carabeen			3			
Euphorbiaceae	*Acalypha nemorum*						1	
Euphorbiaceae	*Mallotus philippensis*	Red Kamala					2	
Eupomatiaceae	*Eupomatia bennettii*	Small Bolwarra				1		
Eupomatiaceae	*Eupomatia laurina*	Bolwarra		3				
Fabaceae (Caesalpinioideae)	*Senna pendula* var. *glabrata*		*	1	1			

Family	Scientific Name	Common Name	Exotic	W2	W3	W4	W5	W6
Fabaceae (Faboideae)	*Austrosteenisia blackii* var. *blackii*	Blood Vine				1		
Fabaceae (Faboideae)	*Desmodium gunnii*	Slender Tick-trefoil		1				
Fabaceae (Faboideae)	*Glycine* sp.			1				
Fabaceae (Faboideae)	*Indigofera australis*	Australian Indigo					1	
Fabaceae (Mimosoideae)	*Acacia maidenii*	Maiden's Wattle		1			2	
Flagellariaceae	*Flagellaria indica*	Whip Vine			1			
Geraniaceae	*Geranium solanderi*	Native Geranium					2	
Lauraceae	*Cryptocarya microneura*	Murrogun		2		2		
Lauraceae	*Cryptocarya rigida*	Forest Maple		3		1		2
Lauraceae	*Neolitsea dealbata*	Hairy-leaved Bolly Gum			2			
Lobeliaceae	*Lobelia gibbosa*	Tall Lobelia						1
Lobeliaceae	*Lobelia trigonocaulis*	Forest Lobelia						1
Lomandraceae	*Lomandra laxa*							1
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush				2		2
Lomandraceae	*Lomandra multiflora* subsp. *multiflora*	Many-flowered Mat-rush					1	
Luzuriagaceae	*Eustrephus latifolius*	Wombat Berry			1	1	1	1
Meliaceae	*Dysoxylum mollissimum* subsp. *molle*	Red Bean		1				1
Meliaceae	*Synoum glandulosum* subsp. *glandulosum*	Scentless Rosewood		2	3	2		2
Menispermaceae	*Sarcopetalum harveyanum*	Pearl Vine						1
Menispermaceae	*Stephania japonica*	Snake vine		4		1		1
Monimiaceae	*Wilkiea huegeliana*	Veiny Wilkiea		1	2	1		
Moraceae	*Ficus coronata*	Creek Sandpaper Fig		1	2			
Moraceae	*Maclura cochinchinensis*	Cockspur Thorn		1	1	1	1	
Myrtaceae	*Angophora costata*	Sydney Red Gum				3	2	
Myrtaceae	*Archirhodomyrtus beckleri*	Rose Myrtle		3	4	3		
Myrtaceae	*Corymbia intermedia*	Pink Bloodwood				1		
Myrtaceae	*Eucalyptus carnea*	Thick-leaved Mahogany					5	

Family	Scientific Name	Common Name	Exotic	W2	W3	W4	W5	W6
Myrtaceae	*Eucalyptus grandis*	Flooded Gum		3	5			
Myrtaceae	*Eucalyptus microcorys*	Tallowwood		5		3		5
Myrtaceae	*Eucalyptus pilularis*	Blackbutt				5		5
Myrtaceae	*Eucalyptus saligna*	Sydney Blue Gum				2		
Myrtaceae	*Lophostemon confertus*	Brush Box		3	4	3		3
Myrtaceae	*Pilidiostigma glabrum*			2	1			
Myrtaceae	*Rhodamnia rubescens*	Scrub Turpentine						1
Myrtaceae	*Syncarpia glomulifera*	Turpentine				3	4	3
Oleaceae	*Notelaea longifolia*	Large Mock-olive		1				
Orchidaceae	*Cymbidium suave*	Snake Orchid				1		
Passifloraceae	*Passiflora aurantia* var. *aurantia*	Blunt-leaved Passionfruit				1		1
Passifloraceae	*Passiflora edulis*	Common Passionfruit	*				1	
Passifloraceae	*Passiflora suberosa*	Cork Passionfruit	*					1
Passifloraceae	*Passiflora subpeltata*	White Passionflower	*	1	1	1	1	
Phormiaceae	*Dianella caerulea*	Blue Flax-lily		1		1		1
Phyllanthaceae	*Breynia oblongifolia*	Coffee Bush						1
Phyllanthaceae	*Phyllanthus similis*					2	1	1
Phyllanthaceae	*Poranthera microphylla*	Small Poranthera						1
Piperaceae	*Piper hederaceum* var. *hederaceum*	Giant Pepper Vine			1			
Pittosporaceae	*Billardiera scandens*	Hairy Apple Berry		1				
Pittosporaceae	*Pittosporum undulatum*	Sweet Pittosporum					1	
Poaceae	*Entolasia marginata*	Bordered Panic		2			2	
Poaceae	*Imperata cylindrica*	Blady Grass		2		2	3	
Poaceae	*Oplismenus aemulus*						2	
Poaceae	*Oplismenus imbecillis*			2	1		2	1
Poaceae	*Ottochloa gracillima*						3	2
Poaceae	*Paspalum mandiocanum*	Broadleaf Paspalum	*	3		1	2	

Family	Scientific Name	Common Name	Exotic	W2	W3	W4	W5	W6
Poaceae	*Poa sieberiana*	Snowgrass						2
Poaceae	*Setaria palmifolia*	Palm Grass	*		1			
Poaceae	*Themeda australis*	Kangaroo Grass					3	
Polypodiaceae	*Platycerium bifurcatum*	Elkhorn Fern						1
Ranunculaceae	*Clematis glycinoides*	Headache Vine				1		1
Ripogonaceae	*Ripogonum elseyanum*	Hairy Supplejack			2			
Rosaceae	*Rubus parvifolius*	Native Raspberry					2	
Rubiaceae	*Morinda jasminoides*	Sweet Morinda			1			1
Rubiaceae	*Psychotria sp. dorrigo*	Hairy Psychotria						1
Rutaceae	*Acronychia pubescens*	Hairy Acronychia			1			
Sapindaceae	*Diploglottis australis*	Native Tamarind			1			
Sapindaceae	*Jagera pseudorhus* var. *pseudorhus*	Foambark Tree		1				
Sapindaceae	*Lepiderema pulchella*	Fine-leaved Tuckeroo			2			
Sapindaceae	*Sarcopteryx stipata*	Steelwood			1			
Sapindaceae	*Toechima dasyrrhache*				1			
Smilacaceae	*Smilax australis*	Lawyer Vine		1	1	2		
Solanaceae	*Solanum hapalum*					2		
Sterculiaceae	*Seringia arborescens*			2				
Uvulariaceae	*Tripladenia cunninghamii*					2		
Verbenaceae	*Lantana camara*	Lantana	*	2	2	2	4	2
Violaceae	*Viola hederacea*	Ivy-leaved Violet		2				1
Vitaceae	*Cayratia clematidea*	Native Grape					1	1
Vitaceae	*Cissus antarctica*	Water Vine			2		1	1
Vitaceae	*Cissus hypoglauca*	Giant Water Vine		1				
Xanthorrhoeaceae	*Xanthorrhoea malacophylla*					4		3
Zamiaceae	*Lepidozamia peroffskyana*					3		1
Zingiberaceae	*Alpinia caerulea*	Native Ginger		2			1	2

Notes: Cover abundance rankings within each survey area: 1 Foliage sparsely or very sparsely present, cover less than 5%; 2 1-5% Plentiful, foliage cover 1-5 %; 3 5-25% foliage cover; 4 26-50% foliage cover; 5 51-75% foliage cover; 6 76-100% foliage cover; x opportunistic record, relative abundance not recorded.

NH2U Boambee SF offset site plant species recorded in plots

Family	*Scientific Name*	Common Name	Exotic	1	2	3	4	5
Acanthaceae	*Pseuderanthemum variabile*	Pastel Flower		2	2		2	2
Adiantaceae	*Adiantum formosum*	Giant Maidenhair		1	3			
Adiantaceae	*Adiantum hispidulum*							1
Adiantaceae	*Adiantum hispidulum*	Rough Maidenhair		1	1			
Anacardiaceae	*Euroschinus falcatus* var. *falcatus*	Ribbonwood		1				
Apiaceae	*Hydrocotyle pedicellosa*						2	
Apocynaceae	*Marsdenia longiloba*	Slender Marsdenia		2				
Apocynaceae	*Marsdenia rostrata*	Milk Vine		1				
Apocynaceae	*Parsonsia straminea*	Common Silkpod						1
Apocynaceae	*Tabernaemontana pandacaqui*	Banana Bush					1	
Araceae	*Alocasia brisbanensis*	Cunjevoi				2		
Araliaceae	*Cephalaralia cephalobotrys*	Climbing Panax				1	2	
Arecaceae	*Archontophoenix cunninghamiana*	Bangalow Palm				3	6	
Arecaceae	*Calamus muelleri*	Southern Lawyer Cane				2	2	
Aspleniaceae	*Asplenium australasicum*	Bird's Nest Fern						1
Asteliaceae	*Cordyline petiolaris*	Broad-leaved Palm Lily					2	
Asteliaceae	*Cordyline sp.*		*	2				
Asteliaceae	*Cordyline stricta*	Narrow-leaved Palm Lily		2	1	1		
Asteraceae	*Ageratina adenophora*	Crofton Weed	*		2		1	2
Asteraceae	*Sigesbeckia orientalis* subsp. *orientalis*	Indian Weed			1			
Bignoniaceae	*Pandorea pandorana*	Wonga Wonga Vine						1
Blechnaceae	*Blechnum cartilagineum*	Gristle Fern		7		2	1	3

Family	*Scientific Name*	Common Name	Exotic	1	2	3	4	5
Blechnaceae	*Doodia aspera*	Prickly Rasp Fern		1	3		2	3
Casuarinaceae	*Allocasuarina torulosa*	Forest Oak		2				3
Celastraceae	*Celastrus subspicata*	Large-leaved Staff Vine			1			
Commelinaceae	*Aneilema acuminatum*					2		
Cyatheaceae	*Cyathea australis*	Rough Treefern		1			1	2
Cyatheaceae	*Cyathea cooperi*	Straw Treefern				1		
Cyatheaceae	*Cyathea leichhardtiana*	Prickly Treefern				2		
Cyperaceae	*Carex sp.*						2	
Cyperaceae	*Cyperus filipes*						2	
Cyperaceae	*Gahnia melanocarpa*	Black Fruit Saw-sedge		1				
Davalliaceae	*Arthropteris tenella*							1
Davalliaceae	*Davallia solida* var. *pyxidata*	Hare's Foot Fern						1
Dennstaedtiaceae	*Hypolepis rugosula*	Ruddy Ground Fern				2		3
Dicksoniaceae	*Calochlaena dubia*	Rainbow Fern			4			
Dilleniaceae	*Hibbertia dentata*	Twining Guinea Flower						1
Dioscoreaceae	*Dioscorea transversa*	Native Yam		2	2	1		2
Dryopteridaceae	*Arachniodes aristata*	Prickly Shield Fern					2	
Dryopteridaceae	*Lastreopsis decomposita*	Trim Shield Fern		3	2			
Elaeocarpaceae	*Sloanea australis*	Maiden's Blush					2	
Escalloniaceae	*Quintinia verdonii*	Grey Possumwood				1		
Euphorbiaceae	*Homalanthus populifolius*						1	
Euphorbiaceae	*Mallotus philippensis*	Red Kamala			1			
Eupomatiaceae	*Eupomatia bennettii*	Small Bolwarra						2
Eupomatiaceae	*Eupomatia laurina*	Bolwarra		2	2			
Fabaceae (Caesalpinioideae)	*Senna pendula* var. *glabrata*		*		1		1	
Fabaceae (Faboideae)	*Derris involuta*				2			
Fabaceae (Faboideae)	*Glycine* sp.					1		

Family	*Scientific Name*	Common Name	Exotic	1	2	3	4	5
Fabaceae (Faboideae)	*Glycine* sp. *Coffs Harbour*	A glycine						1
Flagellariaceae	*Flagellaria indica*	Whip Vine				1		
Lamiaceae	*Clerodendrum floribundum* var. *floribundum*			1				
Lamiaceae	*Plectranthus parviflorus*							2
Lauraceae	*Cinnamomum camphora*	Camphor Laurel	*	1				
Lauraceae	*Cryptocarya glaucescens*	Jackwood				2		
Lauraceae	*Cryptocarya microneura*	Murrogun		2		1	1	
Lauraceae	*Cryptocarya rigida*	Forest Maple		2				3
Lauraceae	*Endiandra muelleri* subsp. *muelleri*					2	2	
Lauraceae	*Endiandra sieberi*	Hard Corkwood		2				
Lauraceae	*Endiandra virens*	White Apple		4	2			
Lauraceae	*Neolitsea dealbata*	Hairy-leaved Bolly Gum				1		
Lobeliaceae	*Lobelia trigonocaulis*	Forest Lobelia			1		2	
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush		1				2
Lomandraceae	*Lomandra spicata*					2		
Luzuriagaceae	*Eustrephus latifolius*	Wombat Berry			1			
Luzuriagaceae	*Geitonoplesium cymosum*	Scrambling Lily		1				
Meliaceae	*Dysoxylum mollissimum* subsp. *molle*	Red Bean				2	2	
Meliaceae	*Synoum glandulosum* subsp. *glandulosum*	Scentless Rosewood		2			1	2
Menispermaceae	*Stephania japonica*	Snake vine		2	2			2
Monimiaceae	*Daphnandra apatela*					2		
Monimiaceae	*Wilkiea huegeliana*	Veiny Wilkiea		2		2	2	
Moraceae	*Ficus coronata*	Creek Sandpaper Fig				2	2	1
Myrtaceae	*Acmena smithii*	Lilly Pilly				1	2	
Myrtaceae	*Angophora costata*	Sydney Red Gum			3			2
Myrtaceae	*Archirhodomyrtus beckleri*	Rose Myrtle			1			2
Myrtaceae	*Corymbia intermedia*	Pink Bloodwood					2	

Family	*Scientific Name*	Common Name	Exotic	1	2	3	4	5
Myrtaceae	*Eucalyptus grandis*	Flooded Gum				4	4	
Myrtaceae	*Eucalyptus microcarpa*	Western Grey Box					3	
Myrtaceae	*Eucalyptus microcorys*	Tallowwood						2
Myrtaceae	*Eucalyptus pilularis*	Blackbutt		6	3			5
Myrtaceae	*Lophostemon confertus*	Brush Box		3	4	2	2	1
Myrtaceae	*Pilidiostigma glabrum*			1				
Myrtaceae	*Rhodamnia rubescens*	Scrub Turpentine						1
Myrtaceae	*Syncarpia glomulifera*	Turpentine		3	1			2
Nyctaginaceae	*Boerhavia coccinea*	Tarvine					2	
Ochnaceae	*Ochna serrulata*	Mickey Mouse Plant	*	1			1	
Passifloraceae	*Passiflora aurantia* var. *aurantia*	Blunt-leaved Passionfruit		1				
Passifloraceae	*Passiflora edulis*	Common Passionfruit	*	2				
Passifloraceae	*Passiflora subpeltata*	White Passionflower	*	2	3	1	2	1
Phormiaceae	*Dianella caerulea*	Blue Flax-lily		2	1			
Phyllanthaceae	*Breynia oblongifolia*	Coffee Bush		2	1			
Phyllanthaceae	*Glochidion ferdinandi*	Cheese Tree		1			2	
Phyllanthaceae	*Phyllanthus gunnii*			2	2			2
Phyllanthaceae	*Poranthera microphylla*	Small Poranthera						2
Piperaceae	*Piper hederaceum* var. *hederaceum*	Giant Pepper Vine			1	2	2	
Pittosporaceae	*Pittosporum multiflorum*	Orange Thorn		1				
Pittosporaceae	*Pittosporum revolutum*	Rough Fruit Pittosporum		1	1			
Poaceae	*Entolasia marginata*	Bordered Panic				2		
Poaceae	*Imperata cylindrica*	Blady Grass			2			
Poaceae	*Oplismenus imbecillis*				2			2
Poaceae	*Ottochloa gracillima*				2		2	
Poaceae	*Paspalum mandiocanum*	Broadleaf Paspalum	*		1		2	
Poaceae	*Poa sieberiana*	Snowgrass						1

Family	*Scientific Name*	Common Name	Exotic	1	2	3	4	5
Poaceae	*Setaria palmifolia*	Palm Grass	*			2		
Polypodiaceae	*Platycerium bifurcatum*	Elkhorn Fern			1		1	
Polypodiaceae	*Pyrrosia rupestris*	Rock Felt Fern			1		2	1
Ripogonaceae	*Ripogonum elseyanum*	Hairy Supplejack				2	3	
Ripogonaceae	*Ripogonum fawcettianum*	Small Supplejack		3				2
Rosaceae	*Rubus moluccanus*	Molucca Bramble					1	
Rosaceae	*Rubus nebulosus*	Green-leaved Bramble				2		
Rosaceae	*Rubus parvifolius*	Native Raspberry			1			
Rubiaceae	*Morinda jasminoides*	Sweet Morinda				1	2	
Rutaceae	*Acronychia oblongifolia*	White Aspen		2				
Rutaceae	*Melicope elleryana*	Pink-flowered Doughwood					1	
Sapindaceae	*Diploglottis australis*	Native Tamarind				2		
Sapindaceae	*Guioa semiglauca*	Guioa		3			2	
Sapindaceae	*Jagera pseudorhus* var. *pseudorhus*	Foambark Tree		2		2		
Sapotaceae	*Niemeyera whitei*	Rusty Plum, Plum Boxwood				1		
Smilacaceae	*Smilax australis*	Lawyer Vine			2			2
Solanaceae	*Cestrum nocturnum*	Lady-of-the-night	*			3		
Solanaceae	*Solanum mauritianum*	Wild Tobacco Bush	*			2	1	
Thelypteridaceae	*Christella dentata*	Binung				1		
Thelypteridaceae	*Cyclosorus interruptus*						2	
Ulmaceae	*Trema tomentosa* var. *aspera*	Native Peach					1	
Uvulariaceae	*Tripladenia cunninghamii*			2	2			2
Verbenaceae	*Lantana camara*	Lantana	*	2	2	5	2	1
Violaceae	*Hybanthus* sp.							1
Violaceae	*Hybanthus stellarioides*			1				
Violaceae	*Viola hederacea*	Ivy-leaved Violet		1	2			3
Vitaceae	*Cayratia clematidea*	Native Grape						1

Family	*Scientific Name*	Common Name	Exotic	1	2	3	4	5
Vitaceae	*Cissus hypoglauca*	Giant Water Vine			1	3	2	2
Vitaceae	*Tetrastigma nitens*				1			
Xanthorrhoeaceae	*Xanthorrhoea malacophylla*				2			2
Zamiaceae	*Lepidozamia peroffskyana*							4
Zingiberaceae	*Alpinia caerulea*	Native Ginger		2	1	1	2	2

Key: Cover abundance rankings within each survey area: 1 Foliage sparsely or very sparsely present, cover less than 5%; 2 1-5% Plentiful, foliage cover 1-5 %; 3 5-25% foliage cover; 4 26-50% foliage cover; 5 51-75% foliage cover; 6 76-100% foliage cover; x opportunistic record, relative abundance not recorded.

Boambee SF offset site fauna observations

Common Name	Scientific Name	Exotic	NSW Status	EPBC Status	Observation Type
Amphibia					
Bleating Tree Frog	*Litoria dentata*		P		W
Broad-palmed Frog	*Litoria latopalmata*		P		W
Brown-striped Frog	*Limnodynastes peronii*		P		O
Eastern Dwarf Tree Frog	*Litoria fallax*		P		O,W
Giant Barred Frog	*^Mixophyes iteratus*		E,P	E	O
Great Barred Frog	*Mixophyes fasciolatus*		P		O
Green Tree Frog	*Litoria caerulea*		P		W
Leaf-green Tree Frog	*Litoria phyllochroa*		P		O,W
Pearson's Green Tree Frog	*Litoria pearsoniana*		P		W
Peron's Tree Frog	*Litoria peronii*		P		W
Red-backed Toadlet	*Pseudophryne coriacea*		P		O,W
Red-eyed Tree Frog	*Litoria chloris*		P		W
Revealed Frog	*Litoria revelata*		P		O,W
Stoney Creek Frog	*Litoria wilcoxii*		P		O
Tusked Frog	*Adelotus brevis*		P		S
Tyler's Tree Frog	*Litoria tyleri*		P		W
Aves					
Australasian Figbird	*Sphecotheres vieilloti*		P		W
Australian Brush-turkey	*Alectura lathami*		P		Q
Australian Owlet-nightjar	*Aegotheles cristatus*		P		W
Black-faced Monarch	*Monarcha melanopsis*		P		O
Blue-faced Honeyeater	*Entomyzon cyanotis*		P		O
Brown Cuckoo-dove	*Macropygia amboinensis*		P		O
Brown Gerygone	*Gerygone mouki*		P		W
Brush Cuckoo	*Cacomantis variolosus*		P		W
Channel-billed Cuckoo	*Scythrops novaehollandiae*		P		W
Cicadabird	*Coracina tenuirostris*		P		W
Dollarbird	*Eurystomus orientalis*		P		O
Eastern Koel	*Eudynamys orientalis*		P		W
Eastern Whipbird	*Psophodes olivaceus*		P		W, Q
Fan-tailed Cuckoo	*Cacomantis flabelliformis*		P		W
Golden Whistler	*Pachycephala pectoralis*		P		W
Green Catbird	*Ailuroedus crassirostris*		P		W
Grey Shrike-thrush	*Colluricincla harmonica*		P		W
Horsfield's Bronze-Cuckoo	*Chalcites basalis*		P		W
Laughing Kookaburra	*Dacelo novaeguineae*		P		W
Lewin's Honeyeater	*Meliphaga lewinii*		P		O
Noisy Pitta	*Pitta versicolor*		P		W
Olive-backed Oriole	*Oriolus sagittatus*		P		W

Common Name	Scientific Name	Exotic	NSW Status	EPBC Status	Observation Type
Painted Button-quail	*Turnix varius*		P		O
Paradise Riflebird	*Ptiloris paradiseus*		P		W
Pheasant Coucal	*Centropus phasianinus*		P		W
Pied Currawong	*Strepera graculina*		P		O
Regent Bowerbird	*Sericulus chrysocephalus*		P		O
Satin Bowerbird	*Ptilonorhynchus violaceus*		P		W
Scarlet Honeyeater	*Myzomela sanguinolenta*		P		W
Shining Bronze-cuckoo	*Chalcites lucidus*		P		W
Southern Boobook	*Ninox novaeseelandiae*		P		W
Spangled Drongo	*Dicrurus bracteatus*		P		O
Spotted Pardalote	*Pardalotus punctatus*		P		W
Striated Pardalote	*Pardalotus striatus*		P		W
Superb Fairy-wren	*Malurus cyaneus*		P		O
Superb Lyrebird	*Menura novaehollandiae*		P		O, Q
Tawny Frogmouth	*Podargus strigoides*		P		O
Topknot Pigeon	*Lopholaimus antarcticus*		P		O
White-bellied Cuckoo-shrike	*Coracina papuensis*		P		W
White-throated Nightjar	*Eurostopodus mystacalis*		P		W
Wompoo Fruit-Dove	*Ptilinopus magnificus*		V, P		W
Yellow-faced Honeyeater	*Lichenostomus chrysops*		P		W
Yellow-throated Scrubwren	*Sericornis citreogularis*		P		W
Mammalia					
Bush rat	*Rattus fuscipes*		P		Q
Dog	*Canis lupus familiaris*	*			O
Grey-headed Flying-fox	*Pteropus poliocephalus*		V, P	V	W
Koala	*Phascolarctos cinereus*		V, P	V	P
Mountain Brushtail Possum	*Trichosurus cunninghami*		P		O
Water-rat	*Hydromys chrysogaster*		P		O
Reptilia					
Eastern Small-eyed Snake	*Cryptophis nigrescens*		P		W
Eastern Water Dragon	*Intellagama lesueurii*		P		S
Yellow-faced Whip Snake	*Demansia psammophis*		P		O

Key: E – endangered species; P – protected species; M – migratory, V – vulnerable species; B – burrow; F – tracks, H – skin, K – dead, O – observed, P – scat, W – heard, Q – camera trap image.

Appendix C – xxxxx Offset Site Field survey results

WC2NH xxxxx offset area BioBanking plot/transect data

Fauna habitat type	Veg Type ID	Plot ID	Native plant species richness	Native over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Over storey regen.	Total length of fallen logs	Easting	Northing	Zone
Wet sclero-phyll forest	NR159	Bench- mark	49	20-90	15-90	0-50	10-70	5-90	0	> = 1	1	> = 10			
		1	46	21.5	65.5	10	22	24	12	0	0	45	511339	6679200	56
		4	53		33	69	4	22	38	0	0	49	511157	6679190	56

Additional xxxxx offset site BioBanking plot/transect data

Fauna habitat type	Veg Type ID	Plot ID	Native plant species richness	Native over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Over storey regen.	Total length of fallen logs	Easting	Northing	Zone
	NR159	Bench- mark	49	20-90	15-90	0-50	10-70	5-90	0	> = 1	1	> = 10			
Wet sclero- phyll forest poor condition		2	47	0	43	56	4	30	19.5	0	0	5	511465	6679010	56
Wet sclero- phyll forest low condition		3	32	0	2.5	0	0	56	52	0	0	7	511453	6679100	56
	NR263	Benchmark	15-50	10-40	5-50	5-40	5-70	0	> = 1	1	> = 20				
Dry sclero- phyll forest		5	35	17.5	18	60	10	2	6.5	2	0.6	4	511272	6679050	56

xxxxx offset site plant species recorded in plots

Family	Common Name	Scientific Name	Exotic	Plot 1 Cover	Plot 1 Abundance	Plot 4 Cover	Plot 4 Abundance	Plot 2 Cover	Plot 2 Abundance	Plot 3 Cover	Plot 3 Abundance	Plot 5 Cover	Plot 5 Abundance
Acanthaceae	Pastel Flower	*Pseuderanthemum variabile*		1	20	1	1	1	5				
Adiantaceae	Giant Maidenhair	*Adiantum formosum*				1	20						
Amaranthaceae	Lesser Joyweed	*Alternanthera denticulata*								1	100		
Anacardiaceae	Ribbonwood	*Euroschinus falcatus* var. *falcatus*		3	1			3	2				
Apiaceae	Indian Pennywort	*Centella asiatica*								1	10		
Apocynaceae	Banana Bush	*Tabernaemontana pandacaqui*		1	2	1	2	1	3				
Apocynaceae	Common Silkpod	*Parsonsia straminea*		1	1	1	1					1	2
Araceae	Settler's Twine	*Gymnostachys anceps*			3	1	6						
Arecaceae	Bangalow Palm	*Archontophoenix cunninghamiana*			35	1	7	1	10	1	1		
Asteraceae		*Vernonia cinerea*										1	5
Asteraceae	Cobbler's Pegs	*Bidens pilosa*	*							1	10		
Asteraceae	Crofton Weed	*Ageratina adenophora*	*					1	1	1	2		
Asteraceae	Mistflower	*Ageratina riparia*	*							1	2		
Asteraceae	Thickhead	*Crassocephalum crepidioides*	*							1	2		
Asteraceae	Wild Aster	*Aster subulatus*	*							1	1		
Blechnaceae	Gristle Fern	*Blechnum cartilagineum*			20	1	50	3	200				
Blechnaceae	Prickly Rasp Fern	*Doodia aspera*			10	1	100						
Caprifoliaceae	Japanese Honeysuckle	*Lonicera japonica*	*					1	10				
Commelinaceae		*Aneilema acuminatum*				1	2						

Family	Common Name	Scientific Name	Exotic	Plot 1 Cover	Plot 1 Abundance	Plot 4 Cover	Plot 4 Abundance	Plot 2 Cover	Plot 2 Abundance	Plot 3 Cover	Plot 3 Abundance	Plot 5 Cover	Plot 5 Abundance
Convolvulaceae	Kidney Weed	*Dichondra repens*						2	200				
Cyperaceae		*Cyperus sanguinolentus*								1	50		
Cyperaceae		*Schoenoplectus mucronatus*								1	30		
Cyperaceae	Common Fringe-sedge	*Fimbristylis dichotoma*								1	10		
Cyperaceae	Rough Saw-sedge	*Gahnia aspera*		1	5			1	1			1	3
Cyperaceae	Tall Sedge	*Carex appressa*				1	50			1	20		
Cyperaceae	Tall Spike Rush	*Eleocharis sphacelata*								7	1000		
Cyperaceae	Variable Sword-sedge	*Lepidosperma laterale*										1	100
Dennstaedtiaceae	Bracken	*Pteridium esculentum*						2	200	1	10		
Dennstaedtiaceae	Harsh Ground Fern	*Hypolepis muelleri*			10			1	50	40	500		
Dilleniaceae	Climbing Guinea Flower	*Hibbertia scandens*				1	2	1	2	1	1		
Dilleniaceae	Twining Guinea Flower	*Hibbertia dentata*				1	1						
Dioscoreaceae	Native Yam	*Dioscorea transversa*		1	4	1	1						
Ebenaceae	Black Plum	*Diospyros australis*										1	1
Ebenaceae	Grey Ebony	*Diospyros fasciculosa*		1	1								
Ericaceae	Prickly Beard-heath	*Leucopogon juniperinus*										1	20
Ericaceae	Tree Heath	*Trochocarpa laurina*		1	2							1	1
Euphorbiaceae	Brittlewood	*Claoxylon australe*		1	2								
Eupomatiaceae	Bolwarra	*Eupomatia laurina*		1	20	2	7						
Eupomatiaceae	Small Bolwarra	*Eupomatia bennettii*				1	1						

Family	Common Name	Scientific Name	Exotic	Plot 1 Cover	Plot 1 Abundance	Plot 4 Cover	Plot 4 Abundance	Plot 2 Cover	Plot 2 Abundance	Plot 3 Cover	Plot 3 Abundance	Plot 5 Cover	Plot 5 Abundance
Fabaceae (Faboideae)	Slender Tick-trefoil	*Desmodium gunnii*										1	20
Fabaceae (Faboideae)	Small-leaf Glycine	*Glycine microphylla*										1	100
Fabaceae (Mimosoideae)	Fringed Wattle	*Acacia fimbriata*						1	5			1	3
Fabaceae (Mimosoideae)	Green Wattle	*Acacia irrorata*						5	2	10	6	2	11
Flacourtiaceae	Flintwood	*Scolopia braunii*				1	3						
Flagellariaceae	Whip Vine	*Flagellaria indica*			1								
Juncaceae		*Juncus mollis*								1	20		
Lamiaceae		*Clerodendrum floribundum* var. *floribundum*		1	1	1	1						
Lamiaceae	White Beech	*Gmelina leichhardtii*						1	6	1	1		
Lauraceae	Camphor Laurel	*Cinnamomum camphora*	*					5	3			1	1
Lauraceae	Forest Maple	*Cryptocarya rigida*		2	20	1	3	1	1				
Lauraceae	Green-leaved Rose Walnut	*Endiandra muelleri*		15	2	1	2						
Lauraceae	Hairy-leaved Bolly Gum	*Neolitsea dealbata*		5	17	1	5	1	20				
Lauraceae	Hard Corkwood	*Endiandra sieberi*		1	2								
Lauraceae	Jackwood	*Cryptocarya glaucescens*		1	4	1	1						
Lauraceae	Murrogun	*Cryptocarya microneura*		1	500	1	200	1	100				
Lauraceae	Rose Walnut	*Endiandra discolor*						1	1				
Lobeliaceae	Forest Lobelia	*Lobelia trigonocaulis*						1	4				
Lobeliaceae	Whiteroot	*Pratia purpurascens*										1	5
Lomandraceae		*Lomandra hystrix*		1	5	1	6			1	1		
Lomandraceae	Mat-rush	*Lomandra* sp.										1	1

Family	Common Name	Scientific Name	Exotic	Plot 1 Cover	Plot 1 Abundance	Plot 4 Cover	Plot 4 Abundance	Plot 2 Cover	Plot 2 Abundance	Plot 3 Cover	Plot 3 Abundance	Plot 5 Cover	Plot 5 Abundance
Lomandraceae	Spiny-headed Mat-rush	*Lomandra longifolia*										1	3
Luzuriagaceae	Scrambling Lily	*Geitonoplesium cymosum*						1	1				
Luzuriagaceae	Wombat Berry	*Eustrephus latifolius*										1	8
Lythraceae		*Cuphea carthagenensis*	*							3	200		
Meliaceae	Red Cedar	*Toona ciliata*						10	1				
Meliaceae	Scentless Rosewood	*Synoum glandulosum* subsp. *glandulosum*			1	1	4	1	10	1	1		
Menispermaceae	Snake vine	*Stephania japonica*						1	2				
Monimiaceae	Veiny Wilkiea	*Wilkiea huegeliana*				1	1	1	2				
Moraceae	Burny Vine	*Trophis scandens*				1	2						
Moraceae	Cockspur Thorn	*Maclura cochinchinensis*				1	3	1	6				
Moraceae	Creek Sandpaper Fig	*Ficus coronata*		1	8	1	2	1	20	1	1		
Myrsinaceae		*Embelia australiana*				1	1	1	1				
Myrsinaceae		*Myrsine variabilis*						1	1				
Myrtaceae	Brush Box	*Lophostemon confertus*				10	2						
Myrtaceae	Brush Cherry	*Syzygium australe*		1	1								
Myrtaceae	Common Guava	*Psidium guajava*	*		1			1	2				
Myrtaceae	Grey Myrtle	*Backhousia myrtifolia*				20	3			1	1		
Myrtaceae	Kanooka	*Tristaniopsis laurina*		10	4	7	4						
Myrtaceae	Lemon-scented Teatree	*Leptospermum petersonii*		1	1								
Myrtaceae	Lilly Pilly	*Acmena smithii*		1	2								
Myrtaceae	Native Guava	*Rhodomyrtus psidioides*						1	3				
Myrtaceae	Pink Bloodwood	*Corymbia intermedia*				7	1						
Myrtaceae	Small-fruited Grey Gum	*Eucalyptus propinqua*										20	11

Family	Common Name	Scientific Name	Exotic	Plot 1 Cover	Plot 1 Abundance	Plot 4 Cover	Plot 4 Abundance	Plot 2 Cover	Plot 2 Abundance	Plot 3 Cover	Plot 3 Abundance	Plot 5 Cover	Plot 5 Abundance
Myrtaceae	Steel Box	*Eucalyptus rummeryi*										10	3
Myrtaceae	Tallowwood	*Eucalyptus microcorys*		30	3	10	2			2	1		
Myrtaceae	Thick-leaved Mahogany	*Eucalyptus carnea*										2	3
Myrtaceae	Turpentine	*Syncarpia glomulifera*				10	4					1	1
Myrtaceae	Willow Bottlebrush	*Callistemon salignus*				5	2						
Oleaceae	Large Mock-olive	*Notelaea longifolia*				1	1					1	1
Orchidaceae	Christmas Orchid	*Calanthe triplicata*				1	1						
Orchidaceae	Greenhood	*Pterostylis* sp.				1	100						
Oxalidaceae		*Oxalis exilis*										1	5
Passifloraceae	Common Passionfruit	*Passiflora edulis*	*									1	2
Philydraceae	Frogsmouth	*Philydrum lanuginosum*								1	50		
Phormiaceae	Blue Flax-lily	*Dianella caerulea*										1	4
Phormiaceae	Blueberry Lily	*Dianella revoluta*		1	5	1	2						
Phyllanthaceae	Cheese Tree	*Glochidion ferdinandi*						20	9	7	5	1	4
Phyllanthaceae	Coffee Bush	*Breynia oblongifolia*		1	2			1	5	1	1	1	3
Poaceae		*Oplismenus aemulus*								1	10		
Poaceae		*Oplismenus imbecillis*		1	100	1	100	1	200				
Poaceae		*Ottochloa gracillima*		2	200	1	2	3	1000	1	10	1	100
Poaceae		*Sporobolus laxus*										1	1
Poaceae	A Lovegrass	*Eragrostis* sp.	*									1	1
Poaceae	Barbed Wire Grass	*Cymbopogon refractus*										1	20

Family	Common Name	Scientific Name	Exotic	Plot 1 Cover	Plot 1 Abundance	Plot 4 Cover	Plot 4 Abundance	Plot 2 Cover	Plot 2 Abundance	Plot 3 Cover	Plot 3 Abundance	Plot 5 Cover	Plot 5 Abundance
Poaceae	Black-seeded Panic	*Panicum bisulcatum*								1	1		
Poaceae	Blady Grass	*Imperata cylindrica*						5	1000				
Poaceae	Broadleaf Paspalum	*Paspalum mandiocanum*	*					1	20	20	100		
Poaceae	Giant Parramatta Grass	*Sporobolus fertilis*	*					1	3				
Poaceae	Indian Cupscale Grass	*Sacciolepis indica*						1	4				
Poaceae	Narrow-leafed Carpet Grass	*Axonopus fissifolius*	*							10	100		
Poaceae	Small-flowered Finger Grass	*Digitaria parviflora*										1	20
Poaceae	Threeawn Speargrass	*Aristida vagans*										1	5
Poaceae	Tussock	*Poa labillardierei* var. *labillardierei*										1	200
Poaceae	Weeping Grass	*Microlaena stipoides*						1	10				
Poaceae	Wiry Panic	*Entolasia stricta*										50	1000
Polygonaceae		*Persicaria strigosa*								1	100		
Polygonaceae	Water Pepper	*Persicaria hydropiper*								1	50		
Proteaceae		*Persoonia cornifolia*										1	1
Proteaceae	Native Honeysuckle	*Triunia youngiana*		1	2								
Ranunculaceae	Headache Vine	*Clematis glycinoides*						1	1				
Rhamnaceae	Red Ash	*Alphitonia excelsa*				1	1						
Rhamnaceae	Red Ash	*Alphitonia excelsa*	*	1	2								
Ripogonaceae	Small Supplejack	*Ripogonum fawcettianum*				1	2						

Family	Common Name	Scientific Name	Exotic	Plot 1 Cover	Plot 1 Abundance	Plot 4 Cover	Plot 4 Abundance	Plot 2 Cover	Plot 2 Abundance	Plot 3 Cover	Plot 3 Abundance	Plot 5 Cover	Plot 5 Abundance
Rosaceae	Green-leaved Bramble	*Rubus nebulosus*								1	2		
Rosaceae	Molucca Bramble	*Rubus moluccanus*				1	1						
Rosaceae	Native Raspberry	*Rubus parvifolius*						1	1				
Rubiaceae	Hairy Psychotria	*Psychotria loniceroides*		1	2	1	6						
Rubiaceae	Mexican Clover	*Richardia brasiliensis*	*					1	1				
Rubiaceae	Sweet Morinda	*Morinda jasminoides*		1	20	1	4	1	5				
Rutaceae	Crow's Ash	*Flindersia australis*		1	1								
Rutaceae	White Aspen	*Acronychia oblongifolia*		1	3	1	1	1	1				
Sapindaceae	Foambark Tree	*Jagera pseudorhus* var. *pseudorhus*		1	9								
Sapindaceae	Guioa	*Guioa semiglauca*		1	3	1	5	2	200				
Sapindaceae	Wild Quince	*Alectryon subcinereus*			1	1	1						
Sapindaceae	Yellow Pear-fruit	*Mischocarpus pyriformis*			1								
Smilacaceae	Lawyer Vine	*Smilax australis*						1	6	1	1		
Solanaceae	Wild Tobacco Bush	*Solanum mauritianum*	*							1	3		
Sparganiaceae	Floating Bur-reed	*Sparganium subglobosum*								1	100		
Thelypteridaceae	Binung	*Christella dentata*						1	2				
Thymelaeaceae		*Pimelea* sp.						1	1				
Ulmaceae	Native Peach	*Trema tomentosa* var. *aspera*								1	1		
Uvulariaceae		*Tripladenia cunninghamii*				1	2						
Verbenaceae	Lantana	*Lantana camara*	*	1	10	1	10	5	10	3	20	5	25
Violaceae		*Hybanthus stellarioides*										1	100

Family	Common Name	Scientific Name	Exotic	Plot 1 Cover	Plot 1 Abundance	Plot 4 Cover	Plot 4 Abundance	Plot 2 Cover	Plot 2 Abundance	Plot 3 Cover	Plot 3 Abundance	Plot 5 Cover	Plot 5 Abundance
Vitaceae	Giant Water Vine	*Cissus hypoglauca*		1	2			3	1				
Vitaceae	Native Grape	*Cayratia clematidea*						1	1				
Vitaceae	Pepper Vine	*Clematicissus opaca*										1	1
Vitaceae	Water Vine	*Cissus antarctica*			2	1	1	1	2	1	1		
Zamiaceae		*Macrozamia fawcettii*										1	1

Notes: Cover – visual estimate of foliage projective cover within the plot, recorded from 1–5% and then to the nearest 5%.

Abundance - relative number of individuals or shoots of a species within the plot. Based on the following intervals: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 20, 50, 100, 500, 1000. Counts above 20 are estimates only

xxxxx offset site fauna observations

Common Name	Scientific Name	NSW Status	EPBC Status	Observation Type
Amphibia				
Giant Barred Frog	*Mixophyes iteratus*	E,P	E	O
Great Barred Frog	*Mixophyes fasciolatus*	P		OW
Red-backed Toadlet	*Pseudophryne coriacea*	P		W
Aves				
Australian King-parrot	*Alisterus scapularis*	P		W
Australian Owlet-nightjar	*Aegotheles cristatus*	P		W
Azure Kingfisher	*Ceyx azureus*	P		O
Bar-shouldered Dove	*Geopelia humeralis*	P		W
Brown Gerygone	*Gerygone mouki*	P		W
Brown Thornbill	*Acanthiza pusilla*	P		W
Eastern Spinebill	*Acanthorhynchus tenuirostris*	P		W
Eastern Whipbird	*Psophodes olivaceus*	P		W
Eastern Yellow Robin	*Eopsaltria australis*	P		W
Emerald Dove	*Chalcophaps indica*	P		O
Forest Kingfisher	*Todiramphus macleayii*	P		O
Grey Butcherbird	*Cracticus torquatus*	P		O
Grey Fantail	*Rhipidura albiscapa*	P		W
Laughing Kookaburra	*Dacelo novaeguineae*	P		O
Lewin's Honeyeater	*Meliphaga lewinii*	P		W
Logrunner	*Orthonyx temminckii*	P		O
Noisy Friarbird	*Philemon corniculatus*	P		W
Peaceful Dove	*Geopelia striata*	P		W
Rainbow Lorikeet	*Trichoglossus haematodus*	P		W
Rufous Fantail	*Rhipidura rufifrons*	P		O
Rufous Whistler	*Pachycephala rufiventris*	P		O
Scarlet Honeyeater	*Myzomela sanguinolenta*	P		O
Silvereye	*Zosterops lateralis*	P		W
Southern Boobook	*Ninox novaeseelandiae*	P		W
Spectacled Monarch	*Symposiachrus trivirgatus*	P		O
Striated Pardalote	*Pardalotus striatus*	P		W
Striated Thornbill	*Acanthiza lineata*	P		OW
Torresian Crow	*Corvus orru*	P		W
Varied Triller	*Lalage leucomela*	P		O
White-bellied Cuckoo-shrike	*Coracina papuensis*	P		W
White-browed Scrubwren	*Sericornis frontalis*	P		W
Wonga Pigeon	*Leucosarcia picata*	P		W
Yellow-faced Honeyeater	*Lichenostomus chrysops*	P		W
Yellow-tailed Black-cockatoo	*Calyptorhynchus funereus*	P		W
Mammalia				
Long-nosed Bandicoot	*Perameles nasuta*	P		O

Notes: E – endangered species; P – protected species; M – migratory, V – vulnerable species;B – burrow; F – tracks, H – skin, K – dead, O – observed, P – scat, W – heard, Q – camera trap image.

Appendix D – Norton biobank site BioBanking Assessment and Management Actions Plan

Roads and Maritime Services

Norton Biobank

BioBanking Assessment

August 2016

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1. Introduction

1.1 Overview

GHD Pty Ltd (GHD) has been engaged by Roads and Maritime Services (Roads and Maritime) to provide a BioBanking Assessment of the proposed 'Norton biobank' to support an application for a BioBanking agreement over the site (see Figure 1). The purpose of the assessment is to determine the biodiversity credit value of the ecosystems and habitats at the Norton biobank using the *BioBanking Assessment Methodology 2014* (BBAM) (OEH 2014a). The BioBanking Credit Report is included as Appendix A.

The BioBanking assessment has been prepared with reference to biodiversity offset strategies and biodiversity management plans that will apply to the site and that have been prepared to meet Roads and Maritime's requirements for biodiversity offsets under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) for the Pacific Highway upgrade program. The BioBanking agreement will provide a secure conservation covenant over the Norton biobank in accordance with the *Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy* (DSEWPaC 2012) (the EPBC Act offset policy).

This report provides an overview of the Biodiversity Banking and Offsets Scheme (BioBanking), the existing environment of the biobank site, the application of the BBAM, the results of the site assessment, the calculation of biodiversity credits and proposed management actions for the site.

1.2 BioBanking

BioBanking was established by the New South Wales (NSW) Department of Environment, Climate Change and Water (DECCW) (now the Office of Environment and Heritage (OEH)) as a method to address the loss of biodiversity and threatened species. The scheme attempts to create a market framework for the conservation of biodiversity values and the offsetting of development impacts. The scheme is currently voluntary.

BioBanking is established under Part 7A of the *NSW Threatened Species Conservation Act 1995* (TSC Act), which was enabled by the *Threatened Species Conservation Amendment (Biodiversity Banking) Bill 2006*. The *Threatened Species Conservation (Biodiversity Banking) Regulation 2008* provides additional rules for specific aspects of the scheme that are important for its operation.

To generate credits at a biobank site a landholder must commit to enhancing and protecting biodiversity values over time. A BioBanking agreement is entered into and registered on the title of the land, binding both the current and future landholders to maintaining biodiversity through the completion of a range of management actions on the site. Each biobank site may generate a number of different ecosystem credits and any of these credits may be sold separately or as a group.

The BBAM sets out how biodiversity values will be assessed, establishes rules for calculating the number and class of credits, and determines the trading rules that will apply. The methodology includes a software package known as the BioBanking Credit Calculator (the credit calculator) which processes site survey and assessment data. The credit calculator specifies the type and extent of surveys required for a BioBanking assessment and then processes survey data to calculate the number and type of biodiversity credits that are either required at a development site or will be generated at a biobank site.

The BioBanking Trust Fund ensures that landowners have the money needed to carry out the management actions required each year and provides a financial incentive to landowners to carry out those actions. The scheme is administered by OEH and ensures accountability and compliance through legislation, regular reporting requirements and financial measures.

1.3 Scope of assessment

The scope of this BioBanking assessment report is to:

- Outline the methods used in the BioBanking assessment.
- Describe the existing environment of the proposed Norton biobank, including the results of site surveys.
- Present the data used to perform the BioBanking assessment and credit calculations for the site.
- Calculate the number and type of biodiversity credits that will be generated when a BioBanking agreement is obtained for the site using Version 4.1 of the credit calculator.
- Provide an overview of the management actions and monitoring program that would be required in perpetuity under a BioBanking agreement, such that a net improvement in biodiversity over time is achieved.

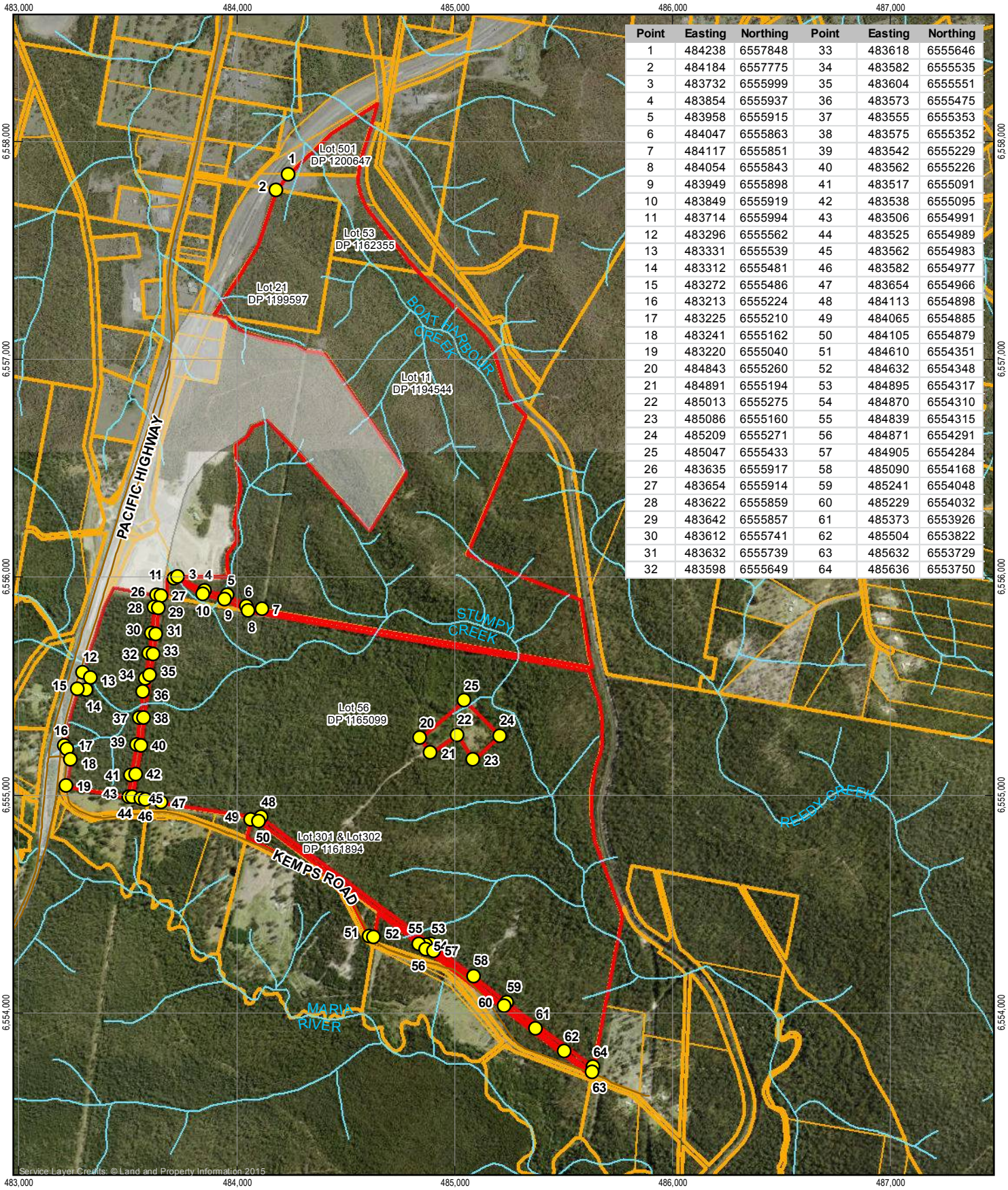
The BioBanking assessment and credit calculations were performed by Ben Harrington (Accredited BioBanking Assessor number 0073) based on site surveys, GIS analysis and draft credit calculations performed by GHD ecologists supported by a specialist botanist, Greg Elks.

This report should be read in conjunction with the Management Actions Plan (MAP) for the Norton biobank (GHD 2016).

1.4 Glossary of terms

Biobank site	Land that is designated by a BioBanking agreement to be a biobank site.
Biobanking agreement	An agreement entered into between the landowner and the Minister under Part 7A of the TSC Act for establishing a biobank site.
BioBanking Assessment Methodology (the methodology; BBAM)	The rules of the BioBanking Scheme established under the TSC Act that determine credits created, credits required and the circumstances that improve or maintain biodiversity values.
BioBanking Scheme (BioBanking; the scheme)	The biodiversity banking and offsets scheme established under Part 7A of the TSC Act.
Biobanking statement	Specifies the number and class of credits to be retired for a particular development. A BioBanking statement can only be issued in circumstances that improve or maintain biodiversity values.
Biobanking Trust Fund	The Trust Fund established under Part 7A of the TSC Act to hold funds from the sale of credits.

Biodiversity credit	Registered biodiversity credits are created for management actions that have been carried out or are proposed to be carried out, in accordance with the BioBanking agreement.
Biodiversity offset	Actions that are put in place to counterbalance (offset) an impact on biodiversity values.
Biodiversity values	The composition, structure and function of ecosystems including threatened species, populations and ecological communities, and their habitats.
Development site	Land that is designated by a BioBanking statement to be a development site.
Ecosystem credit	A credit that relates to a vegetation type and the threatened species that are reliably predicted by that vegetation type (as a habitat surrogate).
Norton biobank (the biobank)	The land that is the subject of this BioBanking assessment, as described in Section 3.1.1 of this report and as shown on Figure 1.
Management action	Means an action or proposed action in respect of which a biodiversity credit may be created.
Species credit	A credit that relates to an individual threatened species whose occurrence at a given site cannot be reliably predicted based on habitat surrogates. Threatened species that require species credits are identified in the Threatened Species Profile Database.



Point	Easting	Northing	Point	Easting	Northing
1	484238	6557848	33	483618	6555646
2	484184	6557775	34	483582	6555535
3	483732	6555999	35	483604	6555551
4	483854	6555937	36	483573	6555475
5	483958	6555915	37	483555	6555353
6	484047	6555863	38	483575	6555352
7	484117	6555851	39	483542	6555229
8	484054	6555843	40	483562	6555226
9	483949	6555898	41	483517	6555091
10	483849	6555919	42	483538	6555095
11	483714	6555994	43	483506	6554991
12	483296	6555562	44	483525	6554989
13	483331	6555539	45	483562	6554983
14	483312	6555481	46	483582	6554977
15	483272	6555486	47	483654	6554966
16	483213	6555224	48	484113	6554898
17	483225	6555210	49	484065	6554885
18	483241	6555162	50	484105	6554879
19	483220	6555040	51	484610	6554351
20	484843	6555260	52	484632	6554348
21	484891	6555194	53	484895	6554317
22	485013	6555275	54	484870	6554310
23	485086	6555160	55	484839	6554315
24	485209	6555271	56	484871	6554291
25	485047	6555433	57	484905	6554284
26	483635	6555917	58	485090	6554168
27	483654	6555914	59	485241	6554048
28	483622	6555859	60	485229	6554032
29	483642	6555857	61	485373	6553926
30	483612	6555741	62	485504	6553822
31	483632	6555739	63	485632	6553729
32	483598	6555649	64	485636	6553750

LEGEND

- Norton biobank site
- Cadastre
- Watercourses
- Recent or proposed development
- Boundary points

0 200 400 800
Metres

Geographic Coordinate System
Horizontal Datum: Geocentric Datum of Australia 1994

N

Roads and Maritime Services
Norton Biobank Site
BioBanking Assessment

Job Number 21-24927
Revision A
Date 20 Jul 2016

Biobank site boundary

Figure 1

G:\21\24927\GIS\Maps\Deliverables\Norton Biobank\21_24927_Z001_Site_Location.mxd
Level 15, 133 Castlereagh Street Sydney NSW 2000 T 61 2 9239 7100 F 61 2 9239 7199 E sydmail@ghd.com.au W www.ghd.com.au

Data Source: NSW Department of Lands: Cadastre - Jan 2011; LPMA Data 2013; Lewis and James (2010) Kempsey to Eungai: Compensatory Habitat package' Created by:mking3

2. Methods

2.1 Approach

GHD have prepared this BioBanking assessment based on field surveys and assessments completed by GHD ecologists supported by a specialist botanist, Greg Elks.

Biodiversity credits were calculated at the biobank site according to the methodology presented in the:

- *BioBanking Assessment Methodology 2014* (OEH 2014a)
- *Credit Calculator for Major Projects and BioBanking Operational Manual* (OEH 2016a).

The credit calculator is the software version of the methodology. Data is entered into the credit calculator based on information collected in the desktop assessment, site surveys and from using GIS mapping software. Data were entered in credit calculator version 4.0.

The methodology establishes two classes of biodiversity credits that may be created:

- Ecosystem credits – these are created or required for all impacts on biodiversity values, including threatened species that can be reliably predicted by habitat surrogates
- Species credits – these are created or required for impacts on threatened species that cannot be reliably predicted to use an area of land based on habitat surrogates. Threatened species that require species credits are identified by the credit calculator.

This BioBanking assessment has been prepared to support an application for a BioBanking agreement for the Norton biobank as follows:

- Geographic information system (GIS) assessment to map the biobank site and calculate the landscape value
- Field survey of the biobank site, including use of the BioBanking plot/transect methodology to calculate the site value
- Credit calculations using the credit calculator 4.0 to determine the ecosystems credits that will be generated when a BioBanking agreement is obtained for the site and it is formally set aside and managed for conservation.

The credit calculator produces a number of reports, including the threatened species predicted to occur, survey effort required at the site and the biodiversity credit profile which are appended to this BioBanking assessment.

The purpose of this BioBanking assessment is to assess the number of credits that may be created by conserving the vegetation on site in perpetuity under a BioBanking agreement.

2.2 Desktop assessment

2.2.1 Literature and database review

The following resources were reviewed to describe the existing environment of the biobank site and to obtain the necessary data to perform BioBanking credit calculations:

- *NSW (Mitchell) Landscapes Version 3 (2008)* (DECC 2008a).
- *Descriptions for NSW (Mitchell) Landscapes* (DECC 2008b).
- *Vegetation Types Database* (OEH 2014b).
- *NSW Vegetation Information System: Classifcation* (OEH 2016b).
- *Pacific Highway Upgrade, Nambucca Heads to Urunga Norton and Griffin Offset Management Plan* (GHD in prep).
- *Kempsey to Eungai: Compensatory Habitat package* (Lewis and James 2010)
- Aerial photographs and satellite imagery of the site.

2.2.2 Geographical Information System (GIS) analysis

GIS analysis is an integral part of the BBAM. GIS was used to plot the biobank site on a high resolution aerial photo base and to map vegetation types and biodiversity values across the site. GIS analysis was used to calculate the extent of native vegetation to be managed within the biobank site, which was entered into the credit calculator.

GIS analysis was used to accurately determine the Catchment Management Authority (CMA), CMA sub-region, Interim Biogeographic Regionalisation of Australia (IBRA) region and sub-region and Mitchell Landscape of the site.

Additional GIS analysis was used to plot the assessment circles surrounding the site in which landscape scores are calculated. Native vegetation cover, extent and connectivity were assessed vegetation zone mapping at the site and using aerial photography interpretation outside the site. Air photo interpretation was also used to identify and record distinct vegetation patches, determine the broad condition state of vegetation types and the location and extent of vegetated habitat corridors.

2.3 Site survey

2.3.1 Survey effort

This BioBanking assessment builds upon the results of field surveys conducted to inform the biodiversity offset strategy for the Pacific Highway upgrade program. The Norton offset site was surveyed by a specialist zoologist and a specialist botanist as documented in Lewis and James (2010). The flora survey of the Norton offset site and an adjoining 100 hectare site was undertaken over five days in May 2010 with a total survey effort of around 50 person-hours (Lewis and James 2010). Additional targeted field surveys were undertaken by GHD and Omvi ecologists within the Norton offset site in September 2014 to assess habitat suitability and the status of local populations of threatened fauna species. The purpose of these supplementary surveys was to more accurately map the extent and quality of habitat for threatened fauna species to inform EPBC Act offset calculations and the development of management actions (GHD in prep.).

Supplementary surveys were conducted in 2016 to collect the specific data required to complete the BioBanking assessment for the site. Staged field surveys of the biobank site were conducted by GHD ecologists and Greg Elks in accordance with the BBAM 2014. Survey effort

that has contributed to this BioBanking assessment is summarised in Table 1 and described below.

Table 1 Survey effort

Stage	Date	Survey Technique
Preliminary biodiversity offset assessment survey (Lewis and James 2010)	May 2010	Broad vegetation mapping, compilation of a flora species list, habitat assessment, opportunistic fauna observations.
Fauna offset assessment survey (GHD in prep.)	September 2014	Habitat assessments, partial BioBanking plot/transects (excluding species richness), food tree canopy plots, Koala 'Spot Assessment Technique' (SAT) searches, walked spotlighting surveys, call playback, nocturnal streamside searches, camera trapping.
Preliminary BioBanking survey	5th – 7th April 2016	Vegetation zone mapping, nine BioBanking plot/transects. Opportunistic fauna observations.
BioBanking survey	11th – 14th April 2016	Vegetation zone mapping, thirty BioBanking plot/transects.

2.3.2 BioBanking assessment

The initial vegetation mapping (Lewis and James 2010) was matched to NSW plant community types (PCTs) and ground-truthed in the field via systematic walked and driven transects across the entire site. Necessary adjustments were made by hand on aerial photographs of the site. The site was divided into vegetation zones for assessment with each zone comprising a distinct PCT and broad condition class. Vegetation types were split into 'Moderate/good' and 'Low' condition classes according to the BBAM, with Moderate/good vegetation featuring native overstorey cover or predominantly native groundcover (OEH 2014a). Vegetation zones at the site are shown on Figure 2.

Plot and transect surveys were conducted on site in accordance with the BBAM to obtain data for the calculation of ecosystem credits. The site value was determined by assessing 10 site condition attributes against benchmark values. Benchmarks are quantitative measures of the range of variability in condition in vegetation with relatively little evidence of alteration, disturbance or modification by humans since European settlement (OEH 2014a).

Plot/transects were distributed between vegetation zones according to the minimum number of plots required by the BBAM. Plot/transects are shown on Figure 2. Plant species were identified according to the nomenclature of the Royal Botanic Gardens and Domain Trust (RBGT) (2016). Cover, abundance, growth form and vegetation stratum data were collected for each species within the 20 metre x 20 metre species richness plot portion of each plot/transect.

Opportunistic and incidental observations of fauna species were recorded at all times during field surveys. Casual fauna observations were made in suitable areas of habitat throughout the course of the flora survey and while incidentally traversing the site. This included visual inspection of nests, creek lines, overhangs and woody debris, active searches for reptiles and frogs and opportunistic observation of scats, tracks, burrows or other traces. The locations of any threatened species identified within the site were captured with a handheld GPS.

2.4 BioBanking assessment

The BioBanking credit calculations were completed by Ben Harrington using the BBAM 2014 and credit calculator Version 4.0. Field survey results, BBAM assessments, GIS calculations and this assessment report have been peer reviewed by an accredited assessor (see Table 2).

The credit calculations have been submitted to OEH and the biodiversity credit report is included as Appendix A.

2.5 Staff qualifications

This report was prepared by Ben Harrington based on field surveys conducted by GHD and Idyll Spaces ecologists. The assessment was peer reviewed by Jayne Tipping and Dan Williams. Staff qualifications are presented in Table 2.

Table 2 Staff qualifications

Name	Position / Project Role	Qualifications	Years' experience
Ben Harrington	Senior Ecologist / desktop assessment, site surveys, credit calculations and reporting	BSc, MSc (Physical Geography) BioBanking Assessor Accreditation[1]	13+
Jayne Tipping	Principal Ecologist / Peer review	BSc, MEnv. Law	23+
Daniel Williams	Principal Environmental Scientist / Peer review, credit calculations, management actions, consultation and planning	B. App. Sc. BioBanking Assessor Accreditation[1]	13+
Jess Sharp	Graduate ecologist / site surveys, reporting	BEnvs	2+
Greg Elks (Idyll Spaces)	Senior Botanist / site surveys	BSc, MLitt	10+

1 Refer to OEH (2016c) list of accredited assessors.

3. Existing environment

3.1 Site context

3.1.1 Location and land uses

The proposed biobank is located at the 'Norton site', which comprise part Lot 501 DP 1200647, Lot 53 DP 1162355, Lot 301 DP 1161894, Lot 302 DP 1161894, Lot 56 DP1165099, Lot 11 DP1194544 and Lot 21 1199597 adjacent to the Pacific Highway, at South Kempsey, NSW as shown on Figure 1. A portion of Lot 56 DP1165099 is excluded from the biobank site, as this area will be maintained as a house site and home paddocks. Lot 56 DP1165099 is currently the subject of an application to the Land and Property Management Authority (LPMA) to update the cadastral boundary to accommodate the Kundabung to Kempsey section of the Pacific Highway upgrade in the southwestern corner of the Lot. The portion of Lot 56 DP1165099 that will be removed for the Pacific Highway upgrade has been excluded from the biobank site.

The site is located in the Kempsey Shire Council Local Government Area (LGA) and is zoned RU2 Rural Landscape in the *Kempsey Local Environment Plan 2012.*

The Norton site is a parcel of privately owned land that was purchased by Roads and Maritime for the purpose of securing biodiversity offsets for various stages of the Pacific Highway upgrade project. The site boundary and associated cadastre have recently been modified to accommodate the Pacific Highway upgrade and a proposed quarry expansion. A service centre has recently been constructed adjacent to the western boundary of the site. This recent and proposed development is shown on Figure 1 and has been treated as cleared land in the BioBanking landscape assessment (see Section 4.2).

The Norton site is around 495.9 hectares in area and contains remnant and regenerating forest on gently undulating terrain. The Norton site is currently unoccupied. Previous land uses include timber harvesting, low intensity grazing and stockpiling of timber, rubbish and fill. There is a limited network of dirt access tracks across the site and some internal fences, generally in poor condition. An electricity easement runs north-south through the southwestern portion of the site and another runs along the southern boundary. Essential Energy have confirmed that the voltage in these electricity easements through the Norton biobank is 11kV (three phase). The width of the easement that is maintained for this voltage is 20 metres. These 20 metre wide easements have been excluded from the biobank site (see Figure 1).

There is an unbuilt Crown Road (i.e. a 'paper road') through the centre of the site which Roads and Maritime are in the process of extinguishing.

Adjacent land uses include:

- The Pacific Highway, including the recently upgraded Kempsey Bypass section to the northwest and Kundabung to Kempsey section to the southwest.
- Farawell's Quarry, including a proposed expansion, a service centre and cleared land proposed for warehousing and light industrial land to the west.
- The north coast railway and sparsely cleared bush blocks and hobby farms to the north and northeast.
- The north coast railway and then the Maria National Park and vegetated private and Crown land to the east.
- Partially cleared grazing land, hobby farms and bush blocks to the southeast and south and beyond that the Maria River State Forest.

3.1.2 Landscape context

The site is in the 'NSW North Coast' Interim Biogeographic Regionalisation for Australia (IBRA), region and the 'Macleay Hastings' IBRA subregion (DSEWPac 2011).

The Norton site is around 495.9 hectares in area and contains wet and dry sclerophyll forest on gently undulating, near-coastal hills. The southern portion of the site comprises a gentle slope, on fine grained sedimentary substrate and recent alluvium that drains northwards to Stumpy Creek. On the north side of Stumpy Creek there is a relatively steep, rocky ridge on fine grained volcanic substrate that rises to a height of 100 m elevation just to the west of the site. The northern portion of the offset site comprises moderate to steep slopes that drain northwards to Boat Harbour creek. There appears to be a transitional area of metamorphic geology between the sedimentary and volcanic portions of the site. This variable geology, combined with the site's disturbance history, is probably contributing to the complex and variable vegetation on site (see Section 3.3 below).

Stumpy Creek is a near-permanent, channel confined, third order stream that runs generally from west to east through the site (Figure 2). It follows a circuitous route through the southern portion of the site and along with its tributaries dominates the geomorphology of this area. Stumpy Creek is generally in good condition with intact riparian and in stream vegetation, intact channel and bank structure, continuous flow, very little weed infestation and no evidence of poor water quality.

Boat Harbour creek is a permanent, channel confined, third order stream that runs generally from southeast to northwest through the site (Figure 2). It is fed by multiple intermittent tributaries in narrow gullies running off the ridge through the centre of the site. Boat Harbour Creek is generally in moderate condition with partially cleared and regenerating riparian vegetation, healthy in stream vegetation, intact channel and bank structure, continuous flow, moderate weed infestation and some evidence of high turbidity.

The southern portion of the Norton site falls within a mapped regional fauna habitat corridor (Scotts et. al, 2003) that runs east-west connecting State forests to the west and south of the site with Maria National Park to the east.

The Norton site is part of a near continuous patch of native vegetation and habitat of many thousands of hectares. The recent and proposed development and the Pacific Highway to the west and north coast railway to the east comprise barriers to fauna movement and other ecological processes. Kalateenee State Forest lies to the west of the Pacific Highway and beyond that there is an extensive network of native vegetation in national parks and State forests that stretches to the Great Dividing Range. The Norton site is partially connected to this extensive area of habitat via the riparian corridors of Boat Harbour and Stumpy Creek and associated culverts and underpasses. There are partial barriers to the south and southeast associated with partly cleared and/or fenced private land. The Maria River State Forest lies to the south of this land and is continuous with the Maria National Park and other native vegetation that stretches to the coast. East of the railway there is native vegetation in the Maria National Park and on private and Crown land that is part of the vegetated corridor to the coast.

The majority of the biobank site is mapped within the 'Brooms Head - Kempsey Coastal Ramp' Mitchell landscape (DECC, 2008a) as shown on Figure 3. This landscape comprises hills and low ranges of the coastal fall on lower Devonian greywacke, slate phyllite and quartzite and Permian Phyllite and schistose sandstone. The general elevation is 50 to 450m with local relief of up to 300m. Soils are thin, stony gradational loams and sandy loams on the slopes grading to yellow brown texture-contrast soils on lower slopes and in valleys. Vegetation comprises dry sclerophyll forest of Blackbutt (*Eucalyptus pilularis*), Sydney Blue Gum (*Eucalyptus saligna*) and Large-fruited Blackbutt (*Eucalyptus pyrocarpa*) (DECC, 2008b). Mid and upper slopes in the biobank site, comprising the majority of the area, are a good match for this Mitchell landscape.

There is a small area of the 'Macleay Coastal Alluvial Plain' Mitchell landscape in the southeast of the site (DECC, 2008a) associated with the riparian corridor of Stumpy Creek (Figure 3). This landscape comprises wide valleys, channels, floodplains, swamps, and terraces of the Manning and Macleay Rivers and other coastal streams on Quaternary alluvium. The general elevation is 0 to 50m, with local relief up to 15m. Soils are dark organic loams and silty clay on the floodplain, gradational brown loams and yellow-brown texture-contrast soil on terraces and organic silty mud in swamps (DECC, 2008b).

The majority of the site is consistent with the 'Brooms Head - Kempsey Coastal Ramp' and so this Mitchell landscape was entered in the BioBanking credit calculations (see Section 4.3).

3.2 Vegetation and habitat resources

3.2.1 Overview

Vegetation was classified according to vegetation structure, species composition, soil type and landscape position. NSW vegetation types were identified with reference to the descriptions and overview of diagnostic species presented in the NSW vegetation types database (OEH 2014b).

Vegetation zones, reflecting vegetation types and condition were identified according to the BBAM. These are shown on Figure 2, and are summarised in Table 3 and described below. There are a number of small, informal, dirt tracks and fence lines that have been included in surrounding vegetation zones because they do not comprise a gap in over storey vegetation and contain partial cover of native understorey vegetation.

Table 3 Vegetation zones within the Norton biobank

Veg Zone ID	NSW Vegetation Type	NSW Veg. ID	Condition	Area in Norton offset site (ha)
1	Blackbutt – Turpentine – Tallowwood shrubby open forest	NR122	Moderate/good	33.4
2	Red Mahogany open forest	NR222	Moderate/good	30.2
3	Forest Red Gum - Swamp Box	NR161	Moderate/good	3.8
4	Spotted Gum – Grey Ironbark open forest	NR247	Moderate/good	19.5
5	Spotted Gum - Grey Ironbark - Pink Bloodwood open forest	NR246	Low	4.0
6	Flooded Gum – Tallowwood – Brush Box moist open forest	NR160	Moderate/good	7.4
7	Blackbutt – Tallowwood dry grassy open forest	NR119	Moderate/good	44.5
8	Blackbutt - Pink Bloodwood shrubby open forest	NR117	Moderate/good	53.4
9	Spotted Gum - Grey Ironbark - Pink Bloodwood open forest	NR246	Moderate/good	135.4
10	Scribbly Gum – Red Bloodwood heathy open forest	NR228	Moderate/good	164.3
			Total	**495.9**

3.2.2 Vegetation zones

The structure, species composition and condition of the vegetation zones within the biobank are described below. Species lists are provided in Appendix B. Plot/transect data is also provided in Appendix B along with benchmark values for each vegetation type.

1 - Blackbutt – Turpentine – Tallowwood shrubby open forest (NR122, Moderate/good)	
Plant community type (OEH, 2015c)	Blackbutt - Turpentine - Tallowwood shrubby open forest of the coastal foothills of the central North Coast
NSW Vegetation Type ID	NR122
Survey effort	Plot/transects 18, 25, 31, 36
Condition (DECC, 2008)	Moderate/good. Remnant or regrowth native vegetation with near-intact over storey that was at or slightly below benchmark values in all but one of the plot/transects sampled. Native mid storey cover was at benchmark values in all of the four plot/transects. Shrub, grass and forb cover attributes and woody debris (i.e. length of fallen logs) were at or above benchmark values for this plant community type in the majority of plot/transects sampled, while overall species richness was slightly below benchmark values. The majority of canopy species were observed regenerating. There were no hollow-bearing trees and no exotic plant ground cover or mid storey noted along 20m x 50m Biobanking plot/transects. Occasional exotic plants were noted within the broader vegetation zone. This vegetation zone has high intrinsic value and moderate potential for achieving gains in biodiversity values through management within a biobank site. Improvements in biodiversity values could be obtained through continuing development of vegetation structure and habitat resources, removal of exotic plants, cessation of timber collection and management of pest fauna.
Conservation significance	Native vegetation. Not listed as a TEC.
Landscape position	Lower slopes and alluvial flats
Structure	Tall forest with a dense mid storey and a dense understorey of shrubs, herbs, ferns and grasses.
Over storey	Continuous, around 20 to 30 metres tall and around 11 - 38.5 per cent cover in the plot/transects sampled. Features a mixed canopy dominated by Blackbutt (*Eucalyptus pilularis)*, Tallowwood (*E. microcorys*) and Pink Bloodwood (*Corymbia intermedia*) with regeneration of all species except Blackbutt observed.
Mid storey	Mid-storey with a range of 14.5 – 55.5 per cent cover was recorded in the plot/transects sampled. Characteristic midstorey species include Turpentine (*Syncarpia glomulifera*), *Sannantha angusta*, Snake vine (*Stephania japonica*), Brush Box (*Lophostemon confertus*), White Sally (*Acacia floribunda*) and Tantoon (*Leptospermum polygalifolium*).
Groundcover	Moderately dense, species rich and structurally variable. Grass cover was well above the benchmark value while both shrubs and 'other' cover was at benchmark value for all plots/transects sampled. There are occasional patches of leaf litter and bare earth.
– grasses	A range of 24 – 68 per cent cover was estimated in the plot/transects sampled. Characteristic species include Wiry Panic (*Entolasia stricta*), Bordered Panic (*Entolasia marginata*) and *Oplismenus imbecillis*.

1 - Blackbutt – Turpentine – Tallowwood shrubby open forest (NR122, Moderate/good)	
– shrubs	A range of 10 – 28 per cent cover was estimated in the plot/transects sampled. Characteristic shrub species include *Sannantha angusta*, Coffee Bush (*Breynia oblongifolia*) and *Persoonia stradbrokensis*.
– 'other' (herbs, ferns and sedges)	A range of 20 – 70 per cent cover was estimated in the plot/transects sampled. Characteristic species include Rainbow Fern (*Calochlaena dubia*), Climbing Guinea Flower (*Hibbertia scandens*), Tall Sedge (*Carex appressa*), Spiny-headed Mat-rush (*Lomandra longifolia*), *Carex maculata*, Harsh Ground Fern (*Hypolepis muelleri*) and Pastel Flower (*Pseuderanthemum variabile*).
Exotic species	Camphor Laurel (*Cinnamomum camphora*) and Lantana (*Lantana camara*) were occasionally present in this vegetation zone, comprising isolated individual plants at very low frequency and cover. There was a thin band of environmental weeds such as Broad-leaved Paspalum (*Paspalum mandiocaunum)* and Pigeon Grass (*Setaria sphacelata)* along disturbed edges adjoining trails, easements and fence lines.
Vegetation zone 1 at Plot/transect 18	

2 - Red Mahogany open forest (NR222 , Moderate/good)	
Plant community type (OEH, 2015c)	Red Mahogany open forest of the coastal lowlands of the North Coast
NSW Vegetation Type ID	NR222
Survey effort	Plot/transects 41, 42, 1, 47
Condition (DECC, 2008)	Moderate/good. Remnant or regrowth native vegetation with near-intact over storey that was at or slightly below benchmark values. Native mid storey cover was at the benchmark values in all but one plot/transects. Native grass cover was significantly higher then the benchmark value while shrub cover, species richness and woody debris were lower. Other ground cover attributes and woody debris were well within the benchmark values for this plant community type in all but one of plot/transects sampled. The dominant canopy species of *Eucalyptus resinifera* was observed regenerating, in addition to a number of main associated over-storey species. There were few hollow-bearing trees recorded, including only one in the four plots sampled. No exotic species were recorded in the ground layer or mid-storey of any of the plots. This vegetation zone has high intrinsic value and moderate potential for achieving gains in biodiversity values through management within a biobank site. Improvements in biodiversity values could be obtained through continuing development of vegetation structure and habitat resources, removal of exotic plants, cessation of timber collection and management of pest fauna.
Conservation significance	Native vegetation. Not listed as a TEC.
Landscape position	Mid-lower slopes.
Structure	Tall open forest with high grass and sedge ground cover and in some instances, in the east of the mapped vegetation area, a distinct 'heathy' mid-storey is coming through. The western portion of the vegetation was more typical of the plant community type.
Over storey	Continuous, around 20 to 30 metres tall with a range of 11-19.5 per cent cover in the plot/transects sampled. Features a mixed canopy of Red Mahogany (*Eucalyptus resinifera),* Diehard Stringybark (*Eucalyptus cameronii*), Thick-leaved Mahogany (*Eucalyptus carnea*) and Red Bloodwood (*Corymbia gummifera*) with regenerating species found in two of the four plot/transects.
Mid storey	Mid-storey with a range of 9 – 20 per cent cover was estimated in the plot/transects sampled. Characteristic midstorey species include Black She-Oak (*Allocasuarina littoralis*), *Pultenaea myrtoides*, *Melaleuca nodosa*, Forest Oak (*Allocasuarina torulosa*) and Willow Bottlebrush (*Callistemon salignus*).
Groundcover	Moderately dense, species rich and structurally variable. High cover of grasses and 'other' with low cover of shrubs in the plot transects sampled. There are occasional patches of leaf litter and bare earth.

2 - Red Mahogany open forest (NR222 , Moderate/good)	
– grasses	A range of 24 – 84 per cent cover was estimated in the plot/transects sampled. Characteristic species include A Wiregrass (*Aristida* sp.), Wiry Panic (*Entolasia stricta*), Kangaroo Grass (*Themeda australis*), Threeawn Speargrass (*Aristida vagans*), A Lovegrass (*Eragrostis* sp.*)* and Blady Grass (*Imperata cylindrica*).
– shrubs	A range of 0 – 6 per cent cover was estimated in the plot/transects sampled. Characteristic shrub species included Rough Guinea Flower (*Hibbertia aspera*).
– 'other' (herbs, ferns and sedges)	A range of 4 – 64 per cent cover was estimated in the plot/transects sampled. Characteristic 'other' species include Poverty Raspwort (*Gonocarpus tetragynus*), *Velleia spathulata*, *Ptilothrix deusta*, *Xanthorrhoea* sp. and Spiny-headed Mat-rush (*Lomandra longifolia*).
Exotic species	No exotic plants were present throughout this vegetation zone, with 0 per cent cover in the four plot/transects sampled.
Open forest with a dense mid storey at Plot/transect 47	

3 - Forest Red Gum - Swamp Box (NR161, Moderate/good)	
Plant community type (OEH, 2015c)	Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the North Coast
NSW Vegetation Type ID	NR161
Survey effort	Plot/transects 48, 49
Condition (DECC, 2008)	Moderate/good. Remnant or regrowth native vegetation with near-intact over storey that was slightly below benchmark values. Native mid storey cover was at the benchmark values in all plot/transects. Native grass cover was at the benchmark value while 'other' cover attributes (moss, ferns and sedges) and species richness were above. Native shrub cover and woody debris was found to be below the benchmark data in one plot, and above in the second for this plant community type in the plot/transects sampled. High leaf litter quantities were noted throughout the vegetation zone. The dominant canopy species *Eucalyptus tereticornis* was observed regenerating. There were no hollow-bearing trees found. While no exotic species were recorded along the 20m x 50m Biobanking plot/transects, occasional exotic shrubs and grasses were noted. This vegetation zone has high intrinsic value and moderate potential for achieving gains in biodiversity values through management within a biobank site. Improvements in biodiversity values could be obtained through continuing development of vegetation structure and habitat resources, removal of exotic plants, cessation of timber collection and management of pest fauna.
Conservation significance	Comprises a local occurrence of 'Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion' (Subtropical Coastal Floodplain Forest), which is listed as an endangered ecological community under the TSC Act.
Landscape position	Alluvial flats.
Structure	Tall open forest with moderate mid-storey and dense ground cover of grasses mosses, ferns, sedges and herbs.
Over storey	Continuous, around 15 to 25 metres tall with a range of 6-9 per cent cover in the plot/transects sampled. Features a canopy dominated by Forest Red Gum (*Eucalyptus tereticornis*), which was observed regenerating in one of the two plot/transects.
Mid storey	Mid-storey with a range of 18.5 – 20.5 per cent cover was estimated in the plot/transects sampled. Characteristic midstorey species include *Sannantha angusta*, Willow Bottlebrush (*Callistemon salignus*), Flax-leaved Paperbark (*Melaleuca linariifolia*), Tantoon (*Leptospermum polygalifolium*) and Black She-Oak (*Allocasuarina littoralis*).
Groundcover	Moderately dense, species rich and structurally variable. High cover of grass and 'other' groundcover attributes while shrub cover varied over the two plots/transects sampled. There are occasional patches of leaf litter and bare earth.

3 - Forest Red Gum - Swamp Box (NR161, Moderate/good)	
– grasses	A range of 50 – 54 per cent cover was estimated in the plot/transects sampled. Characteristic species include Wiry Panic (*Entolasia stricta*), *Ottochloa gracillima*, Bordered Panic (*Entolasia marginata*), *Ischaemum australe*, Weeping Grass (*Microlaena stipoides*) and *Oplismenus imbecillis*.
– shrubs	A range of 6 – 16 per cent cover was estimated in the plot/transects sampled. Characteristic shrub species included Coffee Bush (*Breynia oblongifolia*).
– 'other' (herbs, ferns and sedges)	A range of 28 – 54 per cent cover was estimated in the plot/transects sampled. Characteristic 'other' species include Sphagnum moss (*Sphagnum* sp.), Indian Pennywort (*Centella asiatica*), Kidney Weed (*Dichondra repens*), *Hydrocotyle sibthorpioides*, *Carex maculata*, *Vernonia cinerea* and Spiny-headed Mat-rush (*Lomandra longifolia*).
Exotic species	A variety of exotic plants are present throughout this vegetation zone, all at very low frequency and cover. There was no exotic cover in the plot/transects sampled. However, occasional individual Lantana (*Lantana camara*) and Camphor Laurel (*Cinnamomum camphora*) plants were observed in addition to mild infestations of Whisky Grass (*Andropogen virginicus*) and Giant Paspalum (*Paspalum urvillei*) throughout the vegetation zone.
Forest with a dense understorey of ferns and grasses at Plot/transect 49	

4 - Spotted Gum – Grey Ironbark open forest (NR247, Moderate/good)	
Plant community type (OEH, 2015c)	Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the North Coast
NSW Vegetation Type ID	NR247
Survey effort	Plot/transects 21, 38, 39
Condition (DECC, 2008)	Moderate/good. Remnant or regrowth native vegetation with near-intact over storey that was at benchmark values. Native mid storey cover and woody debris were at the benchmark values in all but one plot/transects. Native grass and 'other' cover were at the benchmark value. Shrub cover ranged from above, below and nil for the three plot/transects. The species richness of the plot/transects sampled found two of the three below benchmark value. High leaf litter quantities were noted throughout the vegetation zone. All of the over-storey species present in this vegetation zone were observed regenerating. Only two hollow-bearing trees were found in one of the plot/transects sampled. No exotic species were recorded in the ground layer or mid-storey in any plot/transects. Occasional exotic plants were observed throughout the vegetation zone. This vegetation zone has high intrinsic value and moderate potential for achieving gains in biodiversity values through management within a biobank site. Improvements in biodiversity values could be obtained through continuing development of vegetation structure and habitat resources, removal of exotic plants, cessation of timber collection and management of pest fauna.
Conservation significance	Native vegetation. Not listed as a TEC.
Landscape position	Mid and upper slopes
Structure	Tall forest with a moderate mid storey and a dense understorey of herbs, ferns and grasses.
Over storey	Continuous, around 20 to 25 metres tall and around 15-27.2 per cent cover in the plot/transects sampled. Features a mixed canopy of Spotted Gum (*Corymbia variegata*), Grey Ironbark (*Eucalyptus siderophloia*), Tallowwood (*Eucalyptus microcorys*), Thick-leaved Mahogany *(Eucalyptus carnea*), Pink Bloodwood (*Corymbia intermedia*) and Small-fruited Grey Gum *(Eucalyptus propinqua*). Regeneration of all these species was observed.
Mid storey	Mid-storey with a range of 4.5 – 29 per cent cover was estimated in the plot/transects sampled. Characteristic midstorey species include *Sannantha pluriflora*, Curracabah (*Acacia concurrens*), Black She-Oak (*Allocasuarina littoralis*), Brush Box (*Lophostemon confertus*) and Cheese Tree (*Glochidion ferdinandi*).
Groundcover	Moderately dense, species rich and structurally variable. There was a high cover of grass groundcover to moderate 'other' cover compared to minimal shrub cover in the plot transects sampled. There were occasional patches of leaf litter and bare earth.

4 - Spotted Gum – Grey Ironbark open forest (NR247, Moderate/good)	
– grasses	A range of 24 – 88 per cent cover was estimated in the plot/transects sampled. Characteristic species include Wiry Panic (*Entolasia stricta*), Bordered Panic (*Entolasia marginata*), Blady Grass (*Imperata cylindrica*), Small-flowered Finger Grass (*Digitaria parviflora*), Open Summer-grass (*Digitaria diffusa*) and Threeawn Speargrass (*Aristida vagans*).
– shrubs	A range of 0 – 8 per cent cover was estimated in the plot/transects sampled. Characteristic shrub species include *Sannantha angusta* and Coffee Bush (*Breynia oblongifolia*).
– 'other' (herbs, ferns and sedges)	A range of 18 – 70 per cent cover was estimated in the plot/transects sampled. Characteristic 'other' species include Spiny-headed Mat-rush (*Lomandra longifolia*), *Vernonia cinerea*, Wattle Matt-rush (*Lomandra filiformis*), Small-leaf Glycine (*Glycine microphylla*), Pastel Flower (*Pseuderanthemum variabile*) and Variable Sword-sedge (*Lepidosperma laterale*).
Exotic species	A variety of exotic plants were present throughout this vegetation zone, all at very low frequency and cover. There was no exotic cover noted in any of the 20 x 50m BioBanking plot/transects sampled. However, occasional individual Lantana (*Lantana camara*) plants and mild infestations of Whisky Grass (*Andropogen virginicus*) were observed throughout the vegetation zone.
Forest with moderate grassy understorey	

5 - Spotted Gum - Grey Ironbark - Pink Bloodwood open forest (NR246, Low)	
Plant community type (OEH, 2015c)	Spotted Gum - Grey Ironbark - Pink Bloodwood open forest of the Clarence Valley lowlands of the North Coast
NSW Vegetation Type ID	NR246
Survey effort	Plot/transects 27, 28
Condition (DECC, 2008)	Low Cleared land with minimal vegetation, primarily exotics, and no remnant over storey. Native mid storey cover was very low, with one plot/transect at the lower end of the benchmark value and one below. For all groundcover attributes, grass, shrubs and 'other' cover was minimal. Each attribute had one plot/transect at benchmark value and the other below while both species richness and woody debris were below benchmark. No remnant canopy species were present. Regeneration of one of the over storey species present in patches of Moderate/good condition Spotted Gum - Grey Ironbark - Pink Bloodwood open forest was observed. There were no hollow-bearing trees recorded due to a distinct lack of mature trees. Numerous exotic species were severe throughout the entire vegetation zone in both the ground cover and mid-storey levels. This vegetation zone has moderate intrinsic value and good potential for achieving gains in biodiversity values through management within a biobank site. Improvements in biodiversity values could be obtained through supplementary planting and development of vegetation structure and habitat resources, removal of exotic plants, cessation of timber collection and management of pest fauna.
Conservation significance	Low condition vegetation dominated by exotic plants.
Landscape position	Lower slopes and mounds of fill.
Structure	Cleared land with primarily exotic ground cover and mid storey cover.
Over storey	Not present. No over storey recorded in either of the two plot/transects sampled.
Mid storey	Sparse mid-storey with a range of 3 – 11 per cent cover was estimated in the plot/transects sampled. Characteristic midstorey species include *Sannantha angusta*, Curracabah (*Acacia concurrens*), *Acacia falcata*, Wattle (*Acacia* sp.), Two-veined Hickory (*Acacia binervata*), and *Persoonia stradbrokensis*.
Groundcover	Moderately dense, exotic dominated groundcover with a grass, 'other' and shrub attributes all near the lower range of benchmark value across all plot transects sampled. There are occasional patches of leaf litter and bare earth.

5 - Spotted Gum - Grey Ironbark - Pink Bloodwood open forest (NR246, Low)	
– grasses	A range of 8 – 30 per cent cover was estimated in the plot/transects sampled. Characteristic species include Common Couch (*Cynodon dactylon*) Indian Cupscale Grass (*Sacciolepis indica*) and Ditch Millet (*Paspalum orbiculare*).
– shrubs	2 per cent cover was estimated in the plot/transects sampled. Characteristic shrub species include Groundsel Bush (*Baccharis halimifolia*), *Pultenaea retusa* and Gorse Bitter Pea (*Daviesia ulicifolia*).
– 'other' (herbs, ferns and sedges)	A range of 4 – 20 per cent cover was estimated in the plot/transects sampled. Characteristic 'other' species include *Gonocarpus chinensis* subsp. *Verrucosus*, *Cyperus polystachyos*, *Mitrasacme alsinoides*, *Velleia spathulata*, Common Fringe-sedge (*Fimbristylis dichotoma*) and Fluke Bogrush (*Schoenus apogon*).
Exotic species	A variety of exotic plants were present throughout this vegetation zone, at very high frequency and cover. There was 68 – 86 per cent cover in the two plot/transects sampled. Moderate infestations of Lantana (*Lantana camara*) and Fireweed (*Senecio madagascariensis*) with severe cover of pasture grasses throughout entire vegetation zone.
Cleared land with dense exotic ground cover and mid-storey at Plot/transect 27	

6 - Flooded Gum – Tallowwood – Brush Box moist open forest (NR160, Moderate/good)	
Plant community type (OEH, 2015c)	Flooded Gum - Tallowwood - Brush Box moist open forest of the coastal ranges of the North Coast
NSW Vegetation Type ID	NR160
Survey effort	Plot/transects 30, 32, 33
Condition (DECC, 2008)	Moderate/good. Remnant or regrowth native vegetation with near-intact over storey that was at or slightly below benchmark values. Dense native mid storey cover was at benchmark standard in all plot/transects. All groundcover attributes, grass, 'other' and shrubs as well as woody debris were at or slightly higher than the benchmark value for this plant community type in all of plot/transects sampled. Species richness in plot/transects were all found to be lower than the benchmark value. No regeneration of overstorey species was recorded and there were no hollow-bearing trees in the three plots sampled. A low density of exotic groundcover was noted in one plot/transect. This vegetation zone has high intrinsic value and moderate potential for achieving gains in biodiversity values through management within a biobank site. Improvements in biodiversity values could be obtained through continuing development of vegetation structure and habitat resources, removal of exotic plants, cessation of timber collection and management of pest fauna.
Conservation significance	Native vegetation. Not listed as a TEC.
Landscape position	Alluvial flats
Structure	Tall forest with a dense mid storey and a dense understorey of shrubs, herbs, ferns and grasses.
Over storey	Continuous, around 25 to 35 metres tall and around 18.5 - 34 per cent cover in the plot/transects sampled. Features a mixed canopy of Flooded Gum (*Eucalyptus grandis*), Tallowwood (*Eucalyptus microcorys*) and Diehard Stringybark *(Eucalyptus cameronii*). No regeneration of these canopy species was noted.
Mid storey	Mid-storey with a range of 20 – 32 per cent cover was estimated in the plot/transects sampled. Characteristic midstorey species include Tantoon (*Leptospermum polygalifolium*), *Sannantha angusta*, White Sally (*Acacia floribunda*), Hairy Apple Berry (*Billardiera scandens*) and Flax-leaved Paperbark (*Melaleuca linariifolia*).
Groundcover	Moderately dense, species rich and structurally variable. All groundcover attributes were of similar densities and at benchmark value or slightly higher across all plot transects sampled. There are occasional patches of leaf litter and bare earth.

6 - Flooded Gum – Tallowwood – Brush Box moist open forest (NR160, Moderate/good)	
– grasses	A range of 36 – 74 per cent cover was estimated in the plot/transects sampled. Characteristic species include Bordered Panic (*Entolasia marginata*), *Oplismenus imbecillis*, *Ottochloa gracillima*, Wiry Panic (*Entolasia stricta*) and South African Pigeon Grass (*Setaria sphacelata*).
– shrubs	A range of 16 – 38 per cent cover was estimated in the plot/transects sampled. Characteristic shrub species include Coffee Bush (*Breynia oblongi*folia) and Scentless Rosewood (*Synoum glandulosum* subsp*. glandulosum*).
– 'other' (herbs, ferns and sedges)	A range of 36 – 78 per cent cover was estimated in the plot/transects sampled. Characteristic 'other' species include Harsh Ground Fern (*Hypolepis muelleri*), Native Wandering Jew (*Commelina cyanea*), Whiteroot (*Pratia purpurascens*) Bracken (*Pteridium esculentum*) and Pastel Flower (*Pseuderanthemum variabile*).
Exotic species	A low cover of exotic grasses and herbs was noted in the groundcover at one plot/transect sampled. There is a broad patch of Broad-leaved Paspalum (*Paspalum mandiocaunum*) and Pigeon Grass (*Setaria sphacelata*) surrounding the location of a disused dwelling and along disturbed edges adjoining trails.
Tall forest with a dense mid storey and understorey at Plot/transect 33	

7 - Blackbutt – Tallowwood dry grassy open forest (NR119, Moderate/good)	
Plant community type (OEH, 2015c)	Blackbutt - Tallowwood dry grassy open forest of the central parts North Coast
NSW Vegetation Type ID	NR119
Survey effort	Plot/transects 34, 44, 45, 47
Condition (DECC, 2008)	Moderate/good. Remnant or regrowth native vegetation with near-intact over storey that was at or slightly below benchmark values. Native mid storey cover was at the benchmark values in all but one plot/transects. Native grass cover was significantly higher than the benchmark value while an overall low count of shrub cover at benchmark value across all plot/transects but one. Other ground cover attributes were at benchmark value, while species richness was lower for this plant community type in all plot/transects sampled. Woody debris was below benchmark value in two plot/transects and at benchmark value for the remaining two plot/transects. High leaf litter quantities were noted throughout the vegetation zone. All dominant canopy species present were found to be regenerating across the plots sampled. No hollow-bearing trees were recorded were recorded in the plots sampled. No exotic plant cover was recorded in the plots sampled though occasional exotic plants were found within the broader vegetation zone. This vegetation zone has high intrinsic value and moderate potential for achieving gains in biodiversity values through management within a biobank site. Improvements in biodiversity values could be obtained through continuing development of vegetation structure and habitat resources, removal of exotic plants, cessation of timber collection and management of pest fauna.
Conservation significance	Native vegetation. Not listed as a TEC.
Landscape position	Slopes on gently undulating coastal hills
Structure	Tall open forest with a moderate mid storey and moderate grassy understorey.
Over storey	Continuous, around 20 to 30 metres tall and around 12.5 – 20.5 per cent cover in the plot/transects sampled. Features a mixed canopy of Blackbutt (*Eucalyptus pilularis),* Tallowwood (*Eucalyptus microcorys*), Diehard Stringybark *(Eucalyptus cameronii*), Pink Bloodwood (*Corymbia intermedia*), Red Bloodwood (*Corymbia gummifera*) and Red Mahogany (*Eucalyptus resinifera).* All dominant over storey species were observed regenerating.
Mid storey	Mid-storey with a range of 8.5 – 14.5 per cent cover was estimated in the plot/transects sampled. Characteristic midstorey species include Turpentine (*Syncarpia glomulifera*), *Sannantha angusta*, *Melaleuca sieberi*, Two-veined Hickory (*Acacia binervata*), Turpentine (*Syncarpia glomulifera*), Two-veined Hickory (*Acacia binervata*) and Forest Oak (*Allocasuarina torulosa*).

7 - Blackbutt – Tallowwood dry grassy open forest (NR119, Moderate/good)	
Groundcover	Moderately dense, species rich and structurally variable. High cover of grasses to a distinct lower cover of shrubs while 'other' attribute groundcover was moderate throughout the plot transects sampled. There are occasional patches of leaf litter and bare earth.
– grasses	A range of 52 – 86 per cent cover was estimated in the plot/transects sampled. Characteristic species include Wiry Panic (*Entolasia stricta*), Blady Grass (*Imperata cylindrica*), *Ottochloa gracillima*, Bordered Panic (*Entolasia marginata*) and Kangaroo Grass (*Themeda australis*).
– shrubs	A range of 0 – 14 per cent cover was estimated in the plot/transects sampled. Characteristic shrub species include Rough Guinea Flower (*Hibbertia aspera*), *Denhamia bilocularis*, *Bossiaea rhombifolia* and *Monotoca scoparia*.
– 'other' (herbs, ferns and sedges)	A range of 18 – 38 per cent cover was estimated in the plot/transects sampled. Characteristic 'other' species include Pastel Flower (*Pseuderanthemum variabile*), Rough Guinea Flower (*Hibbertia aspera*), Variable Sword-sedge (*Lepidosperma laterale*), Bracken (*Pteridium esculentum*) and Spiny-headed Mat-rush (*Lomandra longifolia*).
Exotic species	Low frequency and cover of Lantana (*Lantana camara*) and Camphor Laurel (*Cinnamomum camphora*) plants with mild infestations of Whisky Grass (*Andropogen virginicus*) observed around the edges of disturbed areas.
Open forest with grass dominated groundcover at Plot/transect 34	

8 - Blackbutt - Pink Bloodwood shrubby open forest (NR117, Moderate/good)	
Plant community type (OEH, 2015c)	Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the North Coast
NSW Vegetation Type ID	NR117
Survey effort	Plot/transects 29, 4, 37, 43, 50
Condition (DECC, 2008)	Moderate/good. Remnant or regrowth native vegetation with near-intact over storey for which three of the five plot/transects were slightly below benchmark values. Native mid storey cover was at the benchmark values in all plot/transects. All groundcover attributes, grass, 'other' and shrubs were recorded as at benchmark value for this plant community type in all plot/transects sampled yet species richness was below. The majority of plot/transects had an amount of woody debris at benchmark value. The dominant canopy species were found to be regenerating in multiple plot/transects sampled. There were few hollow-bearing trees recorded, a total of four trees observed over the five plots sampled. High leaf litter quantities were noted throughout the vegetation zone. No exotic species were recorded as present in any of the plots ground layer or mid-storey. Occasional exotic plants were observed within the broader vegetation zone. This vegetation zone has high intrinsic value and moderate potential for achieving gains in biodiversity values through management within a biobank site. Improvements in biodiversity value could be obtained through continuing development of vegetation structure and habitat resources, removal of exotic plants, cessation of timber collection and management of pest fauna.
Conservation significance	Native vegetation. Not listed as a TEC.
Landscape position	Lower slopes and alluvial flats.
Structure	Tall forest with a dense mid storey and a dense understorey of shrubs, herbs, ferns and grasses.
Over storey	Continuous, around 25 to 30 metres tall and 14 – 36 per cent cover in the plot/transects sampled. Features a mixed canopy of Blackbutt (*Eucalyptus pilularis),* Tallowwood (*E. microcorys*), Red Mahogany (*Eucalyptus resinifera)*, Diehard Stringybark *(Eucalyptus cameronii*) and Pink Bloodwood (*Corymbia intermedia*) with regeneration of most canopy species apparent.
Mid storey	Mid-storey with a range of 18 – 48.5 per cent cover was estimated in the plot/transects sampled. Characteristic midstorey species include Tantoon (*Leptospermum polygalifolium*), *Sannantha angusta*, Turpentine (*Syncarpia glomulifera*), Wombat Berry (*Eustrephus latifolius*), Hairy Apple Berry (*Billardiera scandens*),

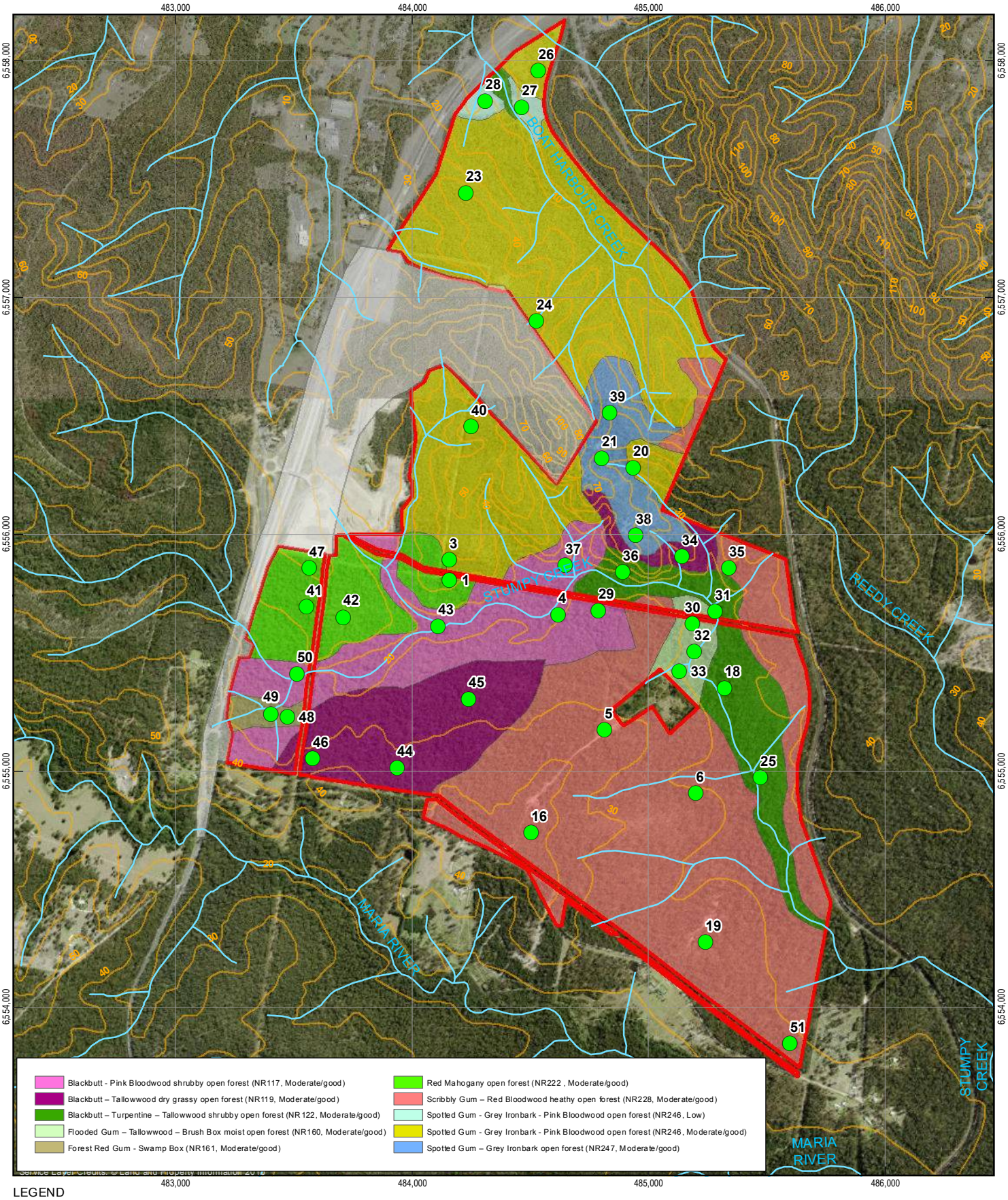
8 - Blackbutt - Pink Bloodwood shrubby open forest (NR117, Moderate/good)	
	White Sally (*Acacia floribunda*) and Green Wattle (*Acacia irrorata*).
Groundcover	Moderately dense, species rich and structurally variable. Grass, shrub and 'other' cover was all of similar, high values in the plot transects sampled. There are occasional patches of leaf litter and bare earth.
- grasses	A range of 14 – 60 per cent cover was estimated in the plot/transects sampled. Characteristic species include Wiry Panic (*Entolasia stricta*), Bordered Panic (*Entolasia marginata*), Blady Grass (I*mperata cylindrica*) and *Oplismenus imbecillis*.
- shrubs	A range of 10 – 42 per cent cover was estimated in the plot/transects sampled. Characteristic shrub species include Rough Guinea Flower (*Hibbertia aspera*) and Elderberry Panax (*Polyscias sambucifolia*).
- 'other' (herbs, ferns and sedges)	A range of 8 – 60 per cent cover was estimated in the plot/transects sampled. Characteristic 'other' species include Pastel Flower (*Pseuderanthemum variabile*), Spiny-headed Mat-rush (*Lomandra longifolia*), Rainbow Fern (*Calochlaena dubia*), Blueberry Lily (*Dianella revoluta*) and Slender Tick-trefoil (*Desmodium gunnii*).
Exotic species	Although there were no exotic species recorded in the groundcover or midstorey of the plot/transects sampled, a variety of exotic plants were present within this vegetation zone. These were mainly at very low frequency and cover, comprising ccasional Lantana (*Lantana camara*) and Camphor Laurel (*Cinnamomum camphora*) plants and mild infestations of Broadleaf Paspalum (*Paspalum mandiocanum*) and Pale Pigeon Grass (*Setaria pumila*).
Forest with a dense understorey at Plot/transect 29	

9 - Spotted Gum - Grey Ironbark - Pink Bloodwood open forest (NR246, Moderate/good)	
Plant community type (OEH, 2015c)	Spotted Gum - Grey Ironbark - Pink Bloodwood open forest of the Clarence Valley lowlands of the North Coast
NSW Vegetation Type ID	NR246
Survey effort	Plot/transects 20, 23, 26, 24, 40, 3
Condition (DECC, 2008)	Moderate/good. Remnant or regrowth native vegetation with near-intact over storey for which half the plot/transects sampled were at the benchmark value while half were slightly below. Native mid storey cover was at benchmark value in all plot/transects. Native grass cover and 'other' groundcover was at or above the benchmark value, while shrub cover was at or slightly lower for this plant community type. All but one of the plot/transects sampled were below benchmark value in species richness. The majority contained woody debris at benchmark value. The dominant canopy species were observed regenerating, in addition to a number of main associated over-storey species. There were few hollow-bearing trees recorded, including two in the six plots sampled. Exotic species were only recorded in the ground layer at one plot/transect. This vegetation zone has high intrinsic value and moderate potential for achieving gains in biodiversity values through management within a biobank site. Improvements in biodiversity values could be obtained through continuing development of vegetation structure and habitat resources, removal of exotic plants, cessation of timber collection and management of pest fauna.
Conservation significance	Native vegetation. Not listed as a TEC.
Landscape position	Mid and upper slopes on coastal hills.
Structure	Tall open forest with a dense mid storey and a dense understorey of herbs, ferns and grasses.
Over storey	Continuous, around 15 to 25 metres tall and around 11 – 43.5 per cent cover in the plot/transects sampled. Features a mixed canopy of Thick-leaved Mahogany *(Eucalyptus carnea*), Diehard Stringybark *(Eucalyptus cameronii*), Blackbutt *(Eucalyptus pilularis*), Small-fruited Grey Gum *(Eucalyptus propinqua*), Tallowwood (*Eucalyptus microcorys*), Narrow-leaved Red Gum *(Eucalyptus seeana*), Pink Bloodwood (*Corymbia intermedia*), Red Bloodwood (*Corymbia gummifera*) Spotted Gum (*Corymbia variegata*) and Grey Ironbark (*Eucalyptus siderophloia*) Regeneration was observed in all but two of the above species.
Mid storey	Mid-storey with a range of 10.5 – 51 per cent cover was estimated in the plot/transects sampled. Characteristic midstorey species include Black She-Oak (*Allocasuarina littoralis*), *Sannantha angusta*, Brush Box (*Lophostemon confertus*), Forest Oak (*Allocasuarina torulosa*), *Melaleuca sieberi*, and Curracabah (*Acacia concurrens*).

9 - Spotted Gum - Grey Ironbark - Pink Bloodwood open forest (NR246, Moderate/good)	
Groundcover	Moderately dense, species rich and structurally variable. Grass and 'other' cover was at benchmark value, with a slightly higher percentage of 'other' cover over grass. There was a lower cover of shrubs, and in two instances nil shrubs found in the six plot transects sampled. There are occasional patches of leaf litter and bare earth.
– grasses	A range of 42 – 82 per cent cover was estimated in the plot/transects sampled. Characteristic species include Wiry Panic (*Entolasia stricta*), Blady Grass (*Imperata cylindrica*), Bordered Panic (*Entolasia marginata*), Broadleaf Paspalum (*Paspalum mandiocanum*) and Open Summer-grass (*Digitaria diffusa*).
– shrubs	A range of 0 – 30 per cent cover was estimated in the plot/transects sampled. Characteristic shrub species include *Sannantha angusta*, Coffee Bush (*Breynia oblongifolia*), Elderberry Panax (*Polyscias sambucifolia*), Hop Goodenia (*Goodenia ovata*) and Rough Guinea Flower (*Hibbertia aspera*).
– 'other' (herbs, ferns and sedges)	A range of 24 – 44 per cent cover was estimated in the plot/transects sampled. Characteristic 'other' species include Spiny-headed Mat-rush (*Lomandra longifolia*) and Variable Sword-sedge (*Lepidosperma laterale*).
Exotic species	Lantana (*Lantana camara*), Camphor Laurel (*Cinnamomum camphora*) and Broadleaf Paspalum (*Paspalum mandiocanum*) were noted within the vegetation zone, including up to 38 per cent ground cover in plot/transects.
Forest with a dense understorey at Plot/transect 24	

10 - Scribbly Gum – Red Bloodwood heathy open forest (NR228, Moderate/good)	
Plant community type (OEH, 2015c)	Scribbly Gum - Red Bloodwood heathy open forest of the coastal lowlands of the North Coast
NSW Vegetation Type ID	NR228
Survey effort	Plot/transects 6, 35, 16, 5, 19, 51
Condition (DECC, 2008)	Moderate/good. Remnant or regrowth native vegetation with near-intact over storey that was at or slightly below benchmark values. Native mid storey cover was at the benchmark value in all but one of the plot/transects. Native grass and shrub cover was at or higher than the benchmark value. Other ground cover attributes and woody debris were at the benchmark values for this plant community type in all but one of plot/transects sampled. Species richness was below benchmark value in four of the six plot/transects. The dominant canopy species were observed regenerating, in addition to a number of main associated over-storey species. There were few hollow-bearing trees recorded, including only 6 in the six plots sampled. No exotic species were recorded in any of the plots ground layer or mid-storey but the occasional Camphor Laurel was noted in the vegetation zone. High leaf litter quantities were noted throughout the vegetation zone. This vegetation zone has high intrinsic value and moderate potential for achieving gains in biodiversity values through management within a biobank site. Improvements in biodiversity values could be obtained through continuing development of vegetation structure and habitat resources, removal of exotic plants, cessation of timber collection and management of pest fauna.
Conservation significance	Native vegetation. Not listed as a threatened ecological community (TEC).
Landscape position	Mid and lower slopes on rolling low hills.
Structure	Tall open forest with a moderate mid storey and a moderate understorey of herbs, ferns and grasses.
Over storey	Continuous, around 10 to 20 metres tall and around 7.8 – 22.2 per cent cover in the plot/transects sampled. Features a mixed canopy of Diehard Stringybark *(Eucalyptus cameronii*), Blackbutt *(Eucalyptus pilularis*), Scribbly Gum *(Eucalyptus signata*), Tallowwood (*Eucalyptus microcorys*), Red Bloodwood (*Corymbia gummifera*) and Grey Ironbark (*Eucalyptus siderophloia*) with regeneration evident in numerous plot/transects.
Mid storey	Mid-storey with a range of 0 – 44.5 per cent cover was estimated in the plot/transects sampled. Characteristic midstorey species include Sannantha angusta, Persoonia stradbrokensis, Black She-Oak (*Allocasuarina littoralis*), Turpentine (*Syncarpia glomulifera*), Forest Oak (*Allocasuarina torulosa*), Two-veined Hickory (*Acacia binervata*) and Tantoon (*Leptospermum polygalifolium*).

10 - Scribbly Gum – Red Bloodwood heathy open forest (NR228, Moderate/good)	
Groundcover	Moderately dense, species rich and structurally variable. Grass and 'other' cover was at benchmark value, with a higher percentage of grass cover over 'other'. There was a lower cover of shrubs in comparison found across the six plot transects sampled. There are occasional patches of leaf litter and bare earth.
– grasses	A range of 24 – 90 per cent cover was estimated in the plot/transects sampled. Characteristic species include Wiry Panic (*Entolasia stricta*) and Blady Grass (*Imperata cylindrica*).
– shrubs	A range of 6 – 16 per cent cover was estimated in the plot/transects sampled. Characteristic shrub species include Rough Guinea Flower (*Hibbertia aspera*), *Monotoca scoparia* and Coffee Bush (*Breynia oblongifolia*).
– 'other' (herbs, ferns and sedges)	A range of 2 – 40 per cent cover was estimated in the plot/transects sampled. Characteristic 'other' species include Bracken (*Pteridium esculentum*), Variable Sword-sedge (*Lepidosperma laterale*), *Ptilothrix deusta* and *Dampiera sylvestris*.
Exotic species	Occasional individual Camphor Laurel (*Cinnamomum camphora*) were observed within the vegetation zone. No exotic species were recorded in the groundcover or mid-storey of any of the six plot/transects sampled.
Forest with a dense understorey at Plot/transect 35	



LEGEND

Norton biobank site

Recent or proposed development

Contours

Plot/transect

Watercourses

0 200 400 800

Metres

Geographic Coordinate System
Horizontal Datum: Geocentric Datum of Australia 1994

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Roads and Maritime Services
Norton Biobank Site
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Vegetation zones

Figure 2

G:\21\24927\GIS\Maps\Deliverables\Norton Biobank\21_24927_Z002_NortonVegetationZones_2.mxd

Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data Source: NSW Department of Lands: Cadastre - Jan 2011; LPMA Data 2013; Lewis and James (2010) Kempsey to Eungai: Compensatory Habitat package' Created by:mking3

3.2.1 Habitat resources

The Norton biobank contains gently undulating near coastal hills and valley floors that are vegetated with wet sclerophyll forest and dry sclerophyll woodland. It features colluvial, depositional and alluvial landscapes on fine-grained sedimentary, metamorphic and medium-grained volcanic substrate. Forest and woodland at the site contains habitat resources for a diverse range of native fauna, including threatened species. Section 4.4.1 lists threatened species that have been recorded at the site and those that are predicted to be associated with the vegetation types and habitat resources by the credit calculator. The following section describes specific habitat resources that may indicate the presence of additional threatened species.

There are no substantial cliff lines or rock outcrops nor associated caves, overhangs or fissures at the biobank site. The biobank site would not support cave-roosting microbats or other threatened fauna of rocky country.

There are two named, third order drainage lines at the site and a number of small, intermittent first and second order tributaries (see Figure 2). Both of the larger drainage lines are near permanent, channel-confined streams. The reaches of these drainage lines through the biobank site are generally in very good condition and feature intact in-stream and riparian vegetation, intact banks and other geomorphic features and good quantities of woody debris. No evidence of unnatural erosion or contamination was observed. Boat Harbour Creek contained occasional deep pools in its lower reaches at the times of each of the GHD field surveys. Stumpy Creek contained many deep pools along its length through the site, including reaches with 50+ metre lengths of deep surface water.

The smaller tributaries contained only shallow, isolated pools and would only flow for brief periods after very heavy rainfall events. These streams would not support threatened species of permanent or rocky streams.

There are no upland swamps at the biobank site.

The BioBanking assessment of habitat resources at the biobank site was completed with reference to the above observations and data collected in vegetation zones and is presented in Appendix B.

3.2.2 Noxious and environmental weeds

The distribution of noxious and environmental weeds at the site is very closely tied to disturbance, with the concentration of weeds greatest on partially cleared and grazed lower slopes. Relatively undisturbed vegetation on mid and upper slopes contains only very occasional weeds.

The biobank features localised moderate infestations of noxious weeds such as Lantana (*Lantana camara*), Privet (*Ligustrum* species), Wild Tobacco (*Solanum mauritianum*) and Camphor Laurel (*Cinnamonum camphora*). These weeds are mainly restricted to previously cleared land in the northwest of the site and are closely associated with the extent of vegetation zone 5: Spotted Gum - Grey Ironbark - Pink Bloodwood open forest (NR246) in Low condition.

There are slight infestations of these noxious weeds and environmental weeds such as African Love Grass (*Eragrostis curvula*), Broad-leaved Paspalum (*Paspalum mandiocaunum*), Whiskey Grass (*Andropogon virginicus*) and Cobblers Pegs (*Bidens pilosa*) throughout the site generally comprising isolated individual plants at very low frequency and cover. There is often a thin band of these weeds and exotic pasture grasses such as Pigeon Grass (*Setaria sphacelata*) along disturbed edges adjoining trails, easements and fence lines.

Management actions for weed control are described in the MAP (GHD 2016).

3.3 Conservation significance

3.3.1 Threatened flora species

No threatened flora species were observed during the field survey of the biobank.

There is potential for a number of threatened flora species to occur within the biobank, given the presence of suitable habitat and previous records within the locality. The survey effort to date has not included targeted seasonal threatened flora surveys. The BBAM allows for modifications to BioBanking agreements to allow generation of species credits based on supplementary survey results and so targeted, seasonal surveys for threatened plants may be conducted as part of a future modification.

3.3.2 Threatened fauna species recorded

A total of 12 threatened fauna species have been recorded at the site as listed in Table 4. Four of these species are species credit-type species.

No species credits were calculated as part of the current assessment. The purpose of this BioBanking assessment is only to obtain a secure conservation covenant over the site. Roads and Maritime Services would purchase and retire all biodiversity credits generated for a price equivalent to the total fund deposit for the site. Only ecosystem credits directly contribute to the total fund deposit and so species credits have not been calculated.

Table 4 threatened species recorded at the Norton biobank site

Common Name	Scientific Name	TSC Act Status	EPBC Act Status	Observation type	Credit type
Giant Barred-frog	*Mixophyes iteratus*	E	E	Heard (GHD in prep.)	Species
Glossy Black-Cockatoo	*Calyptorhynchus lathami*	V	-	Seen (GHD in prep.); chewed cones.	Ecosystem
Green-thighed Frog	*Litoria brevipalmata*	V	-	Seen (Lewis and James 2010)	Species
Koala	*Phascolarctos cinereus*	V	V	Seen, scats (GHD in prep.)	Species
Little Lorikeet	*Glossopsitta pusilla*	V,	-	Seen (GHD in prep.)	Ecosystem
Varied Sittella	*Daphoenositta chrysoptera*	V	-	Seen	Ecosystem
Brush-tailed Phascogale	*Phascogale tapoatafa*	V	-	Seen (Lewis and James 2010)	Species
Yellow-bellied Glider	*Petaurus australis*	E	-	Feed scar (Lewis and James 2010)	Ecosystem
Grey-headed Flying-fox	*Pteropus poliocephalus*	V	V	Seen (Lewis and James 2010)	Ecosystem
Little Bentwing-bat	*Miniopterus australis*	V	-	Anabat recording (Lewis and James 2010)	Ecosystem
Eastern Bentwing-bat	*Miniopterus schreibersii oceanensis*	V	-	Anabat recording (Lewis and James 2010)	Ecosystem

Common Name	Scientific Name	TSC Act Status	EPBC Act Status	Observation type	Credit type
Powerful Owl	*Ninox strenua*	V	-	Heard (Lewis and James 2010)	Ecosystem

There is potential for a number of additional threatened fauna species to occur within the biobank, given the presence of suitable habitat and previous records within the locality.

3.3.3 Threatened ecological communities

Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the North Coast (NR161) at the site (see Figure 2) comprises a local occurrence of Subtropical Coastal Floodplain Forest, which is listed as an endangered ecological community under the TSC Act.

There are no other threatened ecological communities at the biobank site.

4. BioBanking credit calculations

4.1 Overview

The BioBanking credit calculations were completed by Ben Harrington (assessor accreditation number 0073) using the BBAM 2014 and credit calculator Version 4.0. The credit calculations have been submitted to OEH and the biodiversity credit report is included as Appendix A.

A summary of the site location data for credit calculations is provided in Table 5. The other data and assumptions used to perform the BioBanking credit calculations are summarised below.

Table 5 Site location summary

Attribute	Site value
CMA region	Northern Rivers
IBRA region	NSW North Coast
IBRA subregion	Macleay Hastings
Mitchell Landscape	Kempsey Coastal Ramp
LGA	Kempsey
Lot / DP(s)	Lot 501 DP 1200647 Lot 53 DP 1162355 Lot 301 DP 1161894 Lot 302 DP 1161894 Lot 56 DP 1165099 Lot 11 DP 1194544 Lot 21 DP 1199597

4.2 Biobank landscape value

The landscape assessment for the biobank is shown on Figure 3 and the details are summarised in Table 6. The approach to the landscape assessment is described below.

The BBAM uses assessment circles to estimate the extent and connectivity of native vegetation and habitat surrounding the site. Vegetation cover was estimated based on the current situation and after the management of the site using GIS measurement of foliage projective cover within the assessment circles. The outer assessment circle is 2000 hectares in area and the inner assessment circles is 200 hectares in area (see Figure 3). The inner assessment circle was placed so as to capture the greatest change in vegetation cover as a result of the management of the biobank. The percentage change in native vegetation cover was estimated by adding the area of cleared land and exotic vegetation within the biobank site (i.e. the area that would regenerate into native vegetation cover) to the current area of native vegetation within the assessment circles.

The BBAM requires an assessment of whether the biobank is within or partly with in a ‘strategic location’. The Norton biobank does not fall within a strategic location as defined by the BBAM as it is not located within:

- an area of land identified by the assessor as being part of a state significant biodiversity link and in a plan approved by the Chief Executive of OEH, or
- an area of land identified by the assessor as being part of a regionally significant biodiversity link and in a plan approved by the Chief Executive of OEH, or

- the riparian buffer area of a 4th order stream or higher, an important wetland or an estuarine area.

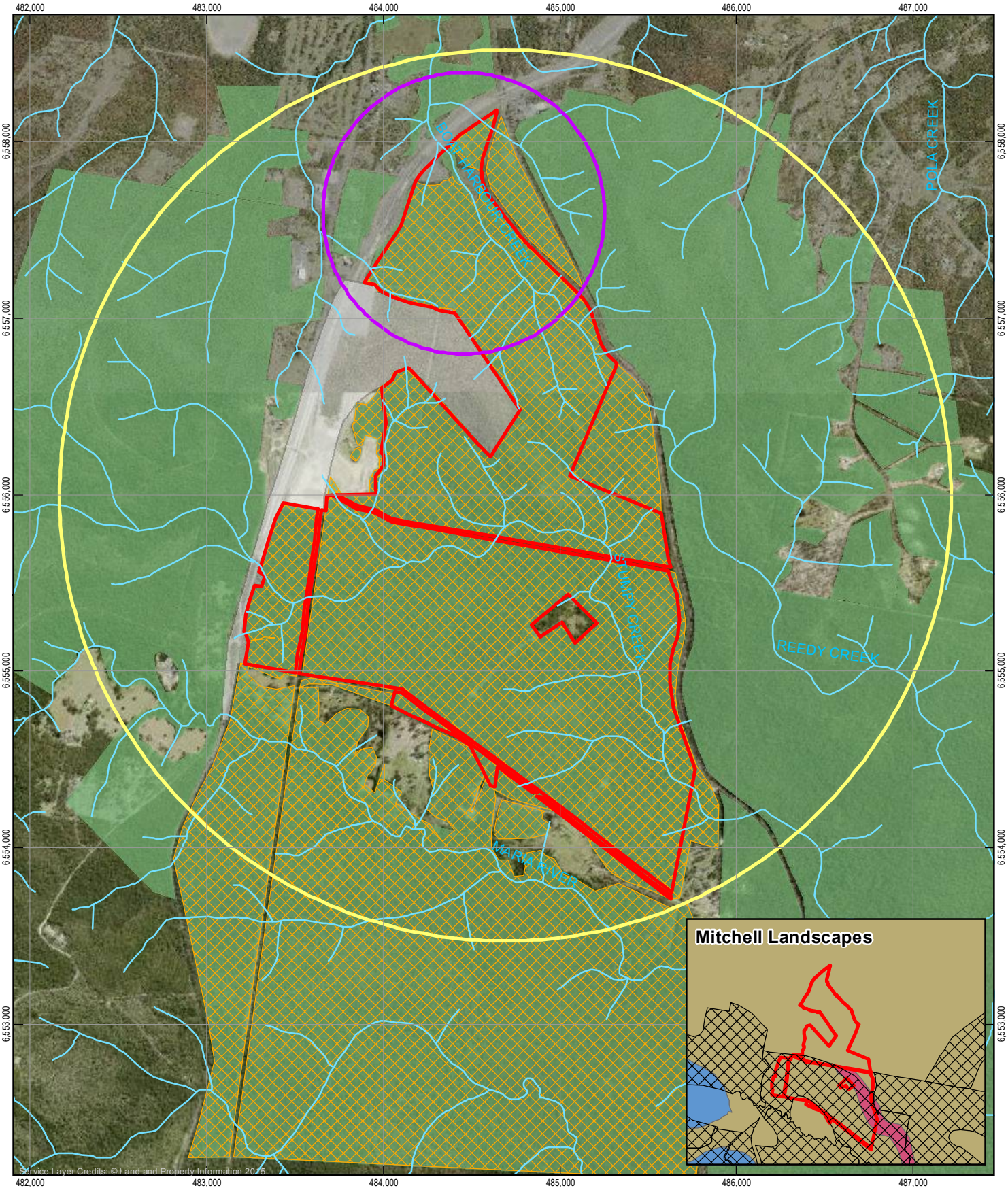
The biobank site is part of a regionally significant biodiversity link as shown on Figure 3 and will therefore affect a strategic location. The Norton biobank lies within a mapped regional fauna habitat corridor (Scotts et. al, 2003) that runs east-west connecting State forests to the west and south of the site with Maria National Park to the east.

Patch size was assessed using GIS and air photo interpretation of native vegetation cover within the assessment circles and adjoining areas of native vegetation. The percent native vegetation cleared in the Mitchell Landscape in which most of the biobank occurs (Brooms Head - Kempsey Coastal Ramp) is 26%. Native vegetation in the biobank site is continuous with a patch of native vegetation in the Maria River State Forest and other open space to the south (see Figure 3). This patch is greater than 1001 hectares in area. Therefore, according to the criteria for assessing patch size in Appendix 4 of the BBAM, the biobank falls within the 'extra large' patch size class (greater than 1000 hectares) (OEH 2014a).

Table 6 Landscape assessment values summary

Landscape Attribute	Before Biobank	After Biobank
% Native vegetation cover in outer (2000) ha assessment circle	81-85% (1652 ha)	81-85% (1656 ha)
% Native vegetation cover in inner (200 ha) assessment circle	66-70% (131 ha)	66-70% (135 ha)
Strategic location	Regional biodiversity corridor	
Patch size score	Extra large (>1000 ha)	Extra large (>1000 ha)

*PFC = percentage foliage cover; BM = benchmark values for the attribute (OEH 2016b).



LEGEND

- Norton biobank site
- Watercourses
- 200 ha assessment circle
- 2000 ha assessment circle
- Native vegetation
- Patch size >1001ha
- Recent or proposed development
- Regional biodiversity corridor

Mitchell Landscapes

- Brooms Head - Kempsey Coastal Ramp
- Manning - Macleay Coastal Alluvial Plain
- Wauchope Coastal Foothills

0 250 500 1,000
Metres

Geographic Coordinate System
Horizontal Datum: Geocentric Datum of Australia 1994

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Roads and Maritime Services
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Landscape assessment

Figure 3

G:\21\24927\GIS\Maps\Deliverables\Norton Biobank\21_24927_Z003_Landscape_Assessment.mxd Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data Source: NSW Department of Lands: Cadastre - Jan 2011; LPMA Data 2013; Lewis and James (2010) Kempsey to Eungai: Compensatory Habitat package' Created by:mking3

4.3 Biobank site value

One vegetation zone was created for each native vegetation type and broad condition state at the site. The area of each zone was calculated using GIS. Vegetation zones within the Norton biobank are mapped on Figure 2 and summarised in Table 7.

All of the Moderate/good condition vegetation zones within the Norton biobank are connected. These vegetated areas are connected to an extensive area of native vegetation associated with the Maria River State Forest and other vegetated land to the south of the site (see Figure 3). As described above this patch of vegetation is many thousands of hectares in area and so the patch size for each vegetation zone at the biobank is 1001 hectares, which is the maximum in the BBAM and falls within the 'very large' patch size score for the Mitchell Landscape.

Table 7 Vegetation zones

Veg Zone ID	Vegetation Zone	PCT. ID	Condition	Area in Norton offset site (ha)	Patch size (ha)	Plot/transects required	Plot/transects sampled
1	Blackbutt – Turpentine – Tallowwood shrubby open forest (NR122, Moderate/good)	NR122	Moderate/good	33.4	1001	4	18, 25, 31, 36
2	Red Mahogany open forest (NR222, Moderate/good)	NR222	Moderate/good	30.2	1001	4	41, 42, 1, 47
3	Forest Red Gum - Swamp Box (NR161, Moderate/good)	NR161	Moderate/good	3.8	1001	2	48, 49
4	Spotted Gum – Grey Ironbark open forest (NR247, Moderate/good)	NR247	Moderate/good	19.5	1001	3	21, 38, 39
5	Spotted Gum - Grey Ironbark - Pink Bloodwood open forest (NR246, Low)	NR246	Low	4.0	0	2	27, 28
6	Blackbutt - Turpentine - Tallowwood shrubby open forest (NR122 moderate/good – other) (calculated for Flooded Gum – Tallowwood – Brush Box moist open forest)	NR122 (calculated for NR160)	Moderate/good	7.4	1001	3	30, 32, 33
7	Blackbutt – Tallowwood dry grassy open forest (NR119, Moderate/good)	NR119	Moderate/good	44.5	1001	4	34, 44, 45, 47
8	Blackbutt - Pink Bloodwood shrubby open forest (NR117, Moderate/good)	NR117	Moderate/good	53.4	1001	5	29, 4, 37, 43, 50
9	Spotted Gum - Grey Ironbark - Pink Bloodwood open forest (NR246, Moderate/good)	NR246	Moderate/good	135.4	1001	6	20, 23, 26, 24, 40, 3
10	Scribbly Gum – Red Bloodwood heathy open forest (NR228, Moderate/good)	NR228	Moderate/good	164.3	1001	6	6, 35, 16, 5, 19, 51

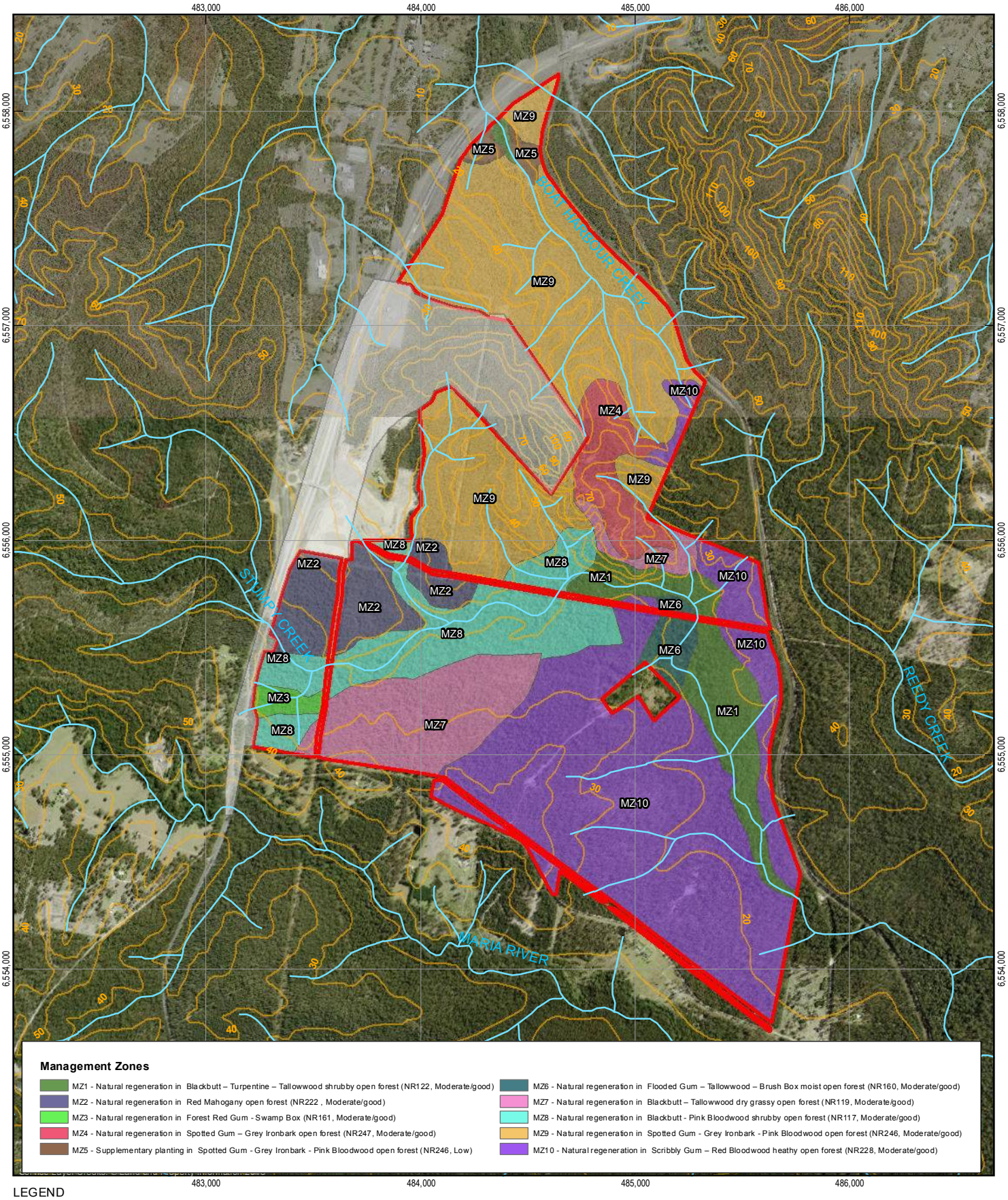
Site value data were collected using the BioBanking plot/transect methodology and entered for each plot/transect field in each vegetation zone. One management zone was created for each vegetation zone across the site (Table 8).

Change in site biodiversity values through the conservation and management of a biobank site is the basis for calculation of biodiversity credits that would be generated. Conservation of vegetation within a biobank increases the site value by a default amount based on expected improvements in the condition of vegetation and habitat resources. There are certain circumstances where portions of a biobank are managed such that a different increase in site value is obtained. This may include intense, targeted management activities such as tree planting. Management zone MZ5 ‘supplementary planting in Spotted Gum - Grey Ironbark - Pink Bloodwood open forest (NR246, Low)’ is dominated by exotic plant species and featured very little natural regeneration. Supplementary planting of canopy and mid storey species is proposed in this zone. An additional half point increase in over storey cover was entered in the credit calculations. The default increase in mid storey cover was equivalent to the maximum possible. The default increase in site value was entered for all other attributes.

No specific, targeted management actions would be performed in any other zones and the default increase in site value was entered. Figure 4 shows the location of management zones.

Table 8 Management zones

Zone ID	Veg Zone ID	Management Zone	Area in Norton offset site (ha)	Management / Attribute Scores	Photo point
MZ1	1	Natural regeneration in Blackbutt – Turpentine – Tallowwood shrubby open forest (NR122, Moderate/good)	33.4	Natural regeneration / default increase in all site value scores.	A
MZ2	2	Natural regeneration in Red Mahogany open forest (NR222, Moderate/good)	30.2	Natural regeneration / default increase in all site value scores.	H
MZ3	3	Natural regeneration in Forest Red Gum - Swamp Box (NR161, Moderate/good)	3.8	Natural regeneration / default increase in all site value scores.	I
MZ4	4	Natural regeneration in Spotted Gum – Grey Ironbark open forest (NR247, Moderate/good)	19.5	Natural regeneration / default increase in all site value scores.	G
MZ5	5	Supplementary planting in Spotted Gum - Grey Ironbark - Pink Bloodwood open forest (NR246, Low)	4.0	Supplementary planting. Additional half point increase in over storey cover / Default increase in all other site value scores.	C
MZ6	6	Natural regeneration in Blackbutt - Turpentine - Tallowwood shrubby open forest (NR122, Moderate/good – other) (calculated for Flooded Gum – Tallowwood – Brush Box moist open forest)	7.4	Natural regeneration / default increase in all site value scores.	E
MZ7	7	Natural regeneration in Blackbutt – Tallowwood dry grassy open forest (NR119, Moderate/good)	44.5	Natural regeneration / default increase in all site value scores.	F
MZ8	8	Natural regeneration in Blackbutt - Pink Bloodwood shrubby open forest (NR117, Moderate/good)	53.4	Natural regeneration / default increase in all site value scores.	D
MZ9	9	Natural regeneration in Spotted Gum - Grey Ironbark - Pink Bloodwood open forest (NR246, Moderate/good)	135.4	Natural regeneration / default increase in all site value scores.	B
MZ10	10	Natural regeneration in Scribbly Gum – Red Bloodwood heathy open forest (NR228, Moderate/good)	164.3	Natural regeneration / default increase in all site value scores.	J



LEGEND

- Norton biobank boundary
- Recent or proposed development
- Contours
- Watercourses

0 200 400 800
Metres

Geographic Coordinate System
Horizontal Datum: Geocentric Datum of Australia 1994

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Roads and Maritime Services
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Management zones

Figure 4

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Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data Source: NSW Department of Lands: Cadastre - Jan 2011; LPMA Data 2013; Lewis and James (2010) Kempsey to Eungai: Compensatory Habitat package' Created by:mking3

4.4 Threatened species assessment

4.4.1 Predicted threatened species

The BioBanking credit calculator reports the suite of threatened fauna species that are predicted to be associated with ecosystem credits generated for the biobank. The suite of predicted threatened species for the Norton biobank is listed in Table 9. There is suitable habitat for each of these threatened species at the biobank site and they may occur at the site from time to time or in the future.

Table 9 Predicted threatened species

Common name	Scientific name	TS offset multiplier[1]	On site[2]
Barking Owl	*Ninox connivens*	3.0	Yes
Barred Cuckoo-shrike	*Coracina lineata*	1.5	Yes
Brown Treecreeper (eastern subspecies)	*Climacteris picumnus* subsp. *victoriae*	2.0	Yes
Bush Stone-curlew	*Burhinus grallarius*	2.6	Yes
Diamond Firetail	*Stagonopleura guttata*	1.3	Yes
Eastern False Pipistrelle	*Falsistrellus tasmaniensis*	2.2	Yes
Eastern Freetail-bat	*Mormopterus norfolkensis*	2.2	Yes
Flame Robin	*Petroica phoenicea*	1.3	Yes
Glossy Black-Cockatoo[3]	*Calyptorhynchus lathami*	1.8	Yes
Golden-tipped Bat	*Kerivoula papuensis*	1.3	Yes
Greater Broad-nosed Bat	*Scoteanax rueppellii*	2.2	Yes
Hoary Wattled Bat	*Chalinolobus nigrogriseus*	2.1	Yes
Hooded Robin (south-eastern form)	*Melanodryas cucullata* subsp. *cucullata*	1.7	Yes
Little Eagle	*Hieraaetus morphnoides*	1.4	Yes
Little Lorikeet[3]	*Glossopsitta pusilla*	1.8	Yes
Long-nosed Potoroo	*Potorous tridactylus*	1.3	Yes
Masked Owl	*Tyto novaehollandiae*	3.0	Yes
Powerful Owl[3]	*Ninox strenua*	3.0	Yes
Red-legged Pademelon	*Thylogale stigmatica*	2.6	Yes
Scarlet Robin	*Petroica boodang*	1.3	Yes
Sooty Owl	*Tyto tenebricosa*	3.0	Yes
Spotted-tailed Quoll	*Dasyurus maculatus*	2.6	Yes
Square-tailed Kite	*Lophoictinia isura*	1.4	Yes
Swift Parrot	*Lathamus discolor*	1.3	Yes
Varied Sittella[3]	*Daphoenositta chrysoptera*	1.3	Yes
Wompoo Fruit-dove	*Ptilinopus magnificus*	1.3	Yes
Yellow-bellied Glider[3]	*Petaurus australis*	2.3	Yes
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*	2.2	Yes

Notes: 1. The TS offset multiplier is an index of the likely response of a threatened species to improvement in habitat condition at a biobank site.

2. The site contains habitat resources for the threatened species and the species may occur at the site from time to time or in the future.

3. The species was directly observed on site.

4.4.2 Species credits

The BBAM references geographic, vegetation and habitat data for the biobank site to generate a list of the species credit-type threatened species predicted to occur at the site and requiring targeted survey.

No species credits were calculated as part of the current assessment. The purpose of this BioBanking assessment is only to obtain a secure conservation covenant over the site to satisfy the biodiversity offsetting requirements for various stages of the Pacific Highway. Roads and Maritime would purchase and retire all biodiversity credits generated for a price equivalent to the total fund deposit for the site. Only ecosystem credits directly contribute to the total fund deposit and so species credits have not been calculated.

In order to complete the credit calculations, default data for each threatened species was entered at the 'Threatened species survey results' stage, comprising: 'Managed at site?' = 'No'; 'ID Method' = 'Survey'; and 'Survey data' = '14/4/16'.

Roads and Maritime, or a future owner of the biobank site, may choose to complete additional targeted surveys and to calculate species credits in the future. Future species credit calculations would require an addendum to this BioBanking assessment report and a modification to the BioBanking agreement. Any future species credit calculations must not include species that are already linked to biodiversity offset packages for the Pacific Highway upgrade project. Biodiversity offsets have already been secured for these species via the purchase and retirement of ecosystem credits that will secure a conservation covenant over an identified area of habitat. Specifically, species credits should not be generated for the Koala or the Giant Barred-frog.

5. Biodiversity credits

This Section of the report summarises the results of credit calculations completed for the biobank.

The data from the fieldwork and mapping were entered in the BioBanking credit calculator version 4.0 to determine the number of biodiversity credits that would be generated when the site is established as a biobank. The BioBanking Credit Report is included in Appendix A and summarised below.

5.1 Ecosystem credits

A total of 6,064 ecosystem credits would be generated at the Norton biobank site. A breakdown of the credits generated for each ecosystem credit (i.e. plant community type) is provided in Table 10. All of these credits are associated with the Macleay Hastings IBRA sub-region.

Table 10 Ecosystem credits generated at Norton biobank

PCT	NSW Veg.type ID	Ecosystem credits generated
Blackbutt – Turpentine – Tallowwood shrubby open forest	NR122	431
Red Mahogany open forest	NR222	454
Forest Red Gum - Swamp Box	NR161	37
Spotted Gum – Grey Ironbark open forest	NR247	224
Blackbutt - Turpentine - Tallowwood shrubby open forest (calculated for Flooded Gum – Tallowwood – Brush Box moist open forest)	NR122 (calculated for NR160[1])	85
Blackbutt – Tallowwood dry grassy open forest	NR119	575
Blackbutt - Pink Bloodwood shrubby open forest	NR117	737
Spotted Gum - Grey Ironbark - Pink Bloodwood open forest	NR246	1808
Scribbly Gum – Red Bloodwood heathy open forest	NR228	1713
	Total	**6,064**

Notes: 1 - The PCT 'Flooded Gum – Tallowwood – Brush Box moist open forest (NR160)' could not be entered in the credit calculator despite being a valid PCT in the VIS PCT database, presumably because of a programming error. The relevant vegetation zone was entered in the credit calculator as the closest matching PCT at the site: 'Vegetation zone 6: NR122 Blackbutt - Turpentine - Tallowwood shrubby open forest of the coastal foothills of the central NSW North Coast Bioregion Moderate/Good_Other' for the purposes of credit calculations.

5.2 Species credits

No species credits were calculated.

5.3 Assumptions and limitations

The assumptions and 'assessor's use of judgement' made for the purposes of this BioBanking assessment and credit calculations are as follows:

- The regional fauna habitat corridor that is mapped through the site (Scotts et. al, 2003) is assumed to comprise a 'regionally significant biodiversity link' for the purpose of assessing landscape value.
- The PCT 'Flooded Gum – Tallowwood – Brush Box moist open forest (NR160)' could not be entered in the credit calculator despite being a valid PCT in the VIS PCT database, presumably because of a programming error. The relevant vegetation zone was entered in the credit calculator as the closest matching PCT at the site: 'Vegetation zone 6 NR122 Blackbutt - Turpentine - Tallowwood shrubby open forest of the coastal foothills of the central NSW North Coast Bioregion Moderate/Good_Other' for the purposes of credit calculations.
- Systematic, targeted surveys for threatened flora and species credit-type fauna species were not conducted. The purpose of this BioBanking assessment is only to obtain a secure conservation covenant over the site. It is assumed that Roads and Maritime Services would purchase and retire all biodiversity credits generated for a price equivalent to the total fund deposit for the site. Only ecosystem credits directly contribute to the total fund deposit and so species credits have not been calculated.
- Default data for each threatened species was entered at the 'Threatened species survey results' stage, comprising: 'Managed at site?' = 'No'; 'ID Method' = 'Survey'; and 'Survey data' = '14/4/2016'.
- Any future amendment to the BioBanking agreement to generate species credits must not calculate any Koala or Giant Barred-frog species credits, because all of the occupied habitat for these species at the site has already been set aside as a biodiversity offset for the Pacific Highway upgrade.
- Supplementary planting is proposed in management zone MZ5 and so an additional half point increase in the site value score for overstorey cover was entered. The default increase was entered for all other site value scores.
- The default increase in site value scores was entered in all other management zones.

6. Management actions

6.1 Management actions

Improvement in biodiversity values through management actions at a biobank site is the basis for creation of species and ecosystem credits. The following sections provide an outline of the actions that would be required for ongoing management of the biobank and to achieve the proposed improvements in biodiversity values within each management zone (as per the scores entered in the credit calculator). A Management Action Plan (MAP) detailing rehabilitation activities for each management zone, cost estimates for proposed rehabilitation works over the life of the biobank and a management program has been prepared (GHD 2016) and is included in the BioBanking agreement application.

6.1.1 Standard management actions

Standard management actions are those actions required on biobank sites to improve vegetation condition when entering into a BioBanking agreement. A detailed description of these actions and their relevance to the biobank site are described in the MAP (GHD 2016). The standard management actions that apply to the Norton biobank site are:

- Weed control.
- Management of fire for conservation (subject to consultation with Roads and Maritime and the Rural Fire Service and confirmation of an appropriate approach).
- Management of human disturbance.
- Retention of regrowth and remnant native vegetation.
- Supplementary planting where natural regeneration will not be sufficient.

BioBanking agreements require all of the above management actions to be carried out. Completing these actions would increase the site value score and biodiversity value of the biobank site.

6.1.2 Site specific management actions

Based on field observations and the BioBanking Credit Report, the following management actions would be required to alleviate site-specific threats:

- Maintain fences and gates.
- Implement feral cat, wild dog and/or fox control, in line with existing control programs in the locality.
- Exclude and/or control feral herbivores (rabbits, goats, pigs, deer etc.) and over-abundant native herbivores.
- Exclude commercial apiaries.

The BioBanking Credit Report nominates ‘slashing’ as an additional management action that is required for all vegetation zones at the biobank site. Slashing of native vegetation would not be an appropriate management action at the biobank site because of the associated loss of fauna habitat resources and risk of injury or mortality of native fauna, harm to threatened plants, increased weed infestation etc. Slashing has not therefore been included in the MAP.

7. BioBanking agreement summary

The proposed BioBanking agreement for the Norton biobank site would ensure that around 495.9 hectares of native vegetation and habitat will be conserved as a biobank site and would generate 6,064 ecosystem credits. The number and type of ecosystem credits that will be generated is summarised in Table 10 and the credit report is provided in Appendix A.

This report makes no comment on:

- The regulations and requirements for trading of credits within the NSW BioBanking and Offsets Scheme or as biodiversity offsets for projects assessed outside of the scheme.
- The financial factors associated with trading (sale or purchase) of credits.

8. Disclaimer

This report: has been prepared by GHD for Roads and Maritime Services and *may only be used and relied on by Roads and Maritime Services for the purpose agreed between GHD and the Roads and Maritime Services as set out in Section 1.3 of this report.*

GHD otherwise disclaims responsibility to any person other than Roads and Maritime Services arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Roads and Maritime Services, *Idyll Spaces Environmental Consultants and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.*

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions (including the presence of hazardous substances and/or site contamination) may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

9. References

Department of Environment and Climate Change (DECC) (2008a) NSW (Mitchell) Landscapes Version 3 (2008).

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OEH (2016c). *List of Accredited Assessors.* http://www.environment.nsw.gov.au/BioBanking/Assessorlist.htm

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Scotts, D., Drielsma, M. and Kingma, L. (2003). *Key habitats and corridors for fauna: A landscape framework for bioregional conservation planning in North-east New South Wales. II. Methods, decision rules, assumptions and mapped outputs*, NPWS, Coffs Harbour

Department of Sustainability, Environment, Water, Populations and Communtieies (DSEWPaC)(2011). *Interim Biogeographic Regionalisation for Australia (IBRA), Version 6.1* DSEWPaC, Canberra, ACT.

Appendices

Appendix A – BioBanking credit report

BioBanking credit report

This report identifies the number and type of credits required at a BIOBANK SITE

Date of report: 21/07/2016 Time: 3:47:59PM Calculator version: v4.0

Biobank details

Proposal ID: 073/2016/3598B

Proposal name: Norton biobank

Proposal address: Kemps Road South Kempsey NSW 2440

Proponent name: Roads and Maritime Services

Proponent address: Level 2 76 Victoria Street Grafton NSW 2460

Proponent phone: 02 6640 1055

Assessor name: Ben Harrington

Assessor address: Level 15 133 Castlereagh Street Sydney NSW 2000

Assessor phone: 02 9239 7189

Assessor accreditation: 073

Additional information required for approval:

- ☐ Use of local benchmark
- ☐ Expert report...
- ☐ Request for additional gain in site value

Ecosystem credits summary

Plant Community type	Area (ha)	Credits created
Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the NSW North Coast Bioregion	53.40	737.00
Blackbutt - Tallowwood dry grassy open forest of the central parts NSW North Coast Bioregion	44.50	575.00
Blackbutt - Turpentine - Tallowwood shrubby open forest of the coastal foothills of the central NSW North Coast Bioregion	40.80	516.00
Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion	3.80	37.00
Red Mahogany open forest of the coastal lowlands of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	30.20	454.00
Scribbly Gum - Red Bloodwood heathy open forest of the coastal lowlands of the NSW North Coast Bioregion	164.30	1,713.00
Spotted Gum - Grey Ironbark - Pink Bloodwood open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion	139.40	1,808.00
Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion	19.50	224.00
Total	495.90	6,064

Credit profiles

1. Blackbutt - Tallowwood dry grassy open forest of the central parts NSW North Coast Bioregion, (NR119)

Number of ecosystem credits created	575
IBRA sub-region	Macleay Hastings - Northern Rivers

2. Red Mahogany open forest of the coastal lowlands of the NSW North Coast Bioregion and northern Sydney Basin Bioregion, (NR222)

Number of ecosystem credits created	454
IBRA sub-region	Macleay Hastings - Northern Rivers

3. Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the NSW North Coast Bioregion, (NR117)

Number of ecosystem credits created	737
IBRA sub-region	Macleay Hastings - Northern Rivers

4. Blackbutt - Turpentine - Tallowwood shrubby open forest of the coastal foothills of the central NSW North Coast Bioregion, (NR122)

Number of ecosystem credits created	516
IBRA sub-region	Macleay Hastings - Northern Rivers

5. Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion, (NR161)

Number of ecosystem credits created	37
IBRA sub-region	Macleay Hastings - Northern Rivers

6. Spotted Gum - Grey Ironbark - Pink Bloodwood open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion, (NR246)

Number of ecosystem credits created	1,764
IBRA sub-region	Macleay Hastings - Northern Rivers

7. Spotted Gum - Grey Ironbark - Pink Bloodwood open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion, (NR246)

Number of ecosystem credits created	44
IBRA sub-region	Macleay Hastings - Northern Rivers

8. Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion, (NR247)

Number of ecosystem credits created	224
IBRA sub-region	Macleay Hastings - Northern Rivers

9. Scribbly Gum - Red Bloodwood heathy open forest of the coastal lowlands of the NSW North Coast Bioregion, (NR228)

Number of ecosystem credits created	1,713
IBRA sub-region	Macleay Hastings - Northern Rivers

Species credits summary

Additional management actions

Additional management actions are required for:

Vegetation type or threatened species	Management action details
Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the NSW North Coast Bioregion	Exclude commercial apiaries
Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the NSW North Coast Bioregion	Exclude miscellaneous feral species
Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the NSW North Coast Bioregion	Feral and/or over-abundant native herbivore control
Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the NSW North Coast Bioregion	Fox control
Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the NSW North Coast Bioregion	Slashing
Blackbutt - Tallowwood dry grassy open forest of the central parts NSW North Coast Bioregion	Exclude commercial apiaries
Blackbutt - Tallowwood dry grassy open forest of the central parts NSW North Coast Bioregion	Exclude miscellaneous feral species
Blackbutt - Tallowwood dry grassy open forest of the central parts NSW North Coast Bioregion	Feral and/or over-abundant native herbivore control
Blackbutt - Tallowwood dry grassy open forest of the central parts NSW North Coast Bioregion	Fox control
Blackbutt - Tallowwood dry grassy open forest of the central parts NSW North Coast Bioregion	Slashing
Blackbutt - Turpentine - Tallowwood shrubby open forest of the coastal foothills of the central NSW North Coast Bioregion	Exclude miscellaneous feral species
Blackbutt - Turpentine - Tallowwood shrubby open forest of the coastal foothills of the central NSW North Coast Bioregion	Feral and/or over-abundant native herbivore control
Blackbutt - Turpentine - Tallowwood shrubby open forest of the coastal foothills of the central NSW North Coast Bioregion	Fox control
Blackbutt - Turpentine - Tallowwood shrubby open forest of the coastal foothills of the central NSW North Coast Bioregion	Slashing
Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion	Exclude commercial apiaries
Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion	Exclude miscellaneous feral species
Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion	Feral and/or over-abundant native herbivore control
Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion	Fox control
Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the NSW North Coast Bioregion	Slashing

Red Mahogany open forest of the coastal lowlands of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	Exclude commercial apiaries
Red Mahogany open forest of the coastal lowlands of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	Exclude miscellaneous feral species
Red Mahogany open forest of the coastal lowlands of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	Feral and/or over-abundant native herbivore control
Red Mahogany open forest of the coastal lowlands of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	Fox control
Red Mahogany open forest of the coastal lowlands of the NSW North Coast Bioregion and northern Sydney Basin Bioregion	Slashing
Scribbly Gum - Red Bloodwood heathy open forest of the coastal lowlands of the NSW North Coast Bioregion	Exclude commercial apiaries
Scribbly Gum - Red Bloodwood heathy open forest of the coastal lowlands of the NSW North Coast Bioregion	Exclude miscellaneous feral species
Scribbly Gum - Red Bloodwood heathy open forest of the coastal lowlands of the NSW North Coast Bioregion	Feral and/or over-abundant native herbivore control
Scribbly Gum - Red Bloodwood heathy open forest of the coastal lowlands of the NSW North Coast Bioregion	Fox control
Scribbly Gum - Red Bloodwood heathy open forest of the coastal lowlands of the NSW North Coast Bioregion	Slashing
Spotted Gum - Grey Ironbark - Pink Bloodwood open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion	Exclude commercial apiaries
Spotted Gum - Grey Ironbark - Pink Bloodwood open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion	Exclude miscellaneous feral species
Spotted Gum - Grey Ironbark - Pink Bloodwood open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion	Feral and/or over-abundant native herbivore control
Spotted Gum - Grey Ironbark - Pink Bloodwood open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion	Fox control
Spotted Gum - Grey Ironbark - Pink Bloodwood open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion	Slashing
Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion	Exclude commercial apiaries
Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion	Exclude miscellaneous feral species
Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion	Feral and/or over-abundant native herbivore control
Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion	Fox control
Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the NSW North Coast Bioregion	Slashing

Appendix B – BioBanking data summary

Appendix Table 1 Norton biobank geographic / habitat assessment results

Impact?[1]	Common name	Scientific name	Feature
☐	Big Nellie Hakea	*Hakea archaeoides*	land east of Mount Banda Banda in Upper Manning CMA subregion
☑	*Dracophyllum macranthum*	*Dracophyllum macranthum*	Occurs on moderate to steep slopes mostly with a southerly aspect often associated with gaps in the forest canopy. It often occurs with dense patches of Coral Fern or on roadside bluffs or on conglomerate outcrops.
☑	Biconvex Paperbark	*Melaleuca biconvexa*	land south of Kempsey in Macleay Hastings CMA subregion
☐	Stuttering Frog	*Mixophyes balbus*	land east of Yarrowitch River in Walcha Plateau CMA subregion
☑	Giant Barred Frog	*Mixophyes iteratus*	land below 1000 m in altitude and within 40 m of rainforest or eucalypt forest with deep leaf litter
☐	Tree Guinea Flower	*Hibbertia hexandra*	land within Landsdowne State Forest or within a 5 km buffer of the SF in Comboyne Plateau CMA subregion
☑	Pale-headed Snake	*Hoplocephalus bitorquatus*	land within 40 m of watercourses, containing hollow-bearing trees, loose bark and/or fallen timber
☑	Milky Silkpod	*Parsonsia dorrigoensis*	subtropical or warm temperate rainforest or open eucalypt forest or ecotones between rainforest and eucalypt forest
☑	North Brother Wattle	*Acacia courtii*	shallow soils in dry open forest or rocky slopes
☐	Pale-vented Bush-hen	*Amaurornis moluccana*	land north of south west Rocks in Macleay Hastings CMA subregion
☐	Brush-tailed Phascogale	*Phascogale tapoatafa*	land east of Guy Fawkes River in Wongwibinda Plateau CMA subregion
☑	Common Planigale	*Planigale maculata*	rainforest, eucalypt forest, heathland, marshland, grassland or rocky areas
☑	Green-thighed Frog	*Litoria brevipalmata*	land within 100 m of semi-permanent or ephemeral ponds or depressions containing leaf litter
☐	Parma Wallaby	*Macropus parma*	land east of Oaky River in Armidale Plateau CMA subregion
☐	Eastern Osprey	*Pandion cristatus*	land within 40 m of fresh/brackish/saline waters of larger rivers or creeks; estuaries, coastal lagoons, lakes and/or inshore marine waters

Impact?[1]	Common name	Scientific name	Feature
☑	Spider orchid	*Dendrobium melaleucaphilum*	land containing Melaleuca styphelioides or rainforest trees/rocks
☑	Willawarrin Doubletail	*Diuris disposita*	grassy open forest
☑	Maundia triglochinoides	*Maundia triglochinoides*	swamps or shallow fresh water on clay
☐	Brush-tailed Rock-wallaby	*Petrogale penicillata*	land east of Avondale State Conservation Area in Wongwibinda Plateau CMA subregion
☐	Scented Acronychia	*Acronychia littoralis*	land within 5 km of coast in Richmond - Tweed (Qld - Scenic Rim) (Part A) CMA subregion
☐	Dwarf Heath Casuarina	*Allocasuarina defungens*	land within 15 km of coast in Yuraygir CMA subregion
☐	Nabiac Casuarina	*Allocasuarina simulans*	land south of Port Macquarie in Macleay Hastings CMA subregion

Notes: 1) the relevant habitat feature for the species is present at the site.

Appendix Table 2 Norton biobank plot/transect data

Vegetation Zone	Veg Type ID	Plot ID	Native plant species richness	Native over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Over storey regeneration	Total length of fallen logs	Easting	Northing	Zone
1	NR122	Benchmark	49	20-90	15-90	0-50	10-70	5-90	0	0.1	1	10			
	M-G	18	44	30.5	55.5	64	28	40	0	1	0.5	76	485324	62555351	56
		25	42	38.5	30.5	24	22	20	0	0	0.5	82	485475	6554973	56
		31	45	23	35	68	10	70	0	0	0.5	25	485281	6555675	56
		36	41	11	14.5	56	20	42	0	0	0.5	21	484893	6555840	56
2	NR222	Benchmark	44	15-50	10-40	5-50	5-40	5-70	0	0.1	1.0	20			
	M-G	41	29	11	20	72	6	4	0	0	0.6	16	483557	6555694	56
		42	27	12	9	24	4	64	0	0	0.6	5	483712	6555651	56
		1	34	19.5	17.5	84	4	56	0	0	0.6	32	484146	6555808	56
		47	22	13.5	12.5	54	0	48	0	1	0.6	5	483570	6555859	56
3	NR161	Benchmark	27	10-35	5-30	10-60	0-10	5-25	0	1	1.0	5			
	M-G	48	36	9	18.5	54	6	28	2	0	1.0	0	483476	6555230	56
		49	28	6	20.5	50	16	54	0	0	1.0	18	483407	6555243	56
4	NR247	Benchmark	37	15-40	10-50	5-60	5-60	5-40	0	1	1.0	10			
	M-G	21	40	27.2	29	88	8	22	0	2	1	65	484803	6556324	56
		38	30	15	4.5	24	0	70	0	0	1.0	20	484949	6555995	56
		39	30	18.5	13.5	48	4	18	0	0	1.0	5	484838	6556515	56
5	NR246	Benchmark	37	20-50	10-60	10-60	5-60	10-50	0	1	1.0	10			
	Low	27	18	0	11	8	2	20	86	0	0.1	0	484466	6557804	56
		28	9	0	3	30	2	4	68	0	0.1	0	484310	6557831	56
6	NR160	Benchmark	49	20-50	15-90	0-50	10-70	5-90	0	0.1	1.0	10			
	M-G	30	36	34	32	74	38	78	0	0	0.0	12	485187	6555625	56
		32	22	24.5	20	36	36	52	0	0	0.0	18	485193	6555505	56

Vegetation Zone	Veg Type ID	Plot ID	Native plant species richness	Native over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Over storey regeneration	Total length of fallen logs	Easting	Northing	Zone
		33	24	18.5	22.5	70	16	36	6	0	0.0	15	485132	6555423	56
7	NR119	Benchmark	44	15-50	10-40	5-50	5-40	5-70	0	0.1	1	20			
	M-G	34	39	15	14.5	58	14	38	0	0	0.83	54	485144	6555906	56
		44	35	12.5	10.5	68	0	18	0	0	0.83	34	483940	6555015	56
		45	29	13	14.5	86	6	32	0	0	0.83	13	483134	6555782	56
		47	22	20.5	8.5	52	6	30	0	0	0.83	0	483570	6555859	56
8	NR117	Benchmark	49	20-90	15-90	0-50	10-70	5-90	0	0.1	1	10			
	M-G	29	33	36	51	14	18	60	0	0	0.6	4	484791	6555678	56
		4	31	17.5	48.5	44	42	22	0	2	0.6	46	484621	6555662	56
		37	36	16	25.5	56	10	38	0	1	0.6	28	484621	6555662	56
		43	42	15.5	21	54	18	36	0	1	0.6	40	484112	6555612	56
		50	35	14	18	60	38	8	0	0	0.6	9	483517	6555412	56
9	NR246	Benchmark	37	20-50	10-60	10-60	5-60	10-50	0	1	1	10			
	M-G	20	37	43.5	46	46	22	34	0	1	0.6	46	484935	6556281	56
		23	32	30.2	28.1	62	8	44	0	1	0.6	32.5	484229	6557443	56
		26	32	30.5	14.5	42	0	44	38	0	0.6	126	484536	6557961	56
		24	30	19.5	23.2	82	30	24	0	0	0.6	95	484526	6556898	56
		40	23	11	10.5	78	0	40	0	0	0.6	36	484254	6556454	56
		3	24	18.5	51	74	20	28	0	0	0.6	5	484161	6555892	56
10	NR228	Benchmark	35	15-50	5-70	5-70	5-60	5-80	0	1.5	1	10			
	M-G	6	30	18	44.5	24	10	16	0	1	1	17	485202	6554907	56
		35	30	13	12	84	8	40	0	0	1	3	485343	6555859	56
		16	33	21.7	34.5	80	16	18	0	3	1	94	484506	6554741	56
		5	34	22.2	0	44	6	2	0	2	1	300	484815	6555175	56

Vegetation Zone	Veg Type ID	Plot ID	Native plant species richness	Native over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Over storey regeneration	Total length of fallen logs	Easting	Northing	Zone
		19	35	7.8	19.1	90	8	22	0	0	1	142	485241	6554276	56
		51	36	18	20.5	66	8	28	0	0	1	18	485598	6553851	56

Appendix Table 3 Norton biobank plant species recorded in vegetation zone 1

Family	Scientific Name	Common Name	Exotic	Plot 18 Cover	Plot 18 Abundance	Plot 25 Cover	Plot 25 Abundance	Plot 31 Cover	Plot 31 Abundance	Plot 36 Cover	Plot 36 Abundance
Acanthaceae	*Pseuderanthemum variabile*	Pastel Flower		1	100	1	10	1	100	1	200
Adiantaceae	*Adiantum aethiopicum*	Common Maidenhair		1	100	1	20			1	30
Apocynaceae	*Tabernaemontana pandacaqui*	Banana Bush		1	1	1	3				
Araceae	*Gymnostachys anceps*	Settler's Twine		1	20			1	30		
Asteliaceae	*Cordyline stricta*	Narrow-leaved Palm Lily		1	1	1	7			1	1
Asteraceae	*Vernonia cinerea*			1	20						
Bignoniaceae	*Pandorea pandorana*	Wonga Wonga Vine								1	16
Casuarinaceae	*Allocasuarina torulosa*	Forest Oak				1	1	1	2	1	4
Convolvulaceae	*Polymeria calycina*			1	2	1	50	1	20	1	8
Cunoniaceae	*Schizomeria ovata*	Crabapple				1	1				
Cyperaceae	*Carex appressa*	Tall Sedge		1	10						
Cyperaceae	*Carex maculata*			1	50						
Cyperaceae	*Lepidosperma laterale*	Variable Sword-sedge								1	3
Dennstaedtiaceae	*Hypolepis muelleri*	Harsh Ground Fern		1	50						
Dennstaedtiaceae	*Pteridium esculentum*	Bracken				1	2	1	3	1	3
Dicksoniaceae	*Calochlaena dubia*	Rainbow Fern				2	50	1	5	1	5
Dilleniaceae	*Hibbertia scandens*	Climbing Guinea Flower		1	20	1	20	1	20	1	7
Dioscoreaceae	*Dioscorea transversa*	Native Yam		1	10	1	10	1	3		

Family	Scientific Name	Common Name	Exotic	Plot 18 Cover	Plot 18 Abundance	Plot 25 Cover	Plot 25 Abundance	Plot 31 Cover	Plot 31 Abundance	Plot 36 Cover	Plot 36 Abundance
Dryopteridaceae	*Lastreopsis acuminata*	Shiny Shield Fern								1	10
Eupomatiaceae	*Eupomatia laurina*	Bolwarra		1	1			1	1		
Fabaceae (Faboideae)	*Desmodium gunnii*	Slender Tick-trefoil		1	10	1	1	1	100	1	1
Fabaceae (Faboideae)	*Desmodium varians*	Slender Tick-trefoil						1	1	1	1
Fabaceae (Faboideae)	*Glycine* sp.					1	1	1	3	1	10
Fabaceae (Mimosoideae)	*Acacia binervata*	Two-veined Hickory						1	1		
Fabaceae (Mimosoideae)	*Acacia floribunda*	White Sally		1	3	1	4	1	2	1	8
Fabaceae (Mimosoideae)	*Acacia irrorata*	Green Wattle								1	3
Hydrocotyle	*Hydrocotyle peduncularis*			1	1						
Lamiaceae	*Clerodendrum floribundum* var. *floribundum*			1	1			1	1		
Lauraceae	*Cinnamomum camphora*	Camphor Laurel	*							1	1
Lauraceae	*Cryptocarya microneura*	Murrogun		1	5	1	1				
Lobeliaceae	*Pratia purpurascens*	Whiteroot		1	10	1	10	1	3	1	3
Lomandraceae	*Lomandra hystrix*					1	20				
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush		1	6	1	2	1	2	1	13
Luzuriagaceae	*Eustrephus latifolius*	Wombat Berry				1	1	1	1	1	15
Luzuriagaceae	*Geitonoplesium cymosum*	Scrambling Lily		1	1	1	1				
Meliaceae	*Synoum glandulosum* subsp. *glandulosum*	Scentless Rosewood		1	2	1	4	1	2		

Family	Scientific Name	Common Name	Exotic	Plot 18 Cover	Plot 18 Abundance	Plot 25 Cover	Plot 25 Abundance	Plot 31 Cover	Plot 31 Abundance	Plot 36 Cover	Plot 36 Abundance
Menispermaceae	*Sarcopetalum harveyanum*	Pearl Vine		1	4						
Menispermaceae	*Stephania japonica*	Snake vine		1	20						
Moraceae	*Ficus coronata*	Creek Sandpaper Fig		1	1						
Myrsinaceae	*Myrsine howittiana*	Brush Muttonwood		1	1			1	1		
Myrsinaceae	*Myrsine variabilis*					1	1	1	3		
Myrtaceae	*Acmena smithii*	Lilly Pilly		1	1	1	5	1	1		
Myrtaceae	*Callistemon salignus*	Willow Bottlebrush		1	2	1	1	1	4	1	4
Myrtaceae	*Corymbia gummifera*	Red Bloodwood						10	3		
Myrtaceae	*Corymbia intermedia*	Pink Bloodwood				5	1				
Myrtaceae	*Eucalyptus cameronii*	Diehard Stringybark								3	2
Myrtaceae	*Eucalyptus microcorys*	Tallowwood		5	1			1	1	5	3
Myrtaceae	*Eucalyptus pilularis*	Blackbutt		15	2	25	3	30	4	30	4
Myrtaceae	*Eucalyptus resinifera*	Red Mahogany		15	3	10	2				
Myrtaceae	*Eucalyptus siderophloia*	Grey Ironbark								1	1
Myrtaceae	*Leptospermum polygalifolium*	Tantoon						1	2	1	7
Myrtaceae	*Lophostemon confertus*	Brush Box		1	2	5	9	15	12	1	6
Myrtaceae	*Melaleuca linariifolia*	Flax-leaved Paperbark		2	5						
Myrtaceae	*Melaleuca styphelioides*	Prickly-leaved Tea Tree				1	1	1	1	1	1
Myrtaceae	*Sannantha angusta*			10	100	2	30	1	3	1	1

Family	Scientific Name	Common Name	Exotic	Plot 18 Cover	Plot 18 Abundance	Plot 25 Cover	Plot 25 Abundance	Plot 31 Cover	Plot 31 Abundance	Plot 36 Cover	Plot 36 Abundance
Myrtaceae	*Syncarpia glomulifera*	Turpentine		20	11	5	8	20	16	40	200
Orchidaceae	*Pterostylis* sp.	Greenhood						1	3		
Phormiaceae	*Dianella revoluta*	Blueberry Lily		1	50	1	50			1	12
Phormiaceae	*Dianella sp.*							1	4		
Phyllanthaceae	*Breynia oblongifolia*	Coffee Bush		1	20			1	2	1	3
Phyllanthaceae	*Glochidion ferdinandi*	Cheese Tree								1	5
Pittosporaceae	*Billardiera scandens*	Hairy Apple Berry				1	2	1	1	1	5
Poaceae	*Digitaria diffusa*	Open Summer-grass				1	1	1	3		
Poaceae	*Entolasia marginata*	Bordered Panic		10	1000	3	1000	1	1		
Poaceae	*Entolasia stricta*	Wiry Panic		1	10	1	200	20	1000	2	200
Poaceae	*imperata cylindrica*	Blady Grass		1	100			1	50	1	50
Poaceae	*Oplismenus imbecillis*			7	1000	2	1000	3	100	1	100
Poaceae	*Ottochloa gracillima*							1	1		
Proteaceae	*Persoonia stradbrokensis*							1	5	1	2
Rubiaceae	*Morinda jasminoides*	Sweet Morinda		1	1						
Rutaceae	*Zieria* sp.					1	1				
Sapindaceae	*Dodonaea triquetra*	Large-leaf Hop-bush				1	1	1	2	1	5
Smilacaceae	*Smilax australis*	Lawyer Vine				1	3	1	1	1	1
Smilacaceae	*Smilax glyciphylla*	Sweet Sarsparilla		1	1						
Sterculiaceae	*Commersonia fraseri*	Brush Kurrajong				1	1				
Violaceae	*Hybanthus stellarioides*			1	1					1	2

Appendix Table 4 Norton biobank plant species recorded in vegetation zone 2

Family	Scientific Name	Common Name	Exotic	Plot 1 Cover	Plot 1 Abundance	Plot 41 Cover	Plot 41 Abundance	Plot 42 Cover	Plot 42 Abundance	Plot 47 Cover	Plot 47 Abundance
Acanthaceae	*Pseuderanthemum variabile*	Pastel Flower		1	20	1	8			1	4
Apocynaceae	*Parsonsia straminea*	Common Silkpod				1	1				
Casuarinaceae	*Allocasuarina littoralis*	Black She-Oak		1	30			5	15	25	80
Casuarinaceae	*Allocasuarina torulosa*	Forest Oak				10	21				
Convolvulaceae	*Polymeria calycina*			1	2						
Cyperaceae	*Lepidosperma laterale*	Variable Sword-sedge		1	50	2	100	1	20	1	25
Cyperaceae	*Ptilothrix deusta*			2	200	1	3	3	200	1	2
Dilleniaceae	*Hibbertia aspera*	Rough Guinea Flower		1	10	1	2	1	2	1	3
Dilleniaceae	*Hibbertia obtusifolia*	Hoary Guinea Flower						1	1		
Fabaceae (Faboideae)	*Glycine clandestina*	Twining glycine								1	1
Fabaceae (Faboideae)	*Gompholobium pinnatum*	Pinnate Wedge Pea						1	4		
Fabaceae (Faboideae)	*Hardenbergia violacea*	False Sarsaparilla		1	2						
Fabaceae (Faboideae)	*Jacksonia scoparia*	Dogwood		1	8						
Fabaceae (Faboideae)	*Pultenaea myrtoides*			1	1	1	1	1	30	1	1
Fabaceae (Faboideae)	*Dillwynia retorta*							1	2		
Fabaceae (Mimosoideae)	*Acacia binervata*	Two-veined Hickory						1	3		

Family	Scientific Name	Common Name	Exotic	Plot 1 Cover	Plot 1 Abundance	Plot 41 Cover	Plot 41 Abundance	Plot 42 Cover	Plot 42 Abundance	Plot 47 Cover	Plot 47 Abundance
Fabaceae (Mimosoideae)	*Acacia concurrens*	Curracabah		1	2						
Fabaceae (Mimosoideae)	*Acacia falcata*			1	2						
Goodeniaceae	*Dampiera sylvestris*					1	2			1	8
Goodeniaceae	*Goodenia ovata*	Hop Goodenia		1	20	1	10				
Goodeniaceae	*Velleia spathulata*							1	200		
Haloragaceae	*Gonocarpus tetragynus*	Poverty Raspwort		1	2	1	4	1	200		
Lauraceae	*Cassytha sp.*			1	4	1	7				
Lauraceae	*Cryptocarya microneura*	Murrogun								1	1
Lindsaeaceae	*Lindsaea microphylla*	Lacy Wedge Fern		1	4						
Lobeliaceae	*Pratia purpurascens*	Whiteroot		1	5	1	1				
Lomandraceae	*Lomandra filiformis*	Wattle Matt-rush						1	50		
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush		5	100					1	4
Myrtaceae	*Callistemon salignus*	Willow Bottlebrush		1	2	3	17			1	7
Myrtaceae	*Corymbia gummifera*	Red Bloodwood		2	2	1	1	3	2	5	2
Myrtaceae	*Eucalyptus cameronii*	Diehard Stringybark				5	3	5	2	15	4
Myrtaceae	*Eucalyptus carnea*	Thick-leaved Mahogany		30	12			5	2		
Myrtaceae	*Eucalyptus pilularis*	Blackbutt								5	1
Myrtaceae	*Eucalyptus resinifera*	Red Mahogany				5	2			15	1
Myrtaceae	*Eucalyptus*	Narrow-leaved		3	3	5	4	3	4		

Family	Scientific Name	Common Name	Exotic	Plot 1 Cover	Plot 1 Abundance	Plot 41 Cover	Plot 41 Abundance	Plot 42 Cover	Plot 42 Abundance	Plot 47 Cover	Plot 47 Abundance
	seeana	Red Gum									
Myrtaceae	*Eucalyptus siderophloia*	Grey Ironbark		1	1						
Myrtaceae	*Leptospermum polygalifolium*	Tantoon				1	1	1	4		
Myrtaceae	*Melaleuca linariifolia*	Flax-leaved Paperbark				1	1				
Myrtaceae	*Melaleuca nodosa*			1	5			2	22	1	1
Myrtaceae	*Melaleuca sieberi*					1	1				
Myrtaceae	*Sannantha angusta*			1	1	2	12	1	1		
Myrtaceae	*Syncarpia glomulifera*	Turpentine		1	3						
Orchidaceae	*Dipodium* sp.					1	2				
Orchidaceae	*Themeda australis*	Kangaroo Grass		1	50						
Oxalidaceae	*Oxalis* sp.			1	1	1	4				
Phormiaceae	*Dianella caerulea*	Blue Flax-lily		1	50	1	50	1	1		
Pittosporaceae	*Billardiera scandens*	Hairy Apple Berry		1	3	1	7			1	3
Poaceae	*Aristida sp.*	A Wiregrass						1	100		
Poaceae	*Aristida vagans*	Threeawn Speargrass		1	6	1	1	1	20		
Poaceae	*Cymbopogon refractus*	Barbed Wire Grass						1	1		
Poaceae	*Digitaria diffusa*	Open Summer-grass						1	1		
Poaceae	*Digitaria parviflora*	Small-flowered Finger Grass		1	2						
Poaceae	*Echinopogon* sp.	A Hedgehog Grass		1	2						
Poaceae	*Entolasia stricta*	Wiry Panic		70	1000	80	1000	70	1000	70	100
Poaceae	*Eragrostis* sp.	A Lovegrass	*					1	10		

Family	Scientific Name	Common Name	Exotic	Plot 1 Cover	Plot 1 Abundance	Plot 41 Cover	Plot 41 Abundance	Plot 42 Cover	Plot 42 Abundance	Plot 47 Cover	Plot 47 Abundance
Poaceae	*imperata cylindrica*	Blady Grass		1	10	1	1			1	1
Poaceae	*Panicum simile*	Two-colour Panic								1	1
Poaceae	*Themeda australis*	Kangaroo Grass						1	50		
Poaceae	*Austrostipa pubescens*									1	9
Xanthorrhoeaceae	*Xanthorrhoea* sp.					1	1	5	200	15	100

Notes: Cover – visual estimate of foliage projective cover within the plot, recorded from 1–5% and then to the nearest 5%. Abundance - relative number of individuals or shoots of a species within the plot. Based on the following intervals: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 20, 50, 100, 500, 1000. Counts above 20 are estimates only.

Appendix Table 5 Norton biobank plant species recorded in vegetation zones 3 and 4

Family	Scientific Name	Common Name	Exotic	Plot 21 Cover	Plot 21 Abundance	Plot 38 Cover	Plot 38 Abundance	Plot 39 Cover	Plot 39 Abundance	Plot 48 Cover	Plot 48 Abundance	Plot 49 Cover	Plot 49 Abundance
Acanthaceae	*Pseuderanthemum variabile*	Pastel Flower		1	50	1	50	1	40	1	1	1	50
Adiantaceae	*Cheilanthes sieberi*	Rock Fern		1	1								
Adiantaceae	*Cheilanthes* sp.	Cloak Fern, Mulga Fern, Rock Fern				1	15	1	4				
Apiaceae	*Centella asiatica*	Indian Pennywort		1	1					1	1000	1	100
Apiaceae	*Hydrocotyle sibthorpioides*									1	1000	1	100
Apocynaceae	*Marsdenia* sp.			1	1								
Apocynaceae	*Parsonsia straminea*	Common Silkpod								1	1	2	7
Asteraceae	*Ozothamnus diosmifolius*	White Dogwood				1	6						
Asteraceae	*Vernonia cinerea*			1	30	1	100	1	1	1	200	1	50
Casuarinaceae	*Allocasuarina littoralis*	Black She-Oak		25	20			3	10	1	2	10	6
Casuarinaceae	*Allocasuarina torulosa*	Forest Oak				1	5	2	4				
Convolvulaceae	*Dichondra repens*	Kidney Weed								1	1000	1	200
Convolvulaceae	*Polymeria calycina*			1	30	1	3			1	100		
Cyperaceae	*Carex appressa*	Tall Sedge								2	25		
Cyperaceae	*Carex maculata*									15	1000		
Cyperaceae	*Cyperus* sp.			1	1								
Cyperaceae	*Fimbristylis dichotoma*	Common Fringe-sedge				1	2			1	1		

Family	Scientific Name	Common Name	Exotic	Plot 21 Cover	Plot 21 Abundance	Plot 38 Cover	Plot 38 Abundance	Plot 39 Cover	Plot 39 Abundance	Plot 48 Cover	Plot 48 Abundance	Plot 49 Cover	Plot 49 Abundance
Cyperaceae	*Gahnia sieberiana*	Red-fruit Saw-sedge										1	15
Cyperaceae	*Lepidosperma laterale*	Variable Sword-sedge		2	50	2	50	1	50	1	1		
Cyperaceae	*Baumea rubiginosa*									1	50		
Cyperaceae	*Chorizandra cymbaria*											3	100
Fabaceae (Faboideae)	*Desmodium gunnii*	Slender Tick-trefoil						1	1				
Fabaceae (Faboideae)	*Desmodium varians*	Slender Tick-trefoil						1	3				
Fabaceae (Faboideae)	*Glycine microphylla*	Small-leaf Glycine		2	50								
Fabaceae (Faboideae)	*Glycine* sp.					1	3	1	7				
Fabaceae (Faboideae)	*Jacksonia scoparia*	Dogwood						1	1				
Fabaceae (Faboideae)	*Pultenaea retusa*					1	1						
Fabaceae (Mimosoideae)	*Acacia concurrens*	Curracabah		10	20	1	4	10	50				
Fabaceae (Mimosoideae)	*Acacia floribunda*	White Sally				1	2			1	7	2	3
Goodeniaceae	*Goodenia ovata*	Hop Goodenia				1	5	1	1				
Goodeniaceae	*Goodenia rotundifolia*			1	20								
Goodeniaceae	*Velleia spathulata*											1	100
Haloragaceae	*Gonocarpus* sp.	Raspwort		1	10								
Haloragaceae	*Gonocarpus tetragynus*	Poverty Raspwort				1	2			1	1	1	20
Lauraceae	*Cassytha* sp.			1	2								

Family	Scientific Name	Common Name	Exotic	Plot 21 Cover	Plot 21 Abundance	Plot 38 Cover	Plot 38 Abundance	Plot 39 Cover	Plot 39 Abundance	Plot 48 Cover	Plot 48 Abundance	Plot 49 Cover	Plot 49 Abundance
Lauraceae	*Cinnamomum camphora*	Camphor Laurel	*									1	1
Lobeliaceae	*Pratia purpurascens*	Whiteroot		1	20			1	1	1	1	1	3
Lomandraceae	*Lomandra filiformis*	Wattle Matt-rush				1	100						
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush		10	50	30	400	1	2	2	40	10	50
Luzuriagaceae	*Eustrephus latifolius*	Wombat Berry								1	1		
Myrtaceae	*Callistemon salignus*	Willow Bottlebrush				1	2			15	14	2	3
Myrtaceae	*Corymbia variegata*			10	1	20	7	20	5				
Myrtaceae	*Eucalyptus cameronii*	Diehard Stringybark		5	1								
Myrtaceae	*Eucalyptus carnea*	Thick-leaved Mahogany				20	9	15	5				
Myrtaceae	*Eucalyptus microcorys*	Tallowwood		20	2								
Myrtaceae	*Eucalyptus propinqua*	Small-fruited Grey Gum		20	10								
Myrtaceae	*Eucalyptus siderophloia*	Grey Ironbark		10	1	2	2	5	3				
Myrtaceae	*Leptospermum polygalifolium*	Tantoon										1	8
Myrtaceae	*Lophostemon confertus*	Brush Box		10	20			1	1				
Myrtaceae	*Melaleuca linariifolia*	Flax-leaved Paperbark								14	4	25	9
Myrtaceae	*Sannantha angusta*							1	2	1	22	7	20
Myrtaceae	*Sannantha pluriflora*			10	30								

Family	Scientific Name	Common Name	Exotic	Plot 21 Cover	Plot 21 Abundance	Plot 38 Cover	Plot 38 Abundance	Plot 39 Cover	Plot 39 Abundance	Plot 48 Cover	Plot 48 Abundance	Plot 49 Cover	Plot 49 Abundance
Myrtaceae	*Eucalyptus tereticornis*	Forest Red Gum								20	12	15	6
Oxalidaceae	*Oxalis sp.*			1	1	1	1			1	8	1	1
Phormiaceae	*Dianella caerulea*	Blue Flax-lily						1	2	1	3		
Phormiaceae	*Dianella longifolia*	Blueberry Lily		1	5								
Phormiaceae	*Dianella revoluta*	Blueberry Lily				1	1						
Phyllanthaceae	*Breynia oblongifolia*	Coffee Bush		1	1					1	1		
Phyllanthaceae	*Glochidion ferdinandi*	Cheese Tree		1	5					1	1	1	1
Poaceae	*Andropogon virginicus*	Whisky Grass	*			1	5			1	1		
Poaceae	*Aristida vagans*	Threeawn Speargrass		2	50	1	20	1	3				
Poaceae	*Axonopus fissifolius*	Narrow-leafed Carpet Grass	*							1	5		
Poaceae	*Cymbopogon refractus*	Barbed Wire Grass		1	10	1	2	1	1	1	1		
Poaceae	*Dichelachne sp.*	A Plumegrass						1	1				
Poaceae	*Digitaria diffusa*	Open Summer-grass		2	30	1	2	1	2				
Poaceae	*Digitaria parviflora*	Small-flowered Finger Grass		3	50	1	4	1	3				
Poaceae	*Echinopogon* sp.	A Hedgehog Grass		1	20	1	1						
Poaceae	*Entolasia marginata*	Bordered Panic		15	100					1	1	1	100

Family	Scientific Name	Common Name	Exotic	Plot 21 Cover	Plot 21 Abundance	Plot 38 Cover	Plot 38 Abundance	Plot 39 Cover	Plot 39 Abundance	Plot 48 Cover	Plot 48 Abundance	Plot 49 Cover	Plot 49 Abundance
Poaceae	*Entolasia stricta*	Wiry Panic		30	500	30	1000	20	1000	5	1000	30	1000
Poaceae	*Eragrostis brownii*	Brown's Lovegrass		1	20								
Poaceae	*Eragrostis* sp.	A Lovegrass	*			1	10	1	1				
Poaceae	*imperata cylindrica*	Blady Grass		5	50			2	100				
Poaceae	*Ischaemum australe*									1	50	2	100
Poaceae	*Microlaena stipoides*	Weeping Grass								1	100	1	100
Poaceae	*Oplismenus aemulus*									1	2		
Poaceae	*Oplismenus imbecillis*											1	100
Poaceae	*Ottochloa gracillima*									5	1000		
Poaceae	*Panicum simile*	Two-colour Panic		1	20	1	12	1	3				
Poaceae	*Paspalum mandiocanum*	Broadleaf Paspalum	*									1	3
Poaceae	*Paspalum orbiculare*	Ditch Millet								1	2		
Poaceae	*Paspalum urvillei*	Vasey Grass	*							1	1		
Poaceae	*Sporobolus fertilis*	Giant Parramatta Grass	*			1	1						
Poaceae	*Themeda australis*	Kangaroo Grass		1	5			1	2	1	1	1	1
Proteaceae	*Lomatia silaifolia*	Crinkle Bush										1	1
Proteaceae	*Persoonia stradbrokensis*			1	1	1	5						
Rubiaceae	*Pomax*	Pomax						1	1				

Family	Scientific Name	Common Name	Exotic	Plot 21 Cover	Plot 21 Abundance	Plot 38 Cover	Plot 38 Abundance	Plot 39 Cover	Plot 39 Abundance	Plot 48 Cover	Plot 48 Abundance	Plot 49 Cover	Plot 49 Abundance
	umbellata												
Verbenaceae	*Lantana camara*	Lantana	*					1	1	1	3	1	2
Violaceae	*Hybanthus stellarioides*			1	2					1	3		

Notes: Cover – visual estimate of foliage projective cover within the plot, recorded from 1–5% and then to the nearest 5%. Abundance - relative number of individuals or shoots of a species within the plot. Based on the following intervals: 1, 2, 3, 4, 5, 6, 7, 8 9, 10, 20, 50, 100, 500, 1000. Counts above 20 are estimates only.

Appendix Table 6 Norton biobank plant species recorded in vegetation zones 5 and 6

Family	Scientific Name	Common Name	Exotic	Plot 27 Cover	Plot 27 Abundance	Plot 28 Cover	Plot 28 Abundance	Plot 30 Cover	Plot 30 Abundance	Plot 32 Cover	Plot 32 Abundance	Plot 33 Cover	Plot 33 Abundance
Acanthaceae	*Pseuderanthemum variabile*	Pastel Flower						1	50				
Apiaceae	*Centella asiatica*	Indian Pennywort						1	10			1	1
Apocynaceae	*Parsonsia straminea*	Common Silkpod								1	1		
Apocynaceae	*Tabernaemontana pandacaqui*	Banana Bush						1	2				
Araceae	*Gymnostachys anceps*	Settler's Twine						1	1				
Asteliaceae	*Cordyline stricta*	Narrow-leaved Palm Lily						1	2				
Asteraceae	*Ageratum houstonianum*		*	1	5								
Asteraceae	*Ambrosia artemisiifolia*	Annual Ragweed	*			2	1000						
Asteraceae	*Aster subulatus*	Wild Aster	*			1	100						
Asteraceae	*Baccharis halimifolia*	Groundsel Bush	*	1	2								
Asteraceae	*Bidens pilosa*	Cobbler's Pegs	*			1	1000						
Asteraceae	*Conyza* sp.	A Fleabane	*	1	8								
Asteraceae	*Hypochaeris radicata*	Catsear	*	2	100								
Asteraceae	*Senecio madagascariensis*	Fireweed	*	1	50								
Asteraceae	*Vernonia cinerea*											1	1
Commelinaceae	*Commelina cyanea*	Native Wandering Jew										1	100

Family	Scientific Name	Common Name	Exotic	Plot 27 Cover	Plot 27 Abundance	Plot 28 Cover	Plot 28 Abundance	Plot 30 Cover	Plot 30 Abundance	Plot 32 Cover	Plot 32 Abundance	Plot 33 Cover	Plot 33 Abundance
Convolvulaceae	*Dichondra repens*	Kidney Weed										1	1
Convolvulaceae	*Polymeria calycina*							1	10	1	2		
Cyperaceae	*Carex appressa*	Tall Sedge						1	2				
Cyperaceae	*Carex fascicularis*	Tassel Sedge								1	2		
Cyperaceae	*Carex maculata*							1	25	1	6	1	2
Cyperaceae	*Cyperus polystachyos*			1	500								
Cyperaceae	*Fimbristylis dichotoma*	Common Fringe-sedge		1	100								
Cyperaceae	*Gahnia sieberiana*	Red-fruit Saw-sedge								1	3		
Cyperaceae	*Gahnia* sp.							1	5				
Cyperaceae	*Schoenus apogon*	Fluke Bogrush		1	100								
Dennstaedtiaceae	*Hypolepis muelleri*	Harsh Ground Fern						5	100				
Dennstaedtiaceae	*Pteridium esculentum*	Bracken						3	50				
Dicksoniaceae	*Calochlaena dubia*	Rainbow Fern						1	5				
Dilleniaceae	*Hibbertia scandens*	Climbing Guinea Flower						1	1				
Dioscoreaceae	*Dioscorea transversa*	Native Yam						1	20				
Fabaceae (Faboideae)	*Crotalaria* sp.		*			1	200						
Fabaceae (Faboideae)	*Daviesia ulicifolia*	Gorse Bitter Pea				1	1						
Fabaceae (Faboideae)	*Desmodium varians*	Slender Tick-trefoil		1	1					1	1		

Family	Scientific Name	Common Name	Exotic	Plot 27 Cover	Plot 27 Abundance	Plot 28 Cover	Plot 28 Abundance	Plot 30 Cover	Plot 30 Abundance	Plot 32 Cover	Plot 32 Abundance	Plot 33 Cover	Plot 33 Abundance
Fabaceae (Faboideae)	*glycine cyrtoloba*											1	50
Fabaceae (Faboideae)	*Glycine* sp.					1	1	1	1				
Fabaceae (Faboideae)	*Hardenbergia violacea*	False Sarsaparilla				1	2						
Fabaceae (Faboideae)	*Kennedia rubicunda*	Dusky Coral Pea				1	1						
Fabaceae (Faboideae)	*Macroptilium atropurpureum*	Siratro	*			1	100						
Fabaceae (Faboideae)	*Pultenaea retusa*			1	2								
Fabaceae (Mimosoideae)	*Acacia binervata*	Two-veined Hickory		1	2					1	1		
Fabaceae (Mimosoideae)	*Acacia concurrens*	Curracabah		2	50	1	4						
Fabaceae (Mimosoideae)	*Acacia falcata*					1	20						
Fabaceae (Mimosoideae)	*Acacia floribunda*	White Sally						1	2	5	50	20	30
Fabaceae (Mimosoideae)	*Acacia irrorata*	Green Wattle										1	1
Fabaceae (Mimosoideae)	*Acacia* sp.	Wattle				1	3						
Geraniaceae	*Geranium solanderi*	Native Geranium										1	2
Goodeniaceae	*Velleia spathulata*			1	100								
Haloragaceae	*Gonocarpus chinensis* subsp. *verrucosus*			1	500								

Family	Scientific Name	Common Name	Exotic	Plot 27 Cover	Plot 27 Abundance	Plot 28 Cover	Plot 28 Abundance	Plot 30 Cover	Plot 30 Abundance	Plot 32 Cover	Plot 32 Abundance	Plot 33 Cover	Plot 33 Abundance
Haloragaceae	*Gonocarpus tetragynus*	Poverty Raspwort						1	1				
Juncaceae	*Juncus cognatus*		*	1	1							1	4
Juncaceae	*Juncus* sp.	A Rush								1	10		
Lauraceae	*Cinnamomum camphora*	Camphor Laurel	*							1	1		
Lauraceae	*Cryptocarya microneura*	Murrogun								1	2	1	1
Lobeliaceae	*Pratia purpurascens*	Whiteroot		1	20			1	10			1	100
Loganiaceae	*Mitrasacme alsinoides*			1	100								
Luzuriagaceae	*Eustrephus latifolius*	Wombat Berry								1	1		
Meliaceae	*Synoum glandulosum subsp. glandulosum*	Scentless Rosewood						1	1				
Myrsinaceae	*Myrsine howittiana*	Brush Muttonwood										1	1
Myrtaceae	*Acmena smithii*	Lilly Pilly						1	1			1	1
Myrtaceae	*Callistemon salignus*	Willow Bottlebrush						1	2	3	4	5	3
Myrtaceae	*Corymbia intermedia*	Pink Bloodwood		1	5								
Myrtaceae	*Eucalyptus cameronii*	Diehard Stringybark						25	3	1	1		
Myrtaceae	*Eucalyptus grandis*	Flooded Gum						25	3	25	9	35	11
Myrtaceae	*Eucalyptus signata*	Scribbly Gum								2	2		
Myrtaceae	*Leptospermum polygalifolium*	Tantoon								5	50		
Myrtaceae	*Melaleuca linariifolia*	Flax-leaved						10	9	5	11	10	8

Family	Scientific Name	Common Name	Exotic	Plot 27 Cover	Plot 27 Abundance	Plot 28 Cover	Plot 28 Abundance	Plot 30 Cover	Plot 30 Abundance	Plot 32 Cover	Plot 32 Abundance	Plot 33 Cover	Plot 33 Abundance
		Paperbark											
Myrtaceae	*Melaleuca quinquenervia*	Broad-leaved Paperbark		1	1								
Myrtaceae	*Melaleuca styphelioides*	Prickly-leaved Tea Tree										1	4
Myrtaceae	*Sannantha angusta*			20	100			10	50	60	500	2	25
Myrtaceae	*Syncarpia glomulifera*	Turpentine						7	2				
Phormiaceae	*Dianella revoluta*	Blueberry Lily						1	20				
Phyllanthaceae	*Breynia oblongifolia*	Coffee Bush										1	1
Phyllanthaceae	*Glochidion ferdinandi*	Cheese Tree						1	2				
Pittosporaceae	*Billardiera scandens*	Hairy Apple Berry						1	6	1	20	1	2
Poaceae	*Andropogon virginicus*	Whisky Grass	*	50	1000								
Poaceae	*Axonopus fissifolius*	Narrow-leafed Carpet Grass	*	30	1000	1	50						
Poaceae	*Cynodon dactylon*	Common Couch				10	1000						
Poaceae	*Echinopogon* sp.	A Hedgehog Grass										1	1
Poaceae	*Entolasia marginata*	Bordered Panic						5	1000	1	50	2	100
Poaceae	*Entolasia stricta*	Wiry Panic						1	100	1	100		
Poaceae	*Eragrostis leptostachya*	Paddock Lovegrass		1	50								
Poaceae	*Oplismenus*											1	100

Family	Scientific Name	Common Name	Exotic	Plot 27 Cover	Plot 27 Abundance	Plot 28 Cover	Plot 28 Abundance	Plot 30 Cover	Plot 30 Abundance	Plot 32 Cover	Plot 32 Abundance	Plot 33 Cover	Plot 33 Abundance
	aemulus												
Poaceae	*Oplismenus imbecillis*							5	1000				
Poaceae	*Ottochloa gracillima*							30	1000			50	1000
Poaceae	*Paspalum mandiocanum*	Broadleaf Paspalum	*	1	10	2	100					1	50
Poaceae	*Paspalum notatum*	Bahia Grass	*			1	10						
Poaceae	*Paspalum orbiculare*	Ditch Millet				1	2						
Poaceae	*Paspalum urvillei*	Vasey Grass	*	10	200	1	100						
Poaceae	*Sacciolepis indica*	Indian Cupscale Grass		1	100								
Poaceae	*Setaria sphacelata*	South African Pigeon Grass	*	1	10	1	200					1	70
Poaceae	*Sporobolus fertilis*	Giant Parramatta Grass	*			1	10						
Proteaceae	*Persoonia stradbrokensis*			1	2								
Rubiaceae	*Morinda jasminoides*	Sweet Morinda								1	2		
Rutaceae	*Acronychia oblongifolia*	White Aspen						1	1				
Rutaceae	*Citrus* sp.		*	1	4								
Verbenaceae	*Lantana camara*	Lantana	*									1	2
Verbenaceae	*Verbena bonariensis*	Purpletop	*	1	1	1	3						
Violaceae	*Viola hederacea*	Ivy-leaved Violet						1	10				
Xyridaceae	*Xyris juncea*	Dwarf Yellow-eye		1	50								

Notes: Cover – visual estimate of foliage projective cover within the plot, recorded from 1–5% and then to the nearest 5%. Abundance - relative number of individuals or shoots of a species within the plot. Based on the following intervals: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 20, 50, 100, 500, 1000. Counts above 20 are estimates only.

Appendix Table 7 Norton biobank plant species recorded in vegetation zone 7

Family	Scientific Name	Common Name	Exotic	Plot 34 Cover	Plot 34 Abundance	Plot 44 Cover	Plot 44 Abundance	Plot 45 Cover	Plot 45 Abundance	Plot 47 Cover	Plot 47 Abundance
Acanthaceae	*Pseuderanthemum variabile*	Pastel Flower		1	10	1	200	1	200	1	4
Araliaceae	*Polyscias sambucifolia*	Elderberry Panax		1	2	1	1	1	3		
Asteraceae	*Vernonia cinerea*			1	2	1	50				
Bignoniaceae	*Pandorea pandorana*	Wonga Wonga Vine		1	2						
Casuarinaceae	*Allocasuarina littoralis*	Black She-Oak								25	80
Casuarinaceae	*Allocasuarina torulosa*	Forest Oak		2	15						
Convolvulaceae	*Polymeria calycina*			1	5			1	3		
Cyperaceae	*Lepidosperma laterale*	Variable Sword-sedge		1	1	5	200	2	100	1	25
Cyperaceae	*Ptilothrix deusta*							1	1	1	2
Dennstaedtiaceae	*Pteridium esculentum*	Bracken				1	3	1	7		
Dilleniaceae	*Hibbertia aspera*	Rough Guinea Flower		1	100	1	3	1	200	1	3
Dilleniaceae	*Hibbertia diffusa*	Wedge Guinea Flower		1	50						
Dilleniaceae	*Hibbertia vestita*					1	50				
Ericaceae	*Monotoca scoparia*			1	4						
Fabaceae (Faboideae)	*Bossiaea rhombifolia*			1	4						
Fabaceae (Faboideae)	*Desmodium varians*	Slender Tick-trefoil		1	2	1	2				
Fabaceae (Faboideae)	*Glycine clandestina*	Twining glycine		1	50	1	7			1	1
Fabaceae (Faboideae)	*Glycine* sp.			1	50						
Fabaceae (Faboideae)	*Gompholobium pinnatum*	Pinnate Wedge Pea				1	4				
Fabaceae (Faboideae)	*Hardenbergia violacea*	False Sarsaparilla						1	1		

Family	Scientific Name	Common Name	Exotic	Plot 34 Cover	Plot 34 Abundance	Plot 44 Cover	Plot 44 Abundance	Plot 45 Cover	Plot 45 Abundance	Plot 47 Cover	Plot 47 Abundance
Fabaceae (Faboideae)	*Pultenaea myrtoides*									1	1
Fabaceae (Faboideae)	*Pultenaea retusa*			1	3						
Fabaceae (Mimosoideae)	*Acacia binervata*	Two-veined Hickory				2	20	5	15		
Fabaceae (Mimosoideae)	*Acacia concurrens*	Curracabah		1	6	1	1				
Fabaceae (Mimosoideae)	*Acacia floribunda*	White Sally		1	1						
Fabaceae (Mimosoideae)	*Acacia irrorata*	Green Wattle		1	2						
Goodeniaceae	*Dampiera sylvestris*					1	50	1	20	1	8
Goodeniaceae	*Goodenia ovata*	Hop Goodenia				1	1				
Haloragaceae	*Gonocarpus tetragynus*	Poverty Raspwort		1	3	1	1				
Iridaceae	*Patersonia sericea*	Silky Purple-Flag				1	1				
Lauraceae	*Cassytha* sp.					1	1	1	2		
Lauraceae	*Cinnamomum camphora*	Camphor Laurel	*	1	1						
Lauraceae	*Cryptocarya microneura*	Murrogun								1	1
Lindsaeaceae	*Lindsaea microphylla*	Lacy Wedge Fern		1	2						
Lobeliaceae	*Pratia purpurascens*	Whiteroot				1	1				
Lomandraceae	*Lomandra filiformis*	Wattle Matt-rush		1	2						
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush		3	50	1	20			1	4
Lomandraceae	*Lomandra multiflora* subsp. *multiflora*	Many-flowered Mat-rush		1	1						
Luzuriagaceae	*Eustrephus latifolius*	Wombat Berry		1	2						
Myrtaceae	*Callistemon salignus*	Willow Bottlebrush		1	1	1	1	1	3	1	7
Myrtaceae	*Corymbia gummifera*	Red Bloodwood				1	2	1	1	5	2

Family	Scientific Name	Common Name	Exotic	Plot 34 Cover	Plot 34 Abundance	Plot 44 Cover	Plot 44 Abundance	Plot 45 Cover	Plot 45 Abundance	Plot 47 Cover	Plot 47 Abundance
Myrtaceae	*Eucalyptus cameronii*	Diehard Stringybark		2	1	5	2	4	1	15	4
Myrtaceae	*Eucalyptus microcorys*	Tallowwood		5	1	10	2	4	1		
Myrtaceae	*Eucalyptus pilularis*	Blackbutt		20	2	20	3	15	2	5	1
Myrtaceae	*Eucalyptus resinifera*	Red Mahogany		5	1					15	1
Myrtaceae	*Leptospermum polygalifolium*	Tantoon				1	1				
Myrtaceae	*Lophostemon confertus*	Brush Box		1	5						
Myrtaceae	*Melaleuca nodosa*									1	1
Myrtaceae	*Melaleuca sieberi*					1	1	5	35		
Myrtaceae	*Sannantha angusta*					1	1	1	2		
Myrtaceae	*Syncarpia glomulifera*	Turpentine		2	9	5	14	10	19		
Oleaceae	*Notelaea ovata*							1	3		
Orchidaceae	*Pterostylis* sp.	Greenhood				1	2	1	20		
Phormiaceae	*Dianella caerulea*	Blue Flax-lily		1	10			1	2		
Pittosporaceae	*Billardiera scandens*	Hairy Apple Berry		1	1	1	2	1	3	1	3
Poaceae	*Cymbopogon refractus*	Barbed Wire Grass		1	10						
Poaceae	*Digitaria diffusa*	Open Summer-grass		1	1						
Poaceae	*Digitaria parviflora*	Small-flowered Finger Grass						1	1		
Poaceae	*Entolasia stricta*	Wiry Panic		5	200	30	1000	50	1000	70	100
Poaceae	*Eragrostis* sp.	A Lovegrass	*			1	1				
Poaceae	*imperata cylindrica*	Blady Grass		20	1000	20	1000	5	100	1	1
Poaceae	*Ischaemum australe*							1	2		
Poaceae	*Panicum simile*	Two-colour Panic								1	1
Poaceae	*Themeda australis*	Kangaroo Grass				2	100				
Poaceae	*Austrostipa*									1	9

Family	Scientific Name	Common Name	Exotic	Plot 34 Cover	Plot 34 Abundance	Plot 44 Cover	Plot 44 Abundance	Plot 45 Cover	Plot 45 Abundance	Plot 47 Cover	Plot 47 Abundance
	pubescens										
Proteaceae	*Lomatia silaifolia*	Crinkle Bush		1	4			1	13		
Proteaceae	*Persoonia stradbrokensis*			1	1	1	3	1	3		
Violaceae	*Hybanthus stellarioides*					1	1				
Xanthorrhoeaceae	*Xanthorrhoea* sp.									15	100

Notes: Cover – visual estimate of foliage projective cover within the plot, recorded from 1–5% and then to the nearest 5%. Abundance - relative number of individuals or shoots of a species within the plot. Based on the following intervals: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 20, 50, 100, 500, 1000. Counts above 20 are estimates only.

Appendix Table 8 Norton biobank plant species recorded in vegetation zone 8

Family	Scientific Name	Common Name	Exotic	Plot 4 Cover	Plot 4 Abundance	Plot 29 Cover	Plot 29 Abundance	Plot 37 Cover	Plot 37 Abundance	Plot 43 Cover	Plot 43 Abundance	Plot 50 Cover	Plot 50 Abundance
Acanthaceae	*Pseuderanthemum variabile*	Pastel Flower		1	50	1	200	1	50	1	3	1	100
Adiantaceae	*Adiantum aethiopicum*	Common Maidenhair								1	1	1	10
Adiantaceae	*Cheilanthes* sp.	Cloak Fern										1	1
Apiaceae	*Centella asiatica*	Indian Pennywort				1	1						
Apocynaceae	*Parsonsia straminea*	Common Silkpod		1	1	1	1					1	2
Apocynaceae	*Tabernaemontana pandacaqui*	Banana Bush								1	1		
Araceae	*Gymnostachys anceps*	Settler's Twine		1	1					1	1	1	2
Araliaceae	*Polyscias sambucifolia*	Elderberry Panax		1	3							1	1
Asteraceae	*Vernonia cinerea*			1	1								
Bignoniaceae	*Pandorea pandorana*	Wonga Wonga Vine						1	1	1	1	1	4
Casuarinaceae	*Allocasuarina littoralis*	Black She-Oak				2	2					1	2
Casuarinaceae	*Allocasuarina torulosa*	Forest Oak						1	20	1	2		
Convolvulaceae	*Dichondra repens*	Kidney Weed								1	1		
Convolvulaceae	*Polymeria calycina*					1	2			1	6	1	1
Cyperaceae	*Lepidosperma laterale*	Variable Sword-sedge		1	50			2	100	1	3		
Dennstaedtiaceae	*Hypolepis muelleri*	Harsh Ground Fern								1	2		
Dennstaedtiaceae	*Pteridium esculentum*	Bracken		1	10	1	5	1	5	1	3	1	1
Dicksoniaceae	*Calochlaena dubia*	Rainbow Fern										2	100
Dilleniaceae	*Hibbertia aspera*	Rough Guinea Flower		1	11								
Dilleniaceae	*Hibbertia scandens*	Climbing Guinea Flower				1	2			1	4	1	3

Family	Scientific Name	Common Name	Exotic	Plot 4 Cover	Plot 4 Abundance	Plot 29 Cover	Plot 29 Abundance	Plot 37 Cover	Plot 37 Abundance	Plot 43 Cover	Plot 43 Abundance	Plot 50 Cover	Plot 50 Abundance
Dilleniaceae	*Hibbertia vestita*							1	30				
Dioscoreaceae	*Dioscorea transversa*	Native Yam								1	1	1	4
Fabaceae (Faboideae)	*Desmodium gunnii*	Slender Tick-trefoil				1	50						
Fabaceae (Faboideae)	*Desmodium varians*	Slender Tick-trefoil		1	1			1	3			1	2
Fabaceae (Faboideae)	*Glycine clandestina*	Twining glycine										1	3
Fabaceae (Faboideae)	*Glycine* sp.			1	6	1	2	1	10	1	6		
Fabaceae (Mimosoideae)	*Acacia binervata*	Two-veined Hickory		1	2	1	2						
Fabaceae (Mimosoideae)	*Acacia floribunda*	White Sally		1	2	5	4	1	13	1	4		
Fabaceae (Mimosoideae)	*Acacia irrorata*	Green Wattle		1	1	5	4	1	5	1	1		
Goodeniaceae	*Dampiera sylvestris*							1	11				
Goodeniaceae	*Goodenia rotundifolia*							1	8				
Haloragaceae	*Gonocarpus tetragynus*	Poverty Raspwort						1	1				
Iridaceae	*Patersonia sericea*	Silky Purple-Flag						1	5			1	2
Lauraceae	*Cassytha* sp.					1	10						
Lauraceae	*Cinnamomum camphora*	Camphor Laurel	*	1	3								
Lauraceae	*Cryptocarya microneura*	Murrogun				1	10						
Lindsaeaceae	*Lindsaea microphylla*	Lacy Wedge Fern						1	5				
Lobeliaceae	*Pratia purpurascens*	Whiteroot		1	1					1	4	1	20
Lomandraceae	*Lomandra filiformis*	Wattle Matt-rush						1	2				
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush		1	5	5	200	2	50	1	8	5	100
Luzuriagaceae	*Eustrephus latifolius*	Wombat Berry		1	25	1	3	1	3	1	4	1	7

Family	Scientific Name	Common Name	Exotic	Plot 4 Cover	Plot 4 Abundance	Plot 29 Cover	Plot 29 Abundance	Plot 37 Cover	Plot 37 Abundance	Plot 43 Cover	Plot 43 Abundance	Plot 50 Cover	Plot 50 Abundance
Meliaceae	*Synoum glandulosum* subsp. *glandulosum*	Scentless Rosewood				1	1						
Myrtaceae	*Acmena smithii*	Lilly Pilly								1	2	1	3
Myrtaceae	*Callistemon salignus*	Willow Bottlebrush		1	3	1	5	1	20	1	7	1	6
Myrtaceae	*Corymbia intermedia*	Pink Bloodwood		1	2			1	1	2	4	2	1
Myrtaceae	*Eucalyptus cameronii*	Diehard Stringybark				15	3						
Myrtaceae	*Eucalyptus microcorys*	Tallowwood		10	2	1	1			1	2		
Myrtaceae	*Eucalyptus pilularis*	Blackbutt		30	2	15	2	30	3	30	3	30	3
Myrtaceae	*Eucalyptus resinifera*	Red Mahogany				1	1						
Myrtaceae	*Eucalyptus seeana*	Narrow-leaved Red Gum								1	1		
Myrtaceae	*Leptospermum polygalifolium*	Tantoon		1	10	10	100	2	20			1	1
Myrtaceae	*Leptospermum trinervium*	Slender Tea-tree						1	3				
Myrtaceae	*Lophostemon confertus*	Brush Box						1	4	1	5		
Myrtaceae	*Melaleuca linariifolia*	Flax-leaved Paperbark								2	1		
Myrtaceae	*Melaleuca styphelioides*	Prickly-leaved Tea Tree						1	3				
Myrtaceae	*Sannantha angusta*			1	20	10	100	15	100	10	50	7	42
Myrtaceae	*Syncarpia glomulifera*	Turpentine		20	70			20	100	30	70	30	31
Orchidaceae	*Pterostylis* sp.	Greenhood						1	1	1	2	1	1
Phormiaceae	*Dianella caerulea*	Blue Flax-lily		1	1					1	15		
Phormiaceae	*Dianella revoluta*	Blueberry Lily				1	100						
Phyllanthaceae	*Breynia oblongifolia*	Coffee Bush								1	1	1	1
Pittosporaceae	*Billardiera scandens*	Hairy Apple Berry		1	5	1	4	1	6	1	5		
Poaceae	*Digitaria diffusa*	Open Summer-grass				1	1						

Family	Scientific Name	Common Name	Exotic	Plot 4 Cover	Plot 4 Abundance	Plot 29 Cover	Plot 29 Abundance	Plot 37 Cover	Plot 37 Abundance	Plot 43 Cover	Plot 43 Abundance	Plot 50 Cover	Plot 50 Abundance
Poaceae	*Digitaria parviflora*	Small-flowered Finger Grass								1	3		
Poaceae	*Entolasia marginata*	Bordered Panic				1	50			2	100	3	200
Poaceae	*Entolasia stricta*	Wiry Panic		2	100	5	500	10	1000	10	500	5	100
Poaceae	*imperata cylindrica*	Blady Grass		2	200	1	50	1	20	1	25	2	200
Poaceae	*Oplismenus aemulus*			1	2	1	100						
Poaceae	*Oplismenus imbecillis*							1	50			1	100
Poaceae	*Ottochloa gracillima*									20	200		
Poaceae	*Paspalidium distans*					1	10						
Poaceae	*Themeda australis*	Kangaroo Grass						1	1				
Proteaceae	*Persoonia stradbrokensis*			1	5			1	3	1	1		
Rubiaceae	*Morinda jasminoides*	Sweet Morinda										1	1
Rubiaceae	*Pomax umbellata*	Pomax		1	1			1	5				
Sapindaceae	*Dodonaea triquetra*	Large-leaf Hop-bush								1	5		
Sterculiaceae	*Commersonia fraseri*	Brush Kurrajong								1	1		
Verbenaceae	*Lantana camara*	Lantana	*									1	2
Violaceae	*Hybanthus stellarioides*					1	10			1	10	1	1
Xanthorrhoeaceae	*Xanthorrhoea macronema*											1	6
Xanthorrhoeaceae	*Xanthorrhoea* sp.							1	1				

Notes: Cover – visual estimate of foliage projective cover within the plot, recorded from 1–5% and then to the nearest 5%. Abundance - relative number of individuals or shoots of a species within the plot. Based on the following intervals: 1, 2, 3, 4, 5, 6, 7, 8, 9,10, 20, 50, 100, 500, 1000. Counts above 20 are estimates only.

Appendix Table 9 Norton biobank plant species recorded in vegetation zone 9

Family	Scientific Name	Common Name	Exotic	Plot 3 Cover	Plot 3 Abundance	Plot 20 Cover	Plot 20 Abundance	Plot 23 Cover	Plot 23 Abundance	Plot 24 Cover	Plot 24 Abundance	Plot 26 Cover	Plot 26 Abundance	Plot 40 Cover	Plot 40 Abundance
Acanthaceae	*Pseuderanthemum variabile*	Pastel Flower		1	20	1	20	1	20	1	100	1	2	1	4
Araliaceae	*Polyscias sambucifolia*	Elderberry Panax				1	4	1	6						
Asteraceae	*Vernonia cinerea*					1	3								
Bignoniaceae	*Pandorea pandorana*	Wonga Wonga Vine				1	1			1	2				
Casuarinaceae	*Allocasuarina littoralis*	Black She-Oak		20	70	1	3			4	18			20	400
Casuarinaceae	*Allocasuarina torulosa*	Forest Oak				2	8	3	20			1	1		
Convolvulaceae	*Polymeria calycina*					1	10			1	100			1	50
Cyperaceae	*Carex maculata*					1	1								
Cyperaceae	*Lepidosperma laterale*	Variable Sword-sedge		1	50	1	100	2	100	2	50	3	100	2	100
Dilleniaceae	*Hibbertia aspera*	Rough Guinea Flower		1	3	1	20	1	1	1	1			1	2
Dilleniaceae	*Hibbertia diffusa*	Wedge Guinea Flower						1	20						
Fabaceae (Faboideae)	*Desmodium gunnii*	Slender Tick-trefoil						1	3			1	1		
Fabaceae (Faboideae)	*Desmodium varians*	Slender Tick-trefoil						1	6			1	20		
Fabaceae (Faboideae)	*Glycine clandestina*	Twining glycine				1	5	1	6	1	1	1	50	1	2
Fabaceae (Faboideae)	*glycine cyrtoloba*											1	5		
Fabaceae (Faboideae)	*Hardenbergia violacea*	False Sarsaparilla				1	1								

Family	Scientific Name	Common Name	Exotic	Plot 3 Cover	Plot 3 Abundance	Plot 20 Cover	Plot 20 Abundance	Plot 23 Cover	Plot 23 Abundance	Plot 24 Cover	Plot 24 Abundance	Plot 26 Cover	Plot 26 Abundance	Plot 40 Cover	Plot 40 Abundance
Fabaceae (Faboideae)	*Jacksonia scoparia*	Dogwood						1	3						
Fabaceae (Faboideae)	*Pultenaea retusa*			1	1			1	2						
Fabaceae (Faboideae)	*Pultenaea villosa*	Hairy Bush-pea						1	1						
Fabaceae (Mimosoideae)	*Acacia concurrens*	Curracabah		1	1	1	6	3	13	1	15	2	10	1	11
Fabaceae (Mimosoideae)	*Acacia floribunda*	White Sally		1	3							1	4		
Goodeniaceae	*Goodenia ovata*	Hop Goodenia		1	2					1	3				
Goodeniaceae	*Goodenia rotundifolia*					1	2								
Haloragaceae	*Gonocarpus* sp.	Raspwort				1	1								
Haloragaceae	*Gonocarpus tetragynus*	Poverty Raspwort								1	1				
Lauraceae	*Cassytha* sp.									1	10				
Lauraceae	*Cinnamomum camphora*	Camphor Laurel	*					1	1			1	1		
Lindsaeaceae	*Lindsaea microphylla*	Lacy Wedge Fern				1	10								
Lobeliaceae	*Pratia purpurascens*	Whiteroot								1	1			1	1
Lomandraceae	*Lomandra filiformis*	Wattle Matt-rush				1	5			1	5	1	20	1	12
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush		1	3	2	100	5	100	30	400	5	200	1	1
Lomandraceae	*Lomandra multiflora subsp. multiflora*	Many-flowered Mat-rush		1	2	1	20			1	1				
Lomandracea	*Lomandra* sp.	Mat-rush						1	20						

Family	Scientific Name	Common Name	Exotic	Plot 3 Cover	Plot 3 Abundance	Plot 20 Cover	Plot 20 Abundance	Plot 23 Cover	Plot 23 Abundance	Plot 24 Cover	Plot 24 Abundance	Plot 26 Cover	Plot 26 Abundance	Plot 40 Cover	Plot 40 Abundance
e															
Luzuriagaceae	*Eustrephus latifolius*	Wombat Berry				1	6	1	5			1	30		
Myrtaceae	*Callistemon salignus*	Willow Bottlebrush		1	1					1	6				
Myrtaceae	*Corymbia gummifera*	Red Bloodwood								10	4			2	3
Myrtaceae	*Corymbia intermedia*	Pink Bloodwood				3	2	1	3			2	1		
Myrtaceae	*Corymbia variegata*			10	3									3	1
Myrtaceae	*Eucalyptus cameronii*	Diehard Stringybark				4	2	2	1	5	3	5	3	1	1
Myrtaceae	*Eucalyptus carnea*	Thick-leaved Mahogany		1	2	4	2	10	4						
Myrtaceae	*Eucalyptus globoidea*	White Stringybark				2	1					10	2		
Myrtaceae	*Eucalyptus microcorys*	Tallowwood				10	2	10	1	1	1				
Myrtaceae	*Eucalyptus pilularis*	Blackbutt										2	1		
Myrtaceae	*Eucalyptus propinqua*	Small-fruited Grey Gum										20	4		
Myrtaceae	*Eucalyptus seeana*	Narrow-leaved Red Gum		5	4									6	4
Myrtaceae	*Eucalyptus siderophloia*	Grey Ironbark		3	5	7	2	5	3	10	2			3	2
Myrtaceae	*Leptospermum polygalifolium*	Tantoon				2	7								
Myrtaceae	*Lophostemon confertus*	Brush Box				5	20			3	8			1	7
Myrtaceae	*Melaleuca sieberi*			2	16										
Myrtaceae	*Melaleuca styphelioides*	Prickly-leaved Tea								1	2				

Family	Scientific Name	Common Name	Exotic	Plot 3 Cover	Plot 3 Abundance	Plot 20 Cover	Plot 20 Abundance	Plot 23 Cover	Plot 23 Abundance	Plot 24 Cover	Plot 24 Abundance	Plot 26 Cover	Plot 26 Abundance	Plot 40 Cover	Plot 40 Abundance
		Tree													
Myrtaceae	*Sannantha angusta*			1	7	1	8			2	23	1	3	1	5
Myrtaceae	*Syncarpia glomulifera*	Turpentine						2	8						
Oleaceae	*Notelaea ovata*											1	3	1	1
Oxalidaceae	*Oxalis* sp.					1	5			1	1				
Phormiaceae	*Dianella caerulea*	Blue Flax-lily		1	1	1	50			1	50	1	10	1	5
Phyllanthaceae	*Breynia oblongifolia*	Coffee Bush								1	7	1	5		
Phyllanthaceae	*Glochidion ferdinandi*	Cheese Tree										1	2		
Pittosporaceae	*Billardiera scandens*	Hairy Apple Berry				1	2	1	3			1	1		
Poaceae	*Aristida vagans*	Threeawn Speargrass										1	5		
Poaceae	*Cymbopogon refractus*	Barbed Wire Grass				1	3					1	6		
Poaceae	*Digitaria diffusa*	Open Summer-grass						1	20					1	4
Poaceae	*Digitaria parviflora*	Small-flowered Finger Grass		1	5										
Poaceae	*Entolasia marginata*	Bordered Panic				1	100								
Poaceae	*Entolasia stricta*	Wiry Panic		50	1000	10	1000	10	1000	20	1000	30	1000	60	1000
Poaceae	*Eragrostis leptostachya*	Paddock Lovegrass						1	3			1	5		
Poaceae	*imperata cylindrica*	Blady Grass				1	100	1	100	1	20	20	1000		
Poaceae	*Ischaemum australe*			1	2										

Family	Scientific Name	Common Name	Exotic	Plot 3 Cover	Plot 3 Abundance	Plot 20 Cover	Plot 20 Abundance	Plot 23 Cover	Plot 23 Abundance	Plot 24 Cover	Plot 24 Abundance	Plot 26 Cover	Plot 26 Abundance	Plot 40 Cover	Plot 40 Abundance
Poaceae	*Microlaena stipoides*	Weeping Grass		1	5										
Poaceae	*Panicum simile*	Two-colour Panic		1	1	1	10	1	5					1	1
Poaceae	*Paspalum mandiocanum*	Broadleaf Paspalum	*									1	50		
Poaceae	*Setaria sphacelata*	South African Pigeon Grass	*									1	3		
Poaceae	*Themeda australis*	Kangaroo Grass		1	1							1	1		
Proteaceae	*Lomatia silaifolia*	Crinkle Bush						1	10						
Proteaceae	*Persoonia stradbrokensis*							1	1	1	1	1	1		
Rubiaceae	*Pomax umbellata*	Pomax						1	30						
Sapindaceae	*Dodonaea triquetra*	Large-leaf Hop-bush								1	8				
Thymelaeaceae	*Pimelea linifolia*	Slender Rice Flower										1	2		
Verbenaceae	*Lantana camara*	Lantana	*									1	6		
Violaceae	*Hybanthus stellarioides*													1	1
Xanthorrhoeaceae	*Xanthorrhoea macronema*							2	30						

Notes: Cover – visual estimate of foliage projective cover within the plot, recorded from 1–5% and then to the nearest 5%. Abundance - relative number of individuals or shoots of a species within the plot. Based on the following intervals: 1, 2, 3, 4, 5, 6, 7, 8, 9,10, 20, 50, 100, 500, 1000. Counts above 20 are estimates only.

Appendix Table 10 Norton biobank plant species recorded in vegetation zone 10

Family	Scientific Name	Common Name	Exotic	Plot 5 Cover	Plot 5 Abundance	Plot 6 Cover	Plot 6 Abundance	Plot 16 Cover	Plot 16 Abundance	Plot 19 Cover	Plot 19 Abundance	Plot 35 Cover	Plot 35 Abundance	Plot 51 Cover	Plot 51 Abundance
Acanthaceae	*Pseuderanthemum variabile*	Pastel Flower		1	30	1	5	1	2	1	4	1	30	1	20
Apocynaceae	*Parsonsia straminea*	Common Silkpod		1	4										
Araliaceae	*Polyscias sambucifolia*	Elderberry Panax		1	1	1	1	1	1						
Asteraceae	*Ozothamnus diosmifolius*	White Dogwood		1	2										
Asteraceae	*Vernonia cinerea*			1	1										
Casuarinaceae	*Allocasuarina littoralis*	Black She-Oak						20	70	20	50	15	25	3	35
Casuarinaceae	*Allocasuarina torulosa*	Forest Oak		10	20										
Convolvulaceae	*Polymeria calycina*									1	2			1	3
Cyperaceae	*Lepidosperma laterale*	Variable Sword-sedge		1	30	2	400	1	5	1	50	5	200	1	10
Cyperaceae	*Ptilothrix deusta*									2	100				
Dennstaedtiaceae	*Pteridium esculentum*	Bracken		1	2	1	20			1	1			30	1000
Dicksoniaceae	*Calochlaena dubia*	Rainbow Fern						1	10						
Dilleniaceae	*Hibbertia aspera*	Rough Guinea Flower		1	10			2	100	1	50	1	7	1	2
Dilleniaceae	*Hibbertia diffusa*	Wedge Guinea Flower				1	8								
Dilleniaceae	*Hibbertia scandens*	Climbing Guinea Flower												1	1
Dilleniaceae	*Hibbertia vestita*					1	20	1	50	1	1			1	6

Family	Scientific Name	Common Name	Exotic	Plot 5 Cover	Plot 5 Abundance	Plot 6 Cover	Plot 6 Abundance	Plot 16 Cover	Plot 16 Abundance	Plot 19 Cover	Plot 19 Abundance	Plot 35 Cover	Plot 35 Abundance	Plot 51 Cover	Plot 51 Abundance
Ericaceae	*Monotoca scoparia*							1	5						
Fabaceae (Faboideae)	*Daviesia genistifolia*	Broom Bitter Pea								1	1				
Fabaceae (Faboideae)	*Desmodium varians*	Slender Tick-trefoil				1	1					1	1		
Fabaceae (Faboideae)	*Glycine clandestina*	Twining glycine								1	1				
Fabaceae (Faboideae)	*Glycine* sp.					1	1	1	1						
Fabaceae (Faboideae)	*Gompholobium pinnatum*	Pinnate Wedge Pea						1	2	1	8	1	1		
Fabaceae (Faboideae)	*Hardenbergia violacea*	False Sarsaparilla		1	3					1	1				
Fabaceae (Faboideae)	*Pultenaea myrtoides*			1	1			1	3			1	1	1	1
Fabaceae (Faboideae)	*Pultenaea retusa*			1	3	1	2			1	8			1	1
Fabaceae (Mimosoideae)	*Acacia binervata*	Two-veined Hickory				5	20	1	7	1	4			2	21
Fabaceae (Mimosoideae)	*Acacia concurrens*	Curracabah		5	8							1	1		
Fabaceae (Mimosoideae)	*Acacia floribunda*	White Sally		2	5	1	2	1	1			1	2		
Fabaceae (Mimosoideae)	*Acacia irrorata*	Green Wattle										1	2		
Goodeniaceae	*Dampiera sylvestris*											1	1	1	100
Goodeniaceae	*Goodenia ovata*	Hop Goodenia								1	1				
Goodeniaceae	*Goodenia rotundifolia*											1	4		
Iridaceae	*Patersonia sericea*	Silky Purple-Flag						1	10	1	2				
Lauraceae	*Cassytha sp.*			1	4					1	7				

Family	Scientific Name	Common Name	Exotic	Plot 5 Cover	Plot 5 Abundance	Plot 6 Cover	Plot 6 Abundance	Plot 16 Cover	Plot 16 Abundance	Plot 19 Cover	Plot 19 Abundance	Plot 35 Cover	Plot 35 Abundance	Plot 51 Cover	Plot 51 Abundance
Lauraceae	*Cinnamomum camphora*	Camphor Laurel	*	1	1			1	2			1	1		
Lindsaeaceae	*Lindsaea microphylla*	Lacy Wedge Fern		1	5							1	50		
Lobeliaceae	*Pratia purpurascens*	Whiteroot		1	10			1	3			1	3	1	5
Lomandraceae	*Lomandra filiformis*	Wattle Matt-rush		1	2									1	1
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush		1	1	1	1	1	2			2	50	1	6
Lomandraceae	*Lomandra multiflora* subsp. *multiflora*	Many-flowered Mat-rush		1	2	1	1			1	6	1	5		
Myrtaceae	*Callistemon salignus*	Willow Bottlebrush				1	2			1	2	1	5		
Myrtaceae	*Corymbia gummifera*	Red Bloodwood		10	13	1	3	4	6	8	11	2	2	2	4
Myrtaceae	*Eucalyptus cameronii*	Diehard Stringybark		10	7	5	2			3	8	25	4	2	2
Myrtaceae	*Eucalyptus microcorys*	Tallowwood				3	2	2	1	1	1			1	1
Myrtaceae	*Eucalyptus pilularis*	Blackbutt		15	2	3	1	4	2					7	1
Myrtaceae	*Eucalyptus siderophloia*	Grey Ironbark										2	1		
Myrtaceae	*Eucalyptus signata*	Scribbly Gum				20	4	10	9	10	5	15	3	25	3
Myrtaceae	*Leptospermum polygalifolium*	Tantoon				1	10	1	14	1	1			1	8
Myrtaceae	*Leptospermum trinervium*	Slender Tea-tree				1	3								
Myrtaceae	*Melaleuca sieberi*									1	2				
Myrtaceae	*Melaleuca styphelioides*	Prickly-leaved Tea										1	2		

Family	Scientific Name	Common Name	Exotic	Plot 5 Cover	Plot 5 Abundance	Plot 6 Cover	Plot 6 Abundance	Plot 16 Cover	Plot 16 Abundance	Plot 19 Cover	Plot 19 Abundance	Plot 35 Cover	Plot 35 Abundance	Plot 51 Cover	Plot 51 Abundance
		Tree													
Myrtaceae	*Sannantha angusta*			1	1			1	2			15	100	1	1
Myrtaceae	*Syncarpia glomulifera*	Turpentine				20	50	2	5	2	9			2	9
Oleaceae	*Notelaea ovata*							1	1	1	3	1	1	1	2
Orchidaceae	*Cryptostylis* sp.					1	9								
Orchidaceae	*Dipodium* sp.													1	1
Orchidaceae	*Pterostylis* sp.	Greenhood						1	1			1	1	1	1
Phormiaceae	*Dianella caerulea*	Blue Flax-lily		1	20			1	3	1	30	1	20	1	50
Phormiaceae	*Dianella revoluta*	Blueberry Lily				1	2								
Phyllanthaceae	*Breynia oblongifolia*	Coffee Bush												1	4
Pittosporaceae	*Billardiera scandens*	Hairy Apple Berry		1	6	1	5	1	3			1	1	1	3
Pittosporaceae	*Pittosporum revolutum*	Rough Fruit Pittosporum										1	2		
Poaceae	*Andropogon virginicus*	Whisky Grass	*	1	1										
Poaceae	*Cymbopogon refractus*	Barbed Wire Grass		1	1										
Poaceae	*Digitaria diffusa*	Open Summer-grass				1	1			1	1				
Poaceae	*Entolasia marginata*	Bordered Panic		1	2										
Poaceae	*Entolasia stricta*	Wiry Panic		20	1000	1	400	50	1000	80	1000	30	1000	2	100
Poaceae	*Eragrostis* sp.	A Lovegrass	*							1	5				
Poaceae	*imperata cylindrica*	Blady Grass		2	100	1	10	5	100	1	50			30	1000
Poaceae	*Themeda*	Kangaroo		1	2			1	1	1	1			1	2

Family	Scientific Name	Common Name	Exotic	Plot 5 Cover	Plot 5 Abundance	Plot 6 Cover	Plot 6 Abundance	Plot 16 Cover	Plot 16 Abundance	Plot 19 Cover	Plot 19 Abundance	Plot 35 Cover	Plot 35 Abundance	Plot 51 Cover	Plot 51 Abundance
	australis	Grass													
Proteaceae	*Lomatia silaifolia*	Crinkle Bush				1	4							1	2
Proteaceae	*Persoonia stradbrokensis*					1	3	1	80	1	3	1	4	1	5
Rubiaceae	*Pomax umbellata*	Pomax												1	1
Schizaeaceae	*Schizaea bifida*	Forked Comb Fern						1	6						
Thymelaeaceae	*Pimelea linifolia*	Slender Rice Flower		1	2					1	1				
Violaceae	*Hybanthus stellarioides*			1	2										
Xanthorrhoeaceae	*Xanthorrhoea* sp.			1	1			1	2	2	25			1	3

Notes: Cover – visual estimate of foliage projective cover within the plot, recorded from 1–5% and then to the nearest 5%. Abundance - relative number of individuals or shoots of a species within the plot. Based on the following intervals: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 20, 50, 100, 500, 1000. Counts above 20 are estimates only.

GHD

133 Castlereagh St Sydney NSW 2000

T: +61 2 9239 7100 F: +61 2 9239 7199 E: sydmail@ghd.com.au

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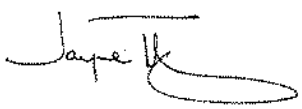
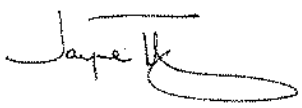
Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
A	B Harrington J Sharp	Jayne Tipping		Jayne Tipping		3/5/16
B	B Harrington J Sharp	Jayne Tipping		Jayne Tipping		1/8/16

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BioBanking
Biodiversity Banking and Offsets Scheme

Instructions for completing the template for management actions

This template for management actions should be filled in by the landowner and submitted to OEH with an application to establish a biobank site. These standard words and format must be used for the management actions (refer to the *Guide to establishing a biobank site* for guidance).

OEH will review the management actions and plans and make any necessary amendments after consultation with the landowner. These management actions will be incorporated into the biobanking agreement as Annexure C.

There are four sections to this template:

1. standard management actions – mandatory
2. additional management actions – only if indicated by the assessment
3. standard management plans (weeds and fire for conservation) – mandatory
4. additional management plans (feral and overabundant herbivores and vertebrate pests) – only if indicated by the assessment.

An additional short section is also included in this template that requires the details of photo points for monitoring purposes. This information will be incorporated into the agreement as Annexure D.

Green boxes like this one provide instructions and examples and will be deleted by OEH before the biobanking agreement is processed.

Yellow highlighted fields need to be customised by the landowner. Usually the landowner needs to provide the information required; sometimes the landowner will need to delete or retain provided options. It is important to ensure that, especially where fields are customised, that the management actions are certain, clear and specific so that it is clear what the requirements of the actions are.

The format and wording of standard and additional management actions must not be changed. Enter site specific information into the yellow highlighted fields as required.

Management actions are divided into passive and active actions. Passive actions have little or no cost and include refraining from doing something, such as not removing fallen logs or bush rock. Passive management actions must be commenced as soon as the biobanking agreement is signed.

If a management action is active, you have to undertake specific activities to improve the site's biodiversity. Active management actions only need to be commenced when 80% of the Total Fund Deposit is met (ie from 'first payment date').

In the table below, the timing column indicates:

- passive actions by the term 'Ongoing from commencement date'
- active actions by a reference to 'Ongoing from first payment date'.

Managing grazing for conservation can be passive or active depending on the biobank site. For example, managing grazing for conservation is a passive management action if the biobank site is already suitably fenced, and it is an active management action if the biobank site needs to be fenced. Both options appear in the timing column and are highlighted yellow. Delete whichever option is not applicable.

Section 1: Standard management actions

Standard management actions		
Item 1	**Management of grazing for conservation**	**Timing**
1.1	Stock must not be permitted to graze in any area of the biobank site.	Ongoing from commencement date.
	If no grazing is to be allowed, replace the above item with: 'Stock must not be permitted to graze in any area of the biobank site.' Then delete the words in item 1.2 and 1.3 (but keep the numbering) and replace with: 'This item is not applicable'. The wording in the adjacent Timing column can also be deleted.	
1.2	This item is not applicable.	
	Insert any requirements specific to the site to accommodate local conditions and allow for flexibility in a framework of reasonable certainty. Delete 'Specific requirements:' if it is not relevant. The landowner can prevent stock from grazing or require stock to graze in specific areas by erecting and maintaining stockproof fencing. Fencing may be permanent or temporary (including electric fences). Indicate the specific type and length of fence to be erected and by when. Soil disturbance may be required (and is permitted) to encourage regeneration of native vegetation in conjunction with management of grazing for conservation.	
1.3	This item is not applicable.	
1.4	If, at any time, the landowner observes stock in any area of the biobank site, other than an area on the biobank site where grazing is permitted, the landowner must take necessary measures to remove the stock from the area immediately.	Ongoing from commencement date.
Item 2	**Weed control**	**Timing**
2.1	The landowner must implement and, at all relevant times, comply	Ongoing from first

	with, the integrated weed management plan included in Section 3 ('**the weed management plan'**) (or such updated integrated weed management plan as has been approved by the Director General under item 2.2 below). To allow for adaptive management, minor alterations can be made to the implementation of the weed management plan. Any alterations must be recorded in writing in accordance with Section 3 of this Annexure.	payment date.
2.2	The weed management plan must be reviewed at intervals of no less than 4 years and no more than 6 years by an appropriately qualified person. The review is to consider the efficacy of the management actions in the plan and consider the effectiveness of the matters contained in the current plan that are outlined in the dot points below. Notification of the date of the review commencement must be provided to the Director General in writing within 14 days of the commencement of the review. The findings of the review must be submitted to the Director General within 3 months of commencing the review. Where the Director General determines from the review that an update of the plan is required, the Director General will notify the landowner in writing that an update of the plan is required. The landowner must update the plan and submit it to the Director General for approval within 3 months of receiving written notification from the Director General that an update of the plan is required. The revised plan must be prepared by an appropriately qualified person and must cover the matters outlined below and any additional matters specified by the Director General in writing: • a description of the target weed/s at the biobank site and their location/s, linked to each management zone where weeds are present • the method/s of weed control in each zone • the frequency of weed control activities at the site, taking into account management practices where weeds are providing habitat for native species • the timing of any planting of native plant species required in each management zone to provide alternative habitat for native species affected by weed control activities • methods for monitoring the success of weed control activities • a timetable/measures for inspections to identify new weed species or exotic plant species (including noxious weeds under the *Noxious Weeds Act 1993*) • additional weed control activities to destroy or remove any new weed species that are found on the site • measures for assessing and reporting monitoring results • a diary for recording actions taken in accordance with the weed management plan and minor alterations to this plan permitted for adaptive management. The details (management zone/s, date, alternative action) and reasons for the minor alterations must be recorded in the diary.	Ongoing from first payment date.

Item 3	Management of fire for conservation	Timing
3.1	The landowner must implement, and at all relevant times, comply with the fire management plan included in Section 3 (or such updated fire management plan as has been approved by the Director General under item 3.2 below) ('**the fire management plan")**. To allow for adaptive management and weather conditions, minor alterations can be made to the implementation of the fire management plan, and must be recorded in writing in accordance with Section 3 of this Annexure.	Ongoing from commencement date.
3.2	The fire management plan must be reviewed at intervals of no less than 4 years and no more than 6 years by an appropriately qualified person. The review is to consider the efficacy of the management actions in the plan and consider the effectiveness of the matters contained in the current plan that are outlined in the dot points below. Notification of the date of the review commencement must be provided to the Director General in writing within 14 days of the commencement of the review. The findings of the review must be submitted to the Director General within 3 months of commencing the review. Where the Director General determines from the review that an update of the fire management plan is required, the Director General will notify the landowner in writing that an update of the plan is required. The landowner must update the plan and submit it to the Director General for approval within 3 months of receiving written notification from the Director General that an update of the plan is required. The revised plan must be prepared by an appropriately qualified person and cover the matters outlined below and any additional matters specified by the Director General in writing:) the year the last fire went through, the type of fire and the extent of the fire and location, where known) frequency of natural fires in the area of the biobank site, where known) a description of locations and management zones where ecological burns will be conducted and areas that will not be burnt) the methods that will be used for ecological burns) the fire frequency intervals recommended for the vegetation types and threatened species present, including any required adjustment to the schedule in the event of a wildfire or activities undertaken under the *Rural Fires Act 1997* to ensure minimum frequency between ecological burns) the fire intensity for the recommended vegetation types) the time of year suitable for ecological burns) the diary for recording actions taken in accordance with the fire management plan and minor alterations to fire management plan permitted for adaptive management. The details (management zone/s, date, alternative action) and reasons for the minor alterations must be recorded in the diary.	Ongoing from first payment date.
3.3	Fires must not be lit on the biobank site other than for the purpose of ecological burning in accordance with the fire management plan or as permitted as a permissible human activity on the biobank site under item 4 of this Annexure or	Ongoing from commencement date.

	clause 3.6 of this agreement.	
Item 4	**Management of human disturbance**	**Timing**
4.1	Except as permitted under clause 3 of this agreement or item 4.2 (below), human activities that adversely affect biodiversity values on the biobank site, including repeated disturbance of native animals, must not be carried out, or caused or permitted to be carried out, on the biobank site.	Ongoing from commencement date.
4.2	Human activities that may have a negative impact on biodiversity values on the biobank site are permitted if they are listed as permissible activities under clause 3.6 of this agreement or if they are undertaken as part of the management actions or management plans.	Ongoing from commencement date.
4.3	All waste shown on the map entitled Property Action Plan dated 01/06/2016 must be removed from the biobank site in an appropriate manner. Miscellaneous rubbish scattered along the length of the access track from Kemps Road to the proposed house lot to be collected. The northern end of the property also includes an old farm pigsty that would be demolished with materials removed from the site. A funding allocation is included in the TFD accordingly. The site includes pile of sleepers (old bridging material) are located along the access track from Kemps Road to the proposed dwelling location. It is proposed to leave these in situ for their habitat value and/or move to other locations in the biobank site as woody debris. A funding allocation for moving woody debris has been included in the TFD. If there is no waste on the biobank site delete the words of this item (but retain the numbering) and replace with: 'This item is not applicable.'	Commencing from first payment date.
4.4	The landowner must not store, dispose of, or cause or permit to be disposed of, any waste on the biobank site. Note: The storage or disposal of waste on the biobank site may require an approval under the *Protection of the Environment Operations Act* 1997.	Ongoing from commencement date.
4.5	The landowner must take all reasonable steps to remove waste deposited by others on the biobank site, or which is otherwise present on the biobank site.	Ongoing from first payment date.
4.6	Fencing and/or signage must be installed and maintained to deter human disturbance including waste dumping. Signage must be the BioBanking signs available from the OEH. **Specific requirements:** The site is bordered by a railway line to the north and east, the Pacific Highway to the west with the southern boundary generally associated with Kemps Road. It has access points via the large service station and from the south from Kemps Road. **Existing Fencing** An existing fence in good condition runs along the entirety of the western border associated with the boundary of the Pacific	Ongoing from first payment date.

	Highway. A new fence has been installed associated with the boundary between the biobank site and the quarry. There is also an existing fence along the southern boundary of the site and associated with the boundary with the quarry and service centre. There is no threat from stock access associated with the northern and eastern boundaries due to the presence of the rail line and large tracts of vegetated lands to the east. **Existing Fence – removal of strands** Existing fencing is shown on the Property Action Plan (dated 01/06/2016) These fences will have wire and star posts removed with timber posts left in situ. Should additional internal fencing be located throughout the site, these would also have wire and star posts removed by the implementing contractor. **New Fence** A new fence would be installed around the perimeter of the proposed 'house lot and home paddocks' in the south of the site with two new gates to provide access to track running north into the biobank (as shown on the Property Action Plan dated 01/06/2016) This would be a simple plain wire and star post fence to delineate the biobank site boundary. The location of gates and the OEH biobank signage is also shown on the Property Action Plan.	
	Signage should be located at points of access and other practical locations interfacing with adjoining properties. For biobank sites that are located fully within a larger private landholding, there should be at least one BioBanking sign to be placed at the main access gate to the site. It is recommended that required signage be installed within 3 months of first payment date.	

Item 5	**Retention of regrowth and remnant native vegetation** Note: An approval under the *Native Vegetation Act 2003* may be required to carry out thinning or any other removal or damage to native vegetation under this item.	**Timing**
5.1	Native vegetation (whether remnant native vegetation or regrowth) on the biobank site must not be cut down, felled, thinned, logged, killed, destroyed, poisoned, ringbarked, uprooted, burnt or otherwise removed, except in accordance with item 5.2 below, or if it is required as part of the management actions or it is essential for the carrying out of permissible development under clause 3.5 of this agreement. Note: Native vegetation on the biobank site may be managed to improve biodiversity values by thinning to benchmark stem densities over no more than 80% of each management zone. Benchmark stem densities has the same meaning as defined in the Vegetation Benchmark Database as published by OEH and updated from time to time. An approval under the *Native Vegetation Act 2003* may be required to carry out thinning or any other removal or damage to native vegetation under this item.	Ongoing from commencement date.
5.2	Native vegetation on the biobank site must not be burnt except in accordance with the fire management plan prepared pursuant to item 3 above.	Ongoing from commencement date.
Item 6	**Replanting or supplementary planting where natural regeneration will not be sufficient**	**Timing**
6.1	The landowner must undertake planting or seeding of the native groundcover/shrub/tree species indicated in the planting schedule for the biobank site as set out in item 6.6 below (**'the planting schedule**') in the areas of planting and within the timeframe indicated in the planting schedule. If the landowner cannot complete the planting within the timeframe indicated in the planting schedule due to local weather conditions, the landowner must complete the planting as soon as possible after that date and must make a record of and retain the reasons why the planting was not completed by the required time. Appropriate site treatment (e.g. weed control) of each area of planting or seeding identified in the planting schedule must be undertaken prior to such planting. Specific requirements: It is proposed to include hand broadcasting of native canopy and *Acacia* species within MZ5 after treatment of introduced grasses to supplement natural regeneration in this location. Hand broadcasting of native seed is proposed in MZ5 which has been identified as Spotted Gum – Grey Ironbark – Pink Bloodwood open forest (NR228) in low condition. The weed control and bush regeneration is to be programmed independently of the broadcasting activities. Targeted weed control activities will occur in Spring and Summer whereas hand broadcasting would occur in Autumn in years 2 and 3. It is anticipated introduced grasses will be 'shaded out' through time as stock is excluded and native plants establish and increase competition for light and nutrients. In addition, these areas have	Commencing from first payment date.

	some existing natural resilience and it is anticipated natural regeneration of native species will supplement the broadcasting of native seed program. Should these activities not achieve the restoration outcomes anticipated within 7 years however, discussion should occur with OEH to discuss potential alternative strategies. A contingency for supplementary planting has been included in the TFD. The long term control of introduced grasses in these areas will be included in the overall weed control and maintenance programs.	
	Include details regarding site treatment that must be undertaken before planting each area under the 'Specific requirements'. Planting or seeding is only required where natural regeneration is not sufficient to bring back native vegetation. Where no replanting is required, delete the words in every point of this item (but retain the numbering) and replace with: 'This item is not applicable.'	
6.2	As stated in Clause 1.1 stock must not be permitted to graze in any area of the biobank site.	Ongoing from the completion of planting in each area of replanting.
	If required, different years or heights for specific types of plants can be listed under 'Specific requirements'.	
6.3	The landowner must survey each area of planting or seeding established under item 6.1 above and document them to determine whether the planted plants or seeds have established and survived, and retain the findings in accordance with the record keeping requirements. If, after the first survey or subsequent surveys, the establishment and survival rate of plants in an area of planting or seeding are below those usual for the species and region, the landowner must supplement the planting in the adversely affected areas within a reasonable timeframe (usually within 12 months, though this can be varied and recorded in a diary with reasons for variation, if the weather is unsatisfactory for the establishment and survival of plants or seeds).	Conduct the first survey 24 months after the completion of planting or seeding in each area of planting or seeding, and then every 12 months thereafter.
6.4	Areas of planting and seeding must be managed as required to assist the establishment and survival of native plant species. Management includes watering, slashing, scalping, spraying of weeds, plant replacement and strategic grazing by stock (in accordance with item 6.2 above) at strategic times of the year to control weeds to improve biodiversity values. The dates of planting must be recorded in accordance with the record keeping requirements set out in Annexure D.	As required, from the date that planting or seeding areas are established.
6.5	Seeds and plants used for planting and seeding must be obtained from locally collected provenances, unless there are reasons to do otherwise (e.g. to ensure genetic variability or for adaptation to climate change).	As required (from commencement date if relevant to prepare for future planting).

The planting schedule should be filled in including:

- **number of plants per area** – for tubestock, the number of plants should be rounded to the nearest 100 if there are more than 1,000 plants or to the nearest 10 if there are 1,000 plants or less; if direct seeding is used leave this field blank
- **planting method** – specify whether plants are to be tubestock, direct seeding or another method
- **timing** – describe as the number of months (or Year if relevant (ie Year 1, Year 2, etc)) for completion of planting from the first payment date.

6.6 Planting schedule at the biobank site

Species' common name	**Species' scientific name**	**Management zone/s of planting**	**Number of plants per area**	**Planting method**	**Timing** (months or Year)
Spotted Gum	*Corymbia variegata*	MZ5		Broadcasting seed	March-May, year 2 and March-May year 3.
Black She-Oak	*Allocasuarina littoralis*	MZ5		Broadcasting seed	March-May, year 2 and March-May year 3
Forest Oak	*Allocasuarina torulosa*	MZ5		Broadcasting seed	March-May, year 2 and March-May year 3
Small-fruited Grey Gum	*Eucalyptus propinqua*	MZ5		Broadcasting seed	March-May, year 2 and March-May year 3
Pink Bloodwood	*Corymbia intermedia*	MZ5		Broadcasting seed	March-May, year 2 and March-May year 3

Diehard Stringybark	*Eucalyptus cameronii*	MZ5		Broadcasting seed	March-May, year 2 and March-May year 3
Tallowwood	*Eucalyptus microcorys*	MZ5		Broadcasting seed	March-May, year 2 and March-May year 3
White Sally	*Acacia floribunda*	MZ5		Broadcasting seed	March-May, year 2 and March-May year 3
Curracabah	*Acacia concurrens*	MZ5		Broadcasting seed	March-May, year 2 and March-May year 3

Item 7	Retention of dead timber	Timing
7.1	Dead timber (whether standing or fallen and including branches and leaf litter) must not be removed from or moved within the biobank site except for the personal (non-commercial) use by the landowner for firewood for one dwelling only or for repair of fencing (not for construction of fencing). Dead timber used for fencing repair must be documented by the landowner in writing and records must be kept in accordance with the record keeping requirements. The landowner must record the approximate amount of dead timber collected from the biobank site for use in fencing, the location that that dead timber was collected from and the date it was collected (month, year). Specific requirements: There are piles of logs and 'off cuts' associated with previous logging activities located along the main track to the proposed housing lot off Kemps Road. These would be 'scattered' in the neighbouring areas of the biobank site to provide additional habitat resources for native fauna.	Ongoing from commencement date.
7.2	Timber from outside the biobank site may be introduced to and placed on the biobank site to improve biodiversity values. Once the timber has been brought onto the site, it is subject to the requirements of item 7.1 above. Timber brought from outside the biobank site must be documented by the landowner in writing and records must be kept in accordance with the record keeping requirements. The landowner must record the approximate amount of timber brought from outside the biobank site, the location where the timber was placed on the biobank site and the date on which it was placed (month, year). Specific requirements: x	When required but not required before the first payment date.
Item 8	**Erosion control**	**Timing**
8.1	All reasonable steps must be undertaken to prevent, control and remedy erosion on the biobank site. Soil management for preventing and controlling erosion is to be undertaken using best practice management, such as that developed by the Soil Conservation Service, applied as relevant for the biobank site. The landowner must manage existing erosion on the biobank site, identified on the map entitled Property Action Plan dated 01/06/2016 by conducting: • Stock exclusion • Revegetation activities – broadcasting native seed • Weed control • Monitoring	Commencing from first payment date.

	Of note is the eroding 'S' bend in Boat Harbour Creek in the northern portion of the site. Vegetation in this location is in low condition. It is recommended this site is monitored for the first 5~~3~~ years and if the location remains unstable after this time active erosion control measures be undertaken. Actions that may need to be considered include: • Small machine (Bobcat recommended) to reshape soil surface • Appropriate topsoil medium applied • Erosion control matting (e.g. 'jute matting') • Placement of logs or other debris • Revegetation (hand plantings and broadcasting native seed) • Plant maintenance Resources have been included in the TFD accordingly. Access tracks shown on the Property Action Plan dated 01/06/2016 will also be maintained and/or established in a manner which considers drainage and erosion control. Access track establishment and maintenance would be limited to periodic slashing and minor earthworks associated with crossing of minor drainage lines.	
	If there is no existing erosion, delete the last paragraph.	

Item 9	Retention of rocks	Timing
9.1	The landowner must not remove, or cause or permit to be removed, rocks from the biobank site or move, or cause or permit to be moved, rocks within the biobank site.	Ongoing from commencement date.
9.2	Rocks from outside the site may be placed on the biobank site to improve habitat for threatened species. Rocks, once placed on the biobank site, are subject to item 9.1 above. The landowner must make and retain records of the location of the rocks placed on the site and the date the rocks were brought onto the site in accordance with the record keeping requirements.	When required but not required before the first payment date.

Section 2: Additional management actions

Additional management actions should only be completed when they are required for creating ecosystem credits or species credits. This will be stated on the Biobanking Agreement Credit Report.

Complete the required fields for any additional management actions required for your site. Leave all other additional management actions and OEH will delete them before including this section in your draft biobanking agreement.

Additional management actions		
Item 10	**Control of feral and overabundant native herbivores**	**Timing**
10.1	The landowner must implement, and at all relevant times, comply with the management plan to control feral and overabundant native herbivores included in Section 4 (or such updated management plan as has been approved by the Director General under item 10.2 below) ('**the feral and overabundant native herbivores management plan**'). To allow for adaptive management, minor alterations can be made to the implementation of the feral and overabundant native herbivores management plan, which must be recorded in writing in accordance with Section 3 of this Annexure. Note: A licence under Section 121 of the *National Parks and Wildlife Act 1974* may be required to control overabundant native herbivores.	Ongoing from first payment date.
10.2	The feral and overabundant native herbivores management plan must be reviewed at intervals of no less than 4 years and no more than 6 years. The review is to consider the efficacy of the management actions in the plan and consider the effectiveness of the matters contained in the plan that are outlined in the dot points below. Notification of the date of the review commencement must be provided to the Director General in writing within 14 days of the commencement of the review. The findings of the review must be submitted to the Director General within 3 months of commencing the review. Where the Director General determines from the review that an update of the feral and overabundant native herbivores management plan is required, the Director General will notify the landowner in writing that an update of the plan is required and the landowner must update the plan and submit the amended plan to the Director General for approval within 3 months of receiving written notification from the Director General that an update of the plan is required. The revised plan must cover the matters outlined below and any additional matters specified by the Director General in writing:) a description of the feral or overabundant native herbivore/s) consideration of relevant current OEH and other pest management programs and methods) the method/s for feral and overabundant native herbivore control in each management zone, determined in accordance with best	Ongoing from first payment date.

	practice management - the frequency and timing of the control actions in each management zone - methods for monitoring the success of the pest control actions - a timetable and measures for inspections to identify new feral or overabundant native herbivores that may adversely affect biodiversity values on the biobank site - additional control actions to destroy or remove any new feral and overabundant native herbivore pest species that occur on site - measures for assessing and reporting monitoring results - a diary for recording actions taken in accordance with the feral and overabundant native herbivores management plan and minor alterations to this plan permitted for adaptive management. The details (management zone/s, date, alternative action) and reasons for the minor alterations must be recorded in the diary.	
Item 11	**Vertebrate pest management – Fox, Wild Dogs Feral Pig and Feral cats**	**Timing**
11.1	The landowner must implement, and at all relevant times, comply with the vertebrate pest management plan included in Section 4 (or such updated vertebrate pest management plan as has been approved by the Director General under item 11.2 below) ('**the vertebrate pest management plan**'). To allow for adaptive management, minor alterations can be made to the implementation of the vertebrate pest management plan, but these must be recorded in writing in accordance with Section 3 of this Annexure.	Ongoing from first payment date.
11.2	The vertebrate pest management plan must be reviewed at intervals of no less than 4 years and no more than 6 years by an appropriately qualified person. The review is to consider the efficacy of the management actions in the plan and consider the effectiveness of the matters contained in the current plan that are outlined in the dot points below. Notification of the review commencement must be provided to the Director General in writing within 14 days of the commencement. The findings of the review must be submitted to the Director General within 3 months of commencing the review. Where the Director General determines from the review that an update of the plan is required, the Director General will notify the landowner in writing that an update of the plan is required. The landowner must update the plan and submit it to the Director General for approval within 3 months of receiving written notification from the Director General that an update of the plan is required. The revised plan must cover the matters outlined below and any additional matters specified by the Director General in writing: - a description of the target fauna species e.g. pigs, foxes or other species such as feral dogs or goats - consideration of relevant current OEH and other pest management programs - the method/s of vertebrate pest control in each management zone determined in accordance with best management practice - the frequency and timing of vertebrate pest control actions in	Ongoing from first payment date.

	each management zone - methods for monitoring the success of vertebrate pest control actions - a timetable and measures for inspections to identify new vertebrate pest species that may negatively impact on threatened species on the biobank site - additional vertebrate pest control actions to destroy or remove any new vertebrate pest species that occur on-site - measures for assessing and reporting monitoring results - a diary for recording actions taken in accordance with the vertebrate pest management plan and minor alterations to this plan permitted for adaptive management. The details (management zone/s, date, alternative actions) and reasons for the minor alterations must be recorded in the diary.	
Item 12	**Nutrient control**	**Timing**
12.1	Fertilisers, pesticides and herbicides must not be applied on the biobank site, except where required to undertake the management actions. Use of fertilisers for establishing native vegetation through planting or seeding, use of herbicides for controlling weeds or use of pesticides for controlling vertebrate pests or feral herbivores can be undertaken in accordance with best practice management when required to undertake the management actions.	Ongoing from commencement date.
Item 13	**Control of exotic fish species**	**Timing**
13.1	This item is not applicable.	
Item 14	**Maintenance or reintroduction of natural flow regimes**	**Timing**
14.1	This item is not applicable.	
14.2	This item is not applicable.	
14.3	Artificial structures such as dams or levee banks that impede the natural flow regimes on the biobank site must not be constructed unless approved by the Director General in writing for the purpose of restoring natural flows.	Ongoing from commencement date.

Section 3: Standard management plans

Completing the compulsory weed management plan

A table is provided below for the integrated weed management plan. Add additional sections to the table if required.

The plan must include, but is not limited to:

- a description of the target weed/s at the biobank site and their location/s, linked to each management zone where weeds are present
- the method/s of weed control in each management zone
- the frequency of weed control activities at the site, taking into account management practices where weeds are providing habitat for native species
- the timing of any planting of native plant species required in each management zone to provide alternative habitat for native species affected by weed control activities
- methods for monitoring weed control activities
- reporting and assessing the results from monitoring
- a timetable/measures for inspections to identify new weed species or exotic plant species (including noxious weeds under the *Noxious Weeds Act 1993*)
- a diary for recording actions taken in accordance with the integrated weed management plan and minor alterations to this plan permitted for adaptive management. The details (management zone/s, date, alternative action) and reasons for the minor alterations must be recorded in the diary.

When the management plan is reviewed (see item 2.2), weed control activities may be amended, deleted or added to take into account the weed species on the site at that time.

Weed management plan

The weed types, description and location (management zone/s) of weed infestations existing at the commencement date are listed in the weed management plan. The methods of weed control (management actions), monitoring and inspections are also listed.

The landowner must perform the methods of weed control and other weed management activities and monitoring in the weed management plan by the methods described (and in accordance with item 2 of this Annexure) for all weeds. The methods of control will apply to the weeds listed in the table below as well as any other weeds that may be present on the site from time to time.

The template for reporting of monitoring activities and the diary template for weed control management must be filled in to record observations during the implementation of the weed management plan, including any minor variations.

Weed types

Weed	Common name of target weed	Scientific name of target weed	Description of infestation (eg intensity (% cover) & location within zone)	Management zone/s
A	Lantana	*Lantana camara*	Moderate 'patches' associated with Boat Harbour Creek and the northern portion of the site (MZ1, MZ5 and MZ9). Scattered individuals across all zones (<10% cover)	All zones
B	Camphor Laurel	*Cinnamomum camphora*	Scattered individuals throughout all zones	All zones
C	Introduced grasses (e.g. Whisky Grass, Paspalum, Kikuyu, Narrow-leaved Carpet Grass)		Moderate 'patches' located within MZ5 and MZ9 (including previous citrus planting area – see below). Minor infestations associated with existing access tracks. These areas are concentrated to the north of the proposed housing lot and in low condition vegetation in the north of the biobank.	All zones
D	Planted citrus trees		Individual planted citrus trees in MZ5 only.	MZ5
E	Small woody and Herbaceous weeds (e.g. Fleabane, Fireweed, Spear thistle, Cobblers Pegs, Paddy's Lucerne, Purpletop, etc.)		Scattered individuals throughout all zones	All zones

Methods of weed control

Management zone/s	Weed/s	Method of weed control	Frequency (months or Year)
All zones	A	Targeted weed control to be carried out by suitably qualified contractors and specialised equipment. As infestations are localised to relatively small areas, back pack spraying is the recommended method of control in most areas, as the ground can be easily traversed on foot.	- 6 sessions per year during years 1 to 3. - 4 sessions

		Methods will include: - using back packs, teams of two spray with glyphosate or selective herbicide at flowering/fruiting stage, when most effective (areas of moderate infestation). - cut and paint with undiluted glyphosate for treatment of scattered individuals - hand pulling/crowning of weeds - scattered individuals **Performance measures** Weed control works will aim to achieve the following outcomes: 1. Lantana reduced to less than 20% of original distribution by the end of year 2. 2. Lantana reduced to less than 10% of original distribution by the end of year 5. 3. Lantana maintained at less than 10% of original distribution from year 6	per year during years 4 - 10
All zones	B	The site contains scattered individuals only. **Methods may include:** - cut and paint crown/lignotuber with undiluted glyphosate or Garlon and diesel or Grazon® immediately for isolated plants or smaller areas of infestation. - hand pulling/crowning of weeds	- 2 sessions per year in years 1 and 2
All zones	C	Active spraying will be used to 'open up' patches. Over time it is anticipated that natural regeneration will shade out the introduced grasses. **Methods may include:** - spot spraying using 'back packs' throughout all zones. - hand pulling/crowning of weeds	- 6 sessions per year in years 1 to 3 - 4 sessions per year in years 4 - 10
MZ5	D	Planted citrus trees exist in rows in MZ5. Treatment will include: - 'cut and paste' with individual trees then left on the ground in situ.	- 2 sessions in year 1
All Zones	All	Ongoing (follow-up) weed control activities to be carried out by qualified contractors. **Methods may include:** - spot spraying using backpacks in large areas of	6 sessions per year in perpetuity

		infestation. - cut and paint crown/lignotuber with undiluted glyphosate - pulling/crowning of weeds **Performance Measures** Weed control work within these management zones will aim to achieve the following outcomes: 1. Mature woody weeds maintained at less than 10% of original distribution in all zones by the end of year 10. 2. Other herbaceous and pasture weeds maintained at less than 10% of original distribution in all zones by the end of year 10. Note: access tracks will not be actively managed to control introduced grasses, rather activities will focus on restricting introduced grasses from recruiting in remnant vegetation.	

Native planting required to provide habitat for native species affected by weed control activities

Management zone	**Description of planting required** (reference planting schedule at item 6.6)	**Timing**

Monitoring and inspections of existing and new weeds

Management zone/s	**Weed/s**	**Method of monitoring**	**Date/s required**
All Zones	All Weeds	A monitoring and evaluation program to address weed regrowth and control measures will be undertaken annually by the landholder through the set-up of fixed photo-points across all restoration zones. Photos should be taken by digital camera and recorded in the project file by date and discrete photo-point number at the locations shown on the Photo Points Plan (01/06/2016) and listed in Annexure D. Photo-point locations should be clearly marked on site and/or recorded using a GPS. The photo-point monitoring will be augmented by a completion of a weed management log (included below) describing actions and observations. The photographic records and observations log will completed by the landholder and provided to OEH. For each management zone, the following information will be reported: • A summary of weed control activities works undertaken for	Annually

		the previous 12 months in the zone and a review of their success or otherwise. • A description of the current condition of the zone. This may include presence/absence of canopy, shrub and/or ground-layer regeneration and any evidence of dieback etc. • Brief descriptions of the type and locations of any significant new or remaining weed infestations. Successful suppression of weeds should also be documented. Refer back to the performance targets in methods of weed control. • Recommendations, if required, of any adaptations to the weed control techniques previously applied.	
All Zones	All Weeds	Condition mapping (floristic and habitat field survey assessment) to determine vegetation quality and ecological condition. This will be provided to OEH.	Every six years by an independent botanical consultant.

Other weed management activities (where required)

Notes:

Qualified contractors includes bush regeneration contractors being used when completing weed control works in areas of native vegetation and/or 'high' natural resilience. Other contractors required may include earthworks operators, farm chemical certificate trained staff, fencing contractors etc.

One session of weed control refers to a team of 2 staff per day using various treatment techniques depending on weed type being treated.

Weed control in perpetuity refers to the ongoing treatment, through time, of any weed that may inhabit the site now and in the future.

Template for reporting of monitoring activities

Management zone/s	**Date**	**Observations and assessment of monitoring** This table must include the information for each zone (or groups of zones) which is described in the table titled 'monitoring and inspections of existing and new weeds'.

Diary template for weed control management			
Date	**Management zone/s**	**Description and type of activity undertaken** (e.g. weed control, observation)	**Minor variations** (details and reasons)

Completing the compulsory fire for conservation management plan

A table is provided below for the fire conservation management plan. Add additional sections to the table if required. The plan must include, but is not limited to:

- a map of the vegetation on the biobank site (with date) and any infrastructure and built assets on the biobank site (the map to be included in the biobanking agreement)
- the year the last fire went through, the type of fire and the extent of the fire and location, where known
- frequency of natural fires in the area of the biobank site, where known
- a description of locations and management zones where ecological burns will be conducted and areas that will not be burnt
- the methods that will be used for ecological burns
- the fire frequency intervals recommended for the vegetation types and threatened species present, including any required adjustment to the schedule in the event of a wildfire or activities undertaken under the *Rural Fires Act 1997* to ensure minimum frequency between ecological burns
- the fire intensity for the recommended vegetation types
- the time of year suitable for ecological burns
- methods for monitoring the outcomes of ecological burns
- reporting and assessing the results from monitoring
- the diary for recording actions taken in accordance with the fire management plan and minor alterations to this plan permitted for adaptive management. The details (management zone/s, date, alternative action) and reasons for the minor alterations must be recorded in the diary in accordance with the record keeping requirements.

Fire for conservation management plan

The plan includes information on all known previous fire events in the 'Fire history' table to demonstrate local fire conditions including intensity and frequency.

The ecological fire requirements for each vegetation type or threatened species on the biobank site are listed in the 'Fire requirements for vegetation types and threatened species' table. These are the fire frequency intervals recommended for the vegetation types and threatened species present on the biobank site. They include any requirement adjustments to the schedule in the event of a wildfire or activities undertaken under the *Rural Fires Act (RFA) 1997* to ensure the minimum frequencies between ecological burns.

The landowner must carry out ecological burns for each management zone according to the method and frequency described (as informed by the history and requirements sections and in accordance with Section 3 of this annexure). These actions are set out in the 'Ecological burning actions table'. Monitoring and inspections (set out in the 'Fire management monitoring' table) as described must also be implemented. The landowner must also carry out the actions listed in the 'Other fire management activities' table.

The table titled 'Template of monitoring activities' must be completed to record observations during the implementation of the plan and assessment of monitoring activities. The landowner must also complete the table titled 'Diary template for fire management activities' to record the management actions undertaken or observations made, including any minor variations.

Fire history for previous 20 years (or longer if known)		
Year of fire	**Hazard reduction, wildfire or ecological burn and extent of fire**	**Management zone/s**
	Unknown	

Fire requirements for vegetation types and threatened species				
Vegetation type and/or threatened species	**Fire frequency required**	**Time of year for burning**	**Fire intensity required**	**Adjustment required due to wildfires or RFA activities**
Blackbutt - Turpentine - Tallowwood shrubby open forest of the coastal foothills of the central North Coast (NR122)	Greater than 7 years, less than 25 years It is anticipated the first ecological burn will occur in Year 7~~6~~.	April/May and August/ September	Avoid successive fires of intensity sufficient to scorch or consume dominant tree crown	In the event that wildfires did not occur for more than 25 years on the property, a prescribed ecological burn would be conducted.
Red Mahogany open forest of the coastal lowlands of the North Coast (NR222)	Greater than 7 years, less than 25 years It is anticipated the first ecological burn will occur in Year 7~~6~~.	April/May and August/ September	Avoid successive fires of intensity sufficient to scorch or consume dominant tree crown	In the event that wildfires did not occur for more than 25 years on the property, a prescribed ecological burn would be conducted.
Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the North Coast (NR161)	Greater than 7 years, less than 25 years It is anticipated the first ecological burn will occur in Year ~~6~~7.	April/May and August/ September	Avoid successive fires of intensity sufficient to scorch or consume dominant tree crown	In the event that wildfires did not occur for more than 25 years on the property, a prescribed ecological burn would be conducted.
Spotted Gum - Grey Ironbark open forest of the Macleay Valley lowlands of the North Coast (NR274)	Greater than 7 years, less than 25 years It is anticipated the first ecological burn will occur in Year ~~6~~7.	April/May and August/ September	Avoid successive fires of intensity sufficient to scorch or consume dominant tree crown	In the event that wildfires did not occur for more than 25 years on the property, a prescribed ecological burn would be conducted.
Spotted Gum -	Greater than 7	April/May and	Avoid	In the event that wildfires

Grey Ironbark - Pink Bloodwood open forest of the Clarence Valley lowlands of the North Coast (NR246)	years, less than 25 years It is anticipated the first ecological burn will occur in Year 7~~6~~.	August/ September	successive fires of intensity sufficient to scorch or consume dominant tree crown	did not occur for more than 25 years on the property, a prescribed ecological burn would be conducted.
Flooded Gum - Tallowwood - Brush Box moist open forest of the coastal ranges of the North Coast (NR160)	Greater than 7 years, less than 25 years It is anticipated the first ecological burn will occur in Year 7~~6~~.	April/May and August/ September	Avoid successive fires of intensity sufficient to scorch or consume dominant tree crown	In the event that wildfires did not occur for more than 25 years on the property, a prescribed ecological burn would be conducted.
Blackbutt - Tallowwood dry grassy open forest of the central parts North Coast (NR119)	Greater than 7 years, less than 25 years It is anticipated the first ecological burn will occur in Year ~~6~~7.	April/May and August/ September	Avoid successive fires of intensity sufficient to scorch or consume dominant tree crown	In the event that wildfires did not occur for more than 25 years on the property, a prescribed ecological burn would be conducted.
Blackbutt - Pink Bloodwood shrubby open forest of the coastal lowlands of the North Coast (NR117)	Greater than 7 years, less than 25 years It is anticipated the first ecological burn will occur in Year 7~~6~~.	April/May and August/ September	Avoid successive fires of intensity sufficient to scorch or consume dominant tree crown	In the event that wildfires did not occur for more than 25 years on the property, a prescribed ecological burn would be conducted.
Scribbly Gum - Red Bloodwood heathy open forest of the coastal lowlands of the North Coast (NR228)	Greater than 7 years, less than 25 years It is anticipated the first ecological burn will occur in Year 7~~6~~.	April/May and August/ September	Avoid successive fires of intensity sufficient to scorch or consume dominant tree crown	In the event that wildfires did not occur for more than 25 years on the property, a prescribed ecological burn would be conducted.

Ecological burning actions

Management zone/s	**Actions**	**Supervision & extinguishing techniques**	**Time of year for burning**	**Frequency** (years)
All	The potential impact of the proposed burn on native vegetation, biodiversity, waterways or important cultural heritage sites will continue to be assessed. Rural Fire Service to be consulted prior to the burn to	Rural Fire Service to be present for protection and advice. Asset control lines ('hoe' lines or similar) to be installed where required	April to September	Approx. 15 years from the date of the previous ecological burn or a wildfire occurring

	determine appropriate regime. Publications such as NSW RFS publication *Standards for Low Intensity Bushfire Hazard Reduction Burning* The biobank has been divided into ~~four~~ five separate 'cells' to promote a mosaic ecological burn program across the site. It is proposed that two cells (as shown in Fire Management Plan dated 01/06/2016) will be burnt on rotation at 7 year intervals. A suggested rotation would be to burn cells 1 and 2 in year 7, cell 3 in year 14 and then cells 4 and 5 in year 21. This rotation would then continue. It should be noted this is a suggested rotation using approximate timeframes only. It is also recommended that burns occur in smaller patches within each cell using existing barriers and access trails to help control fire spread. Ignition points and control locations should coincide with access tracks (which will be maintained), ridge tops, the edge of 'patches' and existing drainage lines. Burning 'downhill' is also recommended. The biobank includes an existing network of degraded tracks. Some of these tracks will require earthworks to re-establish them to a standard suitable for fire management purposes. The proposed access track network, including those locations requiring earthworks, is shown on the Fire Management Plan dated 01/06/2016. Access tracks will then require periodic slashing to maintain. All earthworks associated with the re-establishment or management of the access tracks would be completed in a manner which minimises erosion control and sediment being deposited in areas of existing native vegetation and drainage lines. It is recommended burning should be completed in August/September or late April/May (i.e. cooler weather			on the property.

	with fuel not completely dry) to assist in reducing the potential for burns to enter neighbouring properties at high intensity. All neighbouring property owners would be notified in advance of any controlled burn. Controlled burns should avoid locations where seed has been broadcast (MZ5) for at least the first 7 years of establishment. Targeted surveys for threatened flora and fauna will be conducted across each proposed burn area (cell) prior to burning commencing. Surveys will be conducted during the appropriate season for detection of a given species. Frequency of burns will take into consideration the recommended fire frequencies of any threatened species located. This may mean adjusting the proposed burn regime should a threatened species be identified which requires a different burn pattern. The survey will be a one day site visit focusing on the 'Cell' proposed for burning and will utilise a random meander technique. Funds have been included in the TFD accordingly.			

Methods for monitoring the outcomes of ecological burns

Management zone/s	Method of monitoring	Date/s required
All Zones	Visual auditing and noting of observations in a diary record (template provided below). • A general description of the vegetation structures and species composition within the zone/s impacted by the ecological burn six months after the burn • An interpretation of the ecological outcomes of previous fires (either planned or unplanned) within the zone/s impacted by the ecological burn 6 months after the burn • A recommendation on the timing and location for future planned ecological burns within the zone (or other zones) • A written and photographic report for plots relating to plant species and cover abundance starting 12 months post fire. The plots to be used for this monitoring are 18, 26, 27, 50, 30, 34, 38, 41, 48 and 16. These coincide with the photo points A, B, C, D, E, F, G, H, I, and J)	Monitoring to occur 6 months after fire (summary of initial response) then a follow-up photographic and written report 12 months after the burn.
All Zones	Condition mapping (floristic and habitat field survey assessment)	

	to determine vegetation quality and ecological condition.	

Other fire management activities (where required)
Surrounding residents should be notified at least one month prior to an ecological burn occurring. All existing access tracks will be maintained for use for and during ecological burns. Should containment lines be required during controlled burns, they should be constructed, where possible, without complete removal of vegetation and exposing the soil surface.

Template for reporting of monitoring activities

Management zone/s	**Date**	**Observations and assessment of monitoring**

Diary template for fire management activities

Date	**Management zone/s**	**Description of activity undertaken or observation made**	**Minor variations** (details and reasons)

Section 4: Additional management plans

If required, complete this control of feral and overabundant native herbivores management plan

A table is provided below for the management plan to control feral and overabundant native herbivores. Add additional sections to the table if required. The plan must include, but is not limited to:

- a description of the feral or overabundant native herbivore/s
- consideration of relevant current OEH and other pest management programs and methods
- the method/s for feral and overabundant native herbivore control in each management zone, determined in accordance with best practice management
- the frequency and timing of the control actions in each management zone
- methods for monitoring the success of the pest control actions
- reporting and assessing the results from monitoring
- a timetable and measures for inspections to identify new feral or overabundant native herbivores that may adversely affect biodiversity values on the biobank site
- a diary for recording actions taken in accordance with the management plan to control feral and overabundant native herbivores and minor alterations to this plan permitted for adaptive management. The details (management zone/s, date, alternative action) and reasons for the minor alterations must be recorded in the diary.

When the management plan is reviewed (see item 10.2 in Section 1), control activities may be amended, deleted or added to take into account the feral and overabundant native herbivore on the site at the time.

Management plan to control feral and overabundant native herbivores

The management plan for feral and overabundant native herbivores includes information on the management requirements for the feral and overabundant native herbivores at the biobank site listed in the 'Feral and overabundant native herbivores' table. The possible methods of control for each species, used by OEH and other pest management programs, are listed and the suitability of each method is described in the 'Methods considered' table.

The landowner must carry out the methods for control for feral and overabundant native herbivores for each management zone according to the method and frequency as described in the 'Methods for control' table. The methods of control applied to the feral or overabundant native herbivores listed in the 'Feral or overabundant native herbivores' table as well as any other feral or overabundant herbivores that may be present on the site from time to time.

Monitoring and inspections of existing and new feral and overabundant herbivores at the biobank site as described in the 'Monitoring and inspections' table must be implemented.

The table titled 'Template for reporting of monitoring activities' must be completed to record observations during the implementation of the plan and assessment of the monitoring activities. The landowners must complete the table titled 'Diary template for feral and overabundant herbivore management' to record the management actions undertaken including any minor variations or observations made.

Feral and overabundant native herbivores

Feral type	Name of feral/overabundant native herbivore	Description of extent	Management zone/s
A	Rabbit	No evidence identified during surveys. Results of desktop analysis (NPWS Wildlife Atlas) indicate may be present on the site. Level of infestation appears very low and sporadic if present	All

Methods considered

Feral type	Name and description of program or method	Describe suitability
A	Monitored and controlled as necessary in accordance with the Rabbit control programs administered by the NPWS. The methods considered include: • Active shooting • Gassing of warrens • Baiting program • Trapping program	Baiting, gassing and active trapping considered most suitable. Active shooting may be appropriate though consideration of this technique is required considering proximity to nearby residencies, roads and other amenities.

Methods of control

Management zone/s	Feral type	Method of control	Frequency and timing
All	A	Baiting and/or active trapping are considered the most appropriate control methods due to the level of rabbit infestation appearing to be low. Warrens may also be treated via gassing if located on the site.	Gassing of any active warrens will occur within the first 3 years of the rehabilitation program if required. Baiting and/or trapping is the preferred method after this time in response to monitoring. Shooting may be appropriate though consideration of the proximity of residential dwellings would be required.

Monitoring and inspections

Management zone/s	Feral type/s	Method of monitoring	Date/s required
All	A	The monitoring is to comprise a nocturnal walk over of the site annually and a visual estimate of the level of grazing, browsing and/or burrowing impacts. The level of impact is to be recorded as negligible, minimal, moderate or high. The monitoring is to also include recording the date, number and location of any tracks, traces scats or sightings. This information is to be used in the feral herbivores pest management plan to inform the methods of control listed in that plan. Monitoring survey would include a random meander throughout the biobank site (suggest 2 hours) considering the Rapid Assessment Technique (Cooke et al, 2008).	Annually

Other management activities (where required)

Records will be kept of opportunistic pest animal sightings by the landholder in the "Diary template for vertebrate pest management" included below. These records will be submitted to OEH annually for review and discussion of suitable control methods to be employed.

Note: The above program has been included as a contingency only as no rabbits (or evidence of rabbits) were identified during field surveys. The amount included in the TFD reflects this contingency approach.

Template for reporting of monitoring activities

Management zone/s	Date	Current level of impact on vegetation This column must record impact as Negligible, Minimal, Moderate or High	Observations and assessment of monitoring

Diary template for feral and overabundant herbivore management			
Date of activity	**Management zone/s**	**Description and type of activity undertaken** This column must include details of the feral and overabundant herbivores targeted, control techniques applied and numbers controlled.	**Minor variations** (details and reasons)

If required, complete this vertebrate pest management plan

A table is provided below for the vertebrate pest management plan. Add additional sections to the table if required. The plan must include, but is not limited to:

- a description of the target fauna species e.g. pigs, foxes or other species such as feral dogs or goats
- consideration of relevant current OEH and other pest management programs
- the method/s of vertebrate pest control in each management zone determined in accordance with best management practice
- the frequency and timing of vertebrate pest control actions in each management zone
- methods for monitoring the success of vertebrate pest control actions
- reporting and assessing the results from monitoring
- a timetable and measures for inspections to identify new vertebrate pest species that may negatively impact on threatened species on the biobank site
- a diary for recording actions taken in accordance with the vertebrate pest management plan and minor alterations to this plan permitted for adaptive management. The details (management zone/s, date, alternative actions) and reasons for the minor alterations must be recorded in the diary in accordance with the requirements.

All pest species identified as requiring management on a biobank site must be included in the vertebrate pest management plan.

Separate management plans can be developed for each pest species.

When the management plan is reviewed (see item 11.2 in Section 1), control activities may be amended, deleted or added to take into account vertebrate pest species found on the site at that time.

Vertebrate pest management plan

The management plan for vertebrate pests includes information on the vertebrate pests and their extent existing at the time of the agreement as listed in the 'Vertebrate pests' table. The possible methods of control for each species, used by OEH and other pest management programs are listed and the suitability of each method to the biobank site is described in the 'Methods considered' table.

The landowner must carry out the methods for vertebrate pest control for each management zone according to the method and frequency described in the 'Methods of control' table. The methods of control will apply to the vertebrate pests listed in the 'Vertebrate pests' table as well as any other vertebrate pests that may be present on the site from time to time.

Monitoring and inspections of existing and new vertebrate pests on the biobank site, as described in the 'Monitoring and inspections' table, must be implemented.

The table titled 'Template for reporting of monitoring activities' must be completed to record observations during the implementation of the plan and assessment of monitoring activities. The landowner must also complete the 'Diary template for vertebrate pest management' to record the management actions undertaken, including any minor variations, and observations made.

Vertebrate pests

Pest	Name of vertebrate pest (e.g. pig, fox, goat, dog)	Description of extent	Management zone/s
A	Fox	Recorded during field surveys and known to occur on site.	Possibly present throughout the site, although specific locations unknown.
B	Wild dogs	Recorded during field surveys and known to occur on site.	Possibly present throughout the site, although specific locations unknown.
C	Pigs	Not sited during field assessments or known to occur on site. Should this species be identified treatment will be required as described below.	Possibly present in the northern portion of the site associated with Boat Harbour Creek.
D	Feral cat	Not sited during field assessments or known to occur on site. Results of desktop analysis indicate may be present on the site in a transient nature only. Opportunistic visitation only most likely.	Possibly present throughout the site, although specific locations unknown.

Methods considered

Pest type	Name and description of program or method	Describe suitability
A	Monitored and controlled in accordance with strategies outlined in Best-practice guidelines for fox control contained within the **Predation by the red fox - threat abatement plan (OEH, 2010).** The methods considered include: • Baiting. • Active shooting.	Baiting considered most suitable if sighted due to low potential activity. Shooting may be appropriate though consideration of the proximity of residential dwellings would be required.
B	Monitored and controlled in accordance with strategies outlined in; New South Wales **Wild Dog Management Strategy 2012 – 2015** (DPI, 2012). The methods considered include: • Baiting. • Active shooting.	Baiting considered most suitable if sighted due to low potential activity. Shooting may be considered appropriate though

		consideration of the proximity of residential dwellings would be required.
C	Monitored and controlled in accordance with strategies outlined on the DPI website, titled **Integrated Feral Pig Management.** The methods considered include: ⁾ Active trapping ⁾ Shooting from the ground ⁾ Strategic baiting	Strategic baiting using **1080** is considered most effective treatment if required. Shooting may be considered appropriate though consideration of the proximity of residential dwellings would be required.
D	To be monitored and controlled in accordance with NSW DPI Monitoring Techniques for Vertebrate Pests – Feral Cats (2007). Techniques considered include: ⁾ Ground shooting (in accordance with Standard Operating Procedure CAT001) ⁾ Live Trapping using Cage Traps (in accordance with Standard Operating Procedure CAT002) ⁾ Baiting (using Curiosity®)	Baiting not considered unsuitable at this stage as baiting program can impact on native carnivores such as the Spotted-tailed Quoll. Further research is being completed by the Australian Government which may remove this risk. It is recommended this research be monitored and if baiting approach can be modified to remove the threat to native carnivores it may be considered in the future for this site. Live trapping considered most effective

		treatment if required. Shooting may be considered appropriate though consideration of the proximity of residential dwellings would be required.

Methods of control

Management zone/s	Pest type	Method of control	Frequency and timing
All	A	Baiting will be used to control foxes. The ~~correct~~ type and method of baiting will need to consider the presence of native fauna and their feeding habits, especially the Spotted-tailed Quoll. Active shooting may be suitable but consideration of neighbouring properties is required.	As required.
All	B	Baiting will be used to control wild dogs. The type and method of baiting will need to consider the presence of native fauna and their feeding habits, especially the Spotted-tailed Quoll. Active shooting may be suitable but consideration of neighbouring properties is required.	As required.
All	C	Baiting will be used to control feral pigs should they be identified to be using the site. The type and method of baiting will need to consider the presence of native fauna and their feeding habits, especially the Spotted-tailed Quoll. Active trapping may also be suitable due to low numbers and localised infestation on the site. Active shooting may be suitable but consideration of neighbouring properties is required.	As required.
All	D	Active trapping using cage traps will be used to control feral cats should they be identified on site. Active shooting may also be suitable but consideration of neighbouring properties is required.	As required.

Monitoring and inspections of existing and new vertebrate pests

Management zone/s	Pest type/s	Method of monitoring	Date/s required
All	All	All sightings of feral animals by the landholder are to be recorded in monitoring log, and include the date, location, and the number of animals sighted and any damage noted. Monitoring of damage is essential and can include information on the size of the affected area and feral animal	Annually

		induced impacts. The monitoring is to comprise a nocturnal walk over of the site annually and a visual estimate of the level of grazing, browsing and/or burrowing impacts. The level of impact is to be recorded as negligible, minimal, moderate or high. The monitoring is to include recording the date, number and location of any tracks, traces scats or sightings of feral species. This information is to be used in the vertebrate pest management plan to inform the methods of control listed in that plan.	
All	All	Annual spotlight survey of vehicle accessible tracks and fire trails noting number of feral species identified. This survey can be conducted by the landholder.	Annually

Other management activities (where required)

Records will be kept of opportunistic pest animal sightings by the landholder in the "Diary template for vertebrate pest management" included below. These records will be submitted to OEH annually for review and discussion of suitable control methods to be employed.

Note: The above program has been included as a contingency only as no rabbits (or evidence of rabbits) were identified during field surveys. The amount included in the TFD reflects this contingency approach.

Template for reporting of monitoring activities

Management zone/s	**Date**	**Current level of impact on vegetation or threatened fauna species** This column must record impact as Negligible, Minimal, Moderate or High	**Observations and assessment of monitoring**

Diary template for vertebrate pest management

Date of activity	**Management zone/s**	**Description and type of activity undertaken** This column must include details of the vertebrate pests targeted, control techniques applied and numbers controlled.	**Minor variations** (details and reasons)

Photo points

This section of the management actions template is not part of *Annexure C: Management actions* but is required for *Annexure D* of the biobanking agreement which requires information relating to the placement of photo points for monitoring purposes. Fill in the table below so that this information can be included in the appropriate format in the final agreement. A map of the photo point locations is also required to be submitted.

Photo points should be positioned in areas that are likely to show change over time. Some plot locations can be used as photo points but many plot locations (especially in vegetated areas already in very good condition) may not show any change over time. Locate photo points where there will be changes because of management actions such as areas currently in low to moderate condition, targeted for revegetation and/or intensive weed control.

Photos are required to be taken every 12 months at the same location, direction, height and time of day.

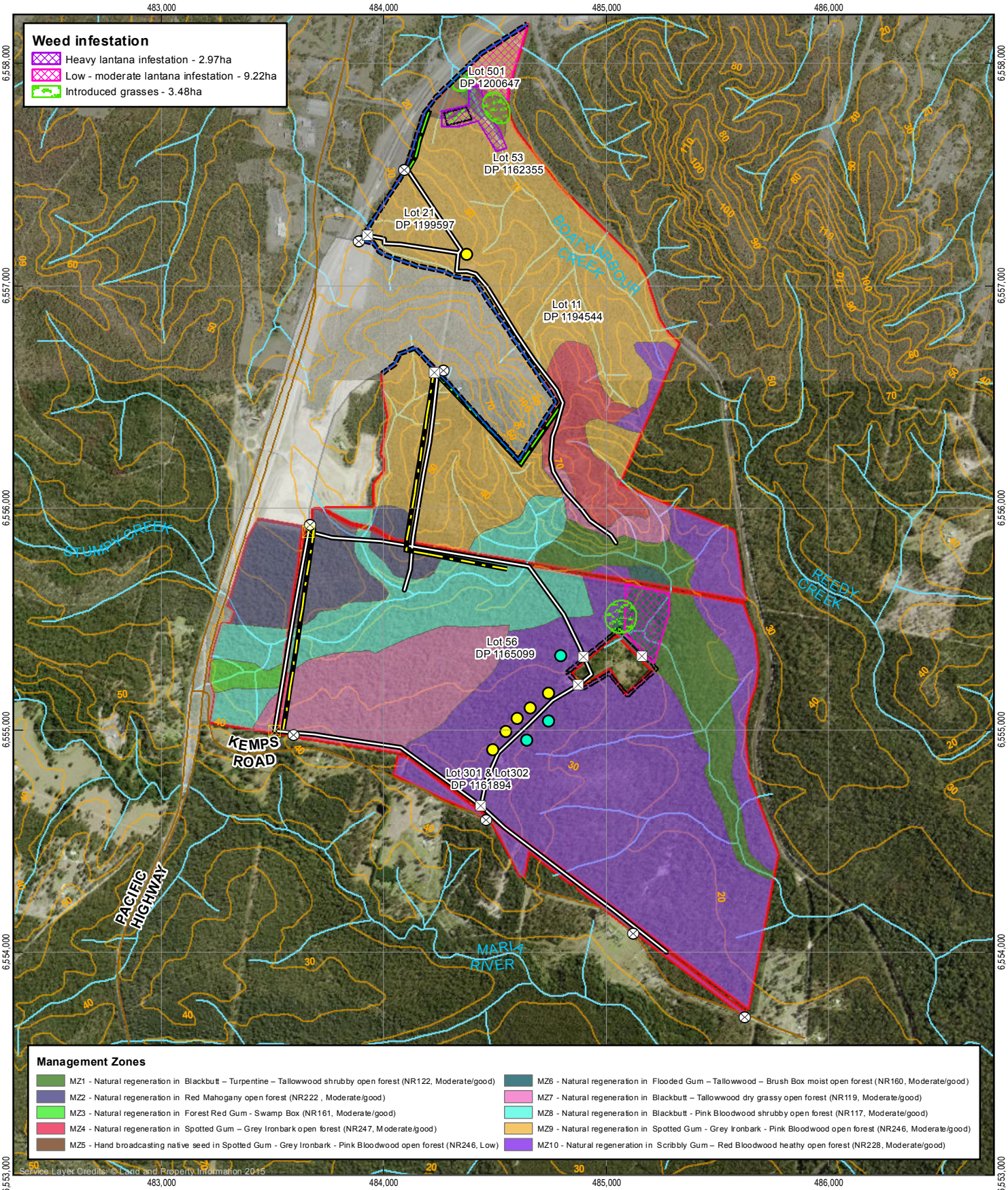
Annexure D: Monitoring, reporting and record keeping requirements

1 Monitoring requirements

1.1 The landowner must ensure that photographs are taken at photo-points at each of the locations and in the direction identified in the table below titled 'Locations of plots and photo points' within 12 months of the commencement date and then at least every 12 months thereafter.

1.2 The photo points are identified on the map entitled Photo Points map dated 01/06/2016 in Annexure A of this agreement. The purpose of the photographs is to show changes over time. Photographs should be taken at approximately the same direction, location, height and time of day (during daylight hours) in each reporting period (as defined in item 2.2 of this Annexure D) and retained for the life of this agreement. All photographs must be dated, stating the direction in which they were taken and identified with their locations.

Locations of photo points			
Projected coordinate system: GDA 94			
Photo point reference	Easting	Northing	Direction of photo (magnetic degrees)
A	485324	6555351	180
B	484536	6557961	180
C	484466	6557804	180
D	483517	6555412	300
E	485187	6555625	180
F	485144	6555906	90
G	484949	6555995	180
H	483557	6555694	180
I	483476	6555230	180
J	484507	6554741	90



Management Zones

- MZ1 - Natural regeneration in Blackbutt – Turpentine – Tallowwood shrubby open forest (NR122, Moderate/good)
- MZ2 - Natural regeneration in Red Mahogany open forest (NR222 , Moderate/good)
- MZ3 - Natural regeneration in Forest Red Gum - Swamp Box (NR161, Moderate/good)
- MZ4 - Natural regeneration in Spotted Gum – Grey Ironbark open forest (NR247, Moderate/good)
- MZ5 - Hand broadcasting native seed in Spotted Gum - Grey Ironbark - Pink Bloodwood open forest (NR246, Low)
- MZ6 - Natural regeneration in Flooded Gum – Tallowwood – Brush Box moist open forest (NR160, Moderate/good)
- MZ7 - Natural regeneration in Blackbutt – Tallowwood dry grassy open forest (NR119, Moderate/good)
- MZ8 - Natural regeneration in Blackbutt - Pink Bloodwood shrubby open forest (NR117, Moderate/good)
- MZ9 - Natural regeneration in Spotted Gum - Grey Ironbark - Pink Bloodwood open forest (NR246, Moderate/good)
- MZ10 - Natural regeneration in Scribbly Gum – Red Bloodwood heathy open forest (NR228, Moderate/good)

LEGEND

- Contours
- Watercourses
- Maintain track
- New track
- Existing strands to be removed
- Existing fence to be retained
- New fence
- Old farm pigsty
- General rubbish removal
- Logs/sleepers pile
- Existing gate
- New gate
- Signage
- Recent or proposed development
- Norton biobank site

0 200 400 800
Metres

Geographic Coordinate System
Horizontal Datum: Geocentric Datum of Australia 1994

N

Roads and Maritime Services
Norton Biobank Site
BioBanking Assessment

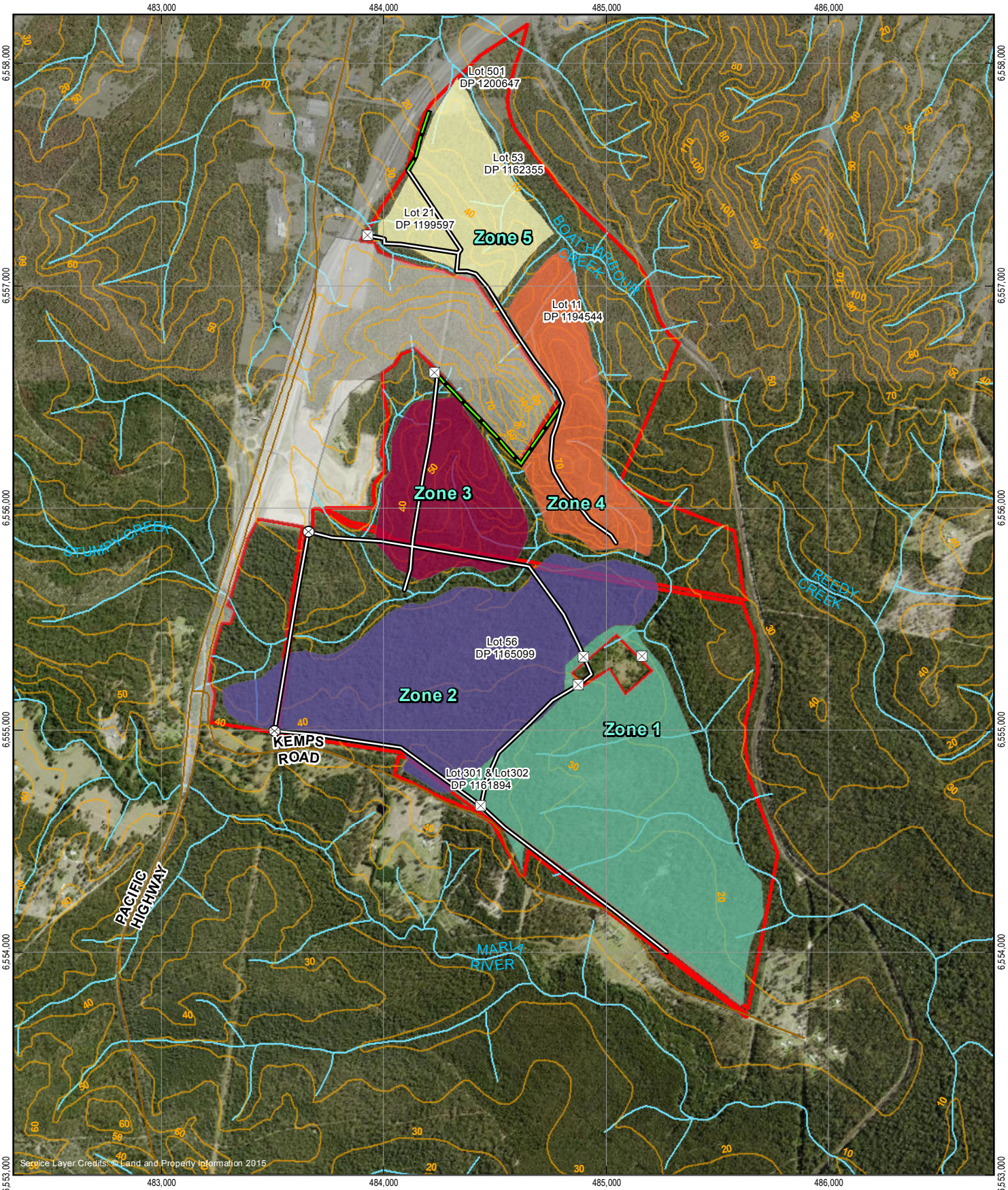
Job Number	21-24927
Revision	A
Date	11 Aug 2016

Biobank property action plan

Figure 5

N:\AU\Sydney\Projects\21\24927\GIS\Maps\Deliverables\Norton MAP\21_24927_Z001_Property_Action_Plan.mxd Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data Source: NSW Department of Lands: Cadastre - Jan 2011; LPMA Data 2013; Lewis and James (2010) Kempsey to Eungai: Compensatory Habitat package' Created by:mking3



LEGEND

- Contours
- Watercourses
- Maintain track
- New track
- Existing gate
- New gate
- Recent or proposed development
- Norton biobank site
- Zone 1
- Zone 2
- Zone 3
- Zone 4
- Zone 5

0 205 410 820

Metres

Geographic Coordinate System
Horizontal Datum: Geocentric Datum of Australia 1994

N

Roads and Maritime Services
Norton Biobank Site
BioBanking Assessment

Job Number	21-24927
Revision	A
Date	18 Aug 2016

Biobank fire management plan

Figure 6

N:\AU\Sydney\Projects\21\24927\GIS\Maps\Deliverables\Norton MAP\21_24927_Z002_Fire_Management_Zones.mxd Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data Source: NSW Department of Lands: Cadastre - Jan 2011; LPMA Data 2013; Lewis and James (2010) Kempsey to Eungai: Compensatory Habitat package' Created by:mking3

Appendix E – Response to the Department's Document Review / Comments

Proponent:	Roads and Maritime Services
Project:	Pacific Highway Upgrade (Warrell Creek to Nambucca Heads)
Document:	Biodiversity Offset Package
EPBC conditions:	EPBC 2013/7101: Condition 12.
Document full title	Roads and Maritime Service, Pacific Highway Upgrade, Warrell Creek to Nambucca Heads, Biodiversity Offset Package, December 2015.
Date document received	11 December 2015
Drafting officer	Kahli Beissner
Reviewing officer	Peter Blackwell

Condition Number	Condition	Has the condition been met?	Comments (Gaps in information, improvements, adequacy of technical/ scientific information and assumption/justifications, etc.)	Response by Proponent to comments/issues
General Comments		ACTION Please ensure that language committing to the proposed actions is used. For example, use 'will' instead of 'would' or 'should'.		Agreed and amended.
		The third paragraph in Section 1.2 says "...impacts on biodiversity values but would result..." Please amend the tense of this statement as the action has already commenced.		Agreed and amended.
		Please provide the ecologists' reports from the targeted field surveys for the Norton offset site undertaken by GHD and Omvi in 2014 (Section 1.5.3).		There are no separate ecologists' reports arising from these field surveys. The field survey results are presented in this BOP.
		Section 1.7 states "This report has been prepared by GHD for Roads and Maritime Services and may only be used and relied on by Roads and Maritime Services for the purpose agreed between GHD and the Roads and Maritime Services as set out in Section 1.2 of this report". It is unclear what 'purpose' has been outlined in Section 1.2.		The reference to Section 1.2 is an error. This should read "…as set out in Section 1.3 of this report" (ie Purpose of report).
		Please explain this comment and consider rewording to encompass RMS's obligations to meet its EPBC conditions of approval including actioning the entire plan, including management actions, monitoring, corrective actions, reporting, etc.		The purpose of this comment is to confirm that GHD have provided a technical report for RMS in accordance with our agreed scope of works and professional services contract. The statement has been reworded to include the purpose: "to assist Roads and Maritime Services meet the conditions of approval relating to biodiversity offsets for the project". However GHD does not accept responsibility for RMS's obligations to meet its EPBC conditions of approval nor for the managers of offset sites to meet their ongoing monitoring and management obligations.
		Please provide the Benwell (2013) as an Appendix to this BOP, particularly to support statements such as those on specific characteristics of the Marsdenia longiloba habitat and population dynamics. Please advise if these findings		Agreed. Survey results have been used to update NSW government biodiversity records (ie submission of locations of plant

Condition Number	Condition	Has the condition been met?	Comments (Gaps in information, improvements, adequacy of technical/ scientific information and assumption/justifications, etc.)	Response by Proponent to comments/issues
		are being used to update NSW government biodiversity records.		observations to BioNet) in accordance with the conditions of our NSW scientific licence. It is a matter for the NSW government to update their threatened species profiles in response to these biodiversity records.
		Please clarify why the dot points in Section 2.6.4 have the numbers 3.1, 3.2, 5.5 and 5.6 consecutively. Similarly, Section 2.7.4 refers to Action 2, Action 4 and Action 4.2; and Section 2.4.4 has Specific objective 1a, 1e, 1f and 2a; Section 2.5.4 refers to Action 1, 2 and 7. It is unclear why the numbers in between have been omitted.		The numbers are from the recovery plans that are referenced at the end of each bullet point list. They are not sequential because it is a list of the“ specific actions of the recovery plan that are applicable to this offset package” as stated in section 2.6.4. i.e. the missing numbers are associated with actions that are not relevant to the offset package. For instance in Section 2.7.4 actions in the frog recovery plan such as “3.1. Investigate the role of disease in frog declines, 3.2. Develop captive husbandry techniques 3.3. Assess the need for translocation experiments, 4.7. Remove stock from the habitat of Kroombit tinkerfrog” etc are not relevant to this offset package.
		Please provide the reference in Section 2.4.3 in place of “(ref)”.		Provided: DECC (2008c) Approved Recovery Plan for the Koala (Phascolarctos cinereus). DECC, Hurstville, Sydney. <http://www.environment.nsw.gov.au/resources/threatenedspecies/08450krp.pdf>
		Section 3.1 mentions the Conservation Agreement that will be implemented on the Norton offset site and that it will encompass a Plan of Management. Please provide a copy of this Plan of Management that will be provided to the landowner or explicitly state that the landowner will be implementing this BOP once approved.		RMS has confirmed that the Norton site will now be protected under a BioBanking Agreement. The management action plan for the Norton biobank site is included in Appendix D.
		“DE, 2013” is referenced numerous times throughout the BOP, however it is not clear from the reference list what this is. Please clarify and amend accordingly.		DotE (2013) Draft EPBC Act referral guidelines for the vulnerable Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory). http://www.environment.gov.au/resource/draft-Koala-referral-guidelines The two mistaken references to ‘DE, 2013 have been amended to ‘DotE, 2013’

Condition Number	Condition	Has the condition been met?	Comments (Gaps in information, improvements, adequacy of technical/ scientific information and assumption/justifications, etc.)	Response by Proponent to comments/issues
		Section 3.5.3 – Please amend: "...above and in in connected..."		Done.
Condition 12	To compensate for the loss of threatened species habitat, within 12 months of the approval of the action, the approval holder must submit to the Minister for approval a Biodiversity Offset Package. The Package must:			
	provide known habitat and compensate for the residual significant impacts on the threatened species and their habitat in Condition 1a) to e);	No	The threatened species to be offset are: Clear Milkvine, Cryptic Forest Twiner, Koala, Grey-headed Flying Fox, Spotted-tail Quoll and Giant Barred Frog. ACTION Section 1.1 mentions the EBPC listed species that are likely to be impacted by the Pacific Highway upgrade between Warrell Creek and Nambucca Heads (WC2NH). It is noted that no offset is required for these species and they do not need to be discussed in detail in the Biodiversity Offset Package (BOP). Please clarify why impacts to the	Section 1.1 amended to read "The Project would result in significant residual impacts on the following threatened biota…" The BOP has only been prepared to address impacts on the threatened species to be offset and so impacts on these additional threatened species are not discussed.

Condition Number	Condition	Has the condition been met?	Comments (Gaps in information, improvements, adequacy of technical/ scientific information and assumption/justifications, etc.)	Response by Proponent to comments/issues
			Australian Painted Snipe, Regent Honeyeater, Swift Parrot and Milky Silkpod have not been mentioned in this section.	
			Section 1.2 outlines the residual impacts on listed species. It includes reference to the removal of 113.3 ha of Spotted-tailed Quoll habitat. However, a Variation dated 11 May 2015 specifies this as 114.1 ha. Please advise which is correct.	The BOP has been updated with latest clearing limit for Spotted-tail Quoll (114.1 ha).
			Please include in Section 1.2 the habitat quality score as entered into the Offsets Assessment Guide calculator for each species in the impact area.	Done
			Condition 1)e. states that the approval holder must not clear more than 0.70 ha of Giant Barred Frog (GBF) habitat. However, Section 1.2 mentions that 0.88 ha of GBF habitat was removed. Please clarify if the Department has been notified of this non-compliance. Please submit to the Department a request to vary the conditions of approval for this project to enable compliance, providing justification for the change.	The Department was notified of a potential unexpected find via an email from David Ledlin at RMS to Manel Samarkoon at the Department on 27 October 2015. The reply email from Manel Samarkoon on 30 October 2015 provided confirmation that the Department accepted that “RMS have undertaken procedures consistent with the Unexpected Threatened Species/EEC Procedure (Attachment J to the approved Giant Barred Frog Management Strategy - GBFMS). “ and “As required under the approved GBFMS, please include an additional area of GBF offset habitat to compensate for 0.18 ha of potential GBF habitat impacted at Butchers Creek in the biodiversity offset package (condition 12 The tadpoles found were later identified as Great Barred Frogs so no variation is required. However, we have committed to increase the offset area for Giant Barred Frogs by 0.18 ha.
	demonstrate consistency with and meets the	No	RMS provided copies of the Offset Assessment Guide calculations (as Excel spreadsheets) for the Boambee SF offset	Noted

Condition Number	Condition	Has the condition been met?	Comments (Gaps in information, improvements, adequacy of technical/ scientific information and assumption/justifications, etc.)	Response by Proponent to comments/issues
	requirements of the EPBC Act Environmental Offsets Policy;		area (Cryptic Forest Twiner/Clear Milkvine, Grey-headed Flying Fox, Koala, Spotted-tailed Quoll) and the Norton offset area (Grey-headed Flying Fox, Koala, Spotted-tailed Quoll). Section 7 discusses the quality of the offset areas and justifies scores entered into the Offset Assessment Guide calculator.	
			ACTION Please explain why the Offset Assessment Guide calculator for Giant Barred Frog are “hypothetical” (as stated in the spreadsheet provided).	This was an error. The Offset Assessment Guide calculator was mistakenly sent without the ‘Offset Area’ and ‘Information source’ fields having been updated. All other fields contained the correct data for the impact area and Boambee SF offset area as summarised in Table 20 of the BOP. An updated Offset Assessment Guide calculator will be sent with the updated BOP.
			Please include the habitat quality for each species in Section 7.1 (impact site and offset areas).	Disagree. Section 7.1 is intended to provide a summary only with the detail provided in Section 7.4. Including site quality scores for impact area and start, with and without the offset at two separate offset areas would require adding up to 7 separate quality scores for each species. This is too much detail for a summary.
			Section 7.2.1 mentions a risk of loss with offset of 3% for the Norton offset site. Please increase this to 5% or above. The offset could fail due to natural disasters, or the covenant could be overturned so these factors need to be considered.	Disagree. A BioBanking agreement is the strongest conservation covenant available on private land in NSW. Approval from the NSW Minister for Environment is required to overturn it and this can only be granted for State significant mineral exploration or infrastructure. In these instances, a matching like for like offset must be provided to compensate for the loss of the original offset and so the net impact on biodiversity values would be averted. 3% is a reasonable estimate of the risk of a catastrophic natural disaster in any given area of around 200 hectares in 20 years. Further the Department has accepted a 2% risk of loss with offset for offset areas protected by a BioBanking agreement on offset plans approved in January 2016 for EPBC 2012/6394 Woolgoolga to Ballina project.

Condition Number	Condition	Has the condition been met?	Comments (Gaps in information, improvements, adequacy of technical/ scientific information and assumption/justifications, etc.)	Response by Proponent to comments/issues
			Section 7.2.2 mentions a risk of loss with offset of 3% for the Boambee SF offset site. Please justify or revise this to at least 10% as there are risks in a designated SF of accidental clearing (through misreading of maps, etc), unauthorised activities during periods when no active management is present and natural disasters (eg intense fire).	Disagree. A Flora Reserve is one of the strongest conservation covenants available in NSW. FCNSW have rigorous systems in place to avoid accidental impacts to Flora Reserves and other protected areas. Additional support for this score has been provided by FCNSW and included in Section 7.2.2. Unauthorised activities may result in localised or incremental impacts to the offset area but would not result in the loss of the entire offset area. 3% is a reasonable estimate of the risk of a catastrophic natural disaster in any given area of around 100 hectares in 20 years.
			Tables 16, 17, 18 refers to an approved offset strategy (BEM, 2014) as justification. Please ensure that detailed justifications are provided for all of the scores entered into the Offset Assessment Guide calculator, particularly for habitat quality.	Noted.
			Please provide the BEM (2014) report as it is referenced in this BOP but not publicly available.	Agreed.
			Referencing “DSEWPaC (2013) Description of EPBC Act Offsets Assessment Guide functionality for fictional offset scenarios – Industry Training. Department of Sustainability, Environment, Water, Population and Communities, Canberra” is not suitable justification. 95% confidence in result (averted loss) is extremely high and requires considerably more justification (Table 16).	Noted. Additional justification provided in Tables 16, 17, 18. The Department has accepted a 95% confidence in result (averted loss) for offset areas on recent project approvals we have delivered for offset sites protected under secure conservation covenants. This confidence reflects the legislation, systems, policies and governance connected to biobank sites and Flora Reserves.
			Please justify or correct the 80% risk of loss without offset, yet providing a score	As stated in Table 16 the habitat quality would probably continue to decline, but by less than 10%, but “These incremental impacts

Condition Number	Condition	Has the condition been met?	Comments (Gaps in information, improvements, adequacy of technical/ scientific information and assumption/justifications, etc.)	Response by Proponent to comments/issues
			of 7 (same as start quality) as the future quality without offset (Table 16).	are distinct from the removal of habitat associated with a timber harvesting event at the WC2NH offset area, which is assessed under 'risk of loss of offset'." If the offset area was lost through a timber harvesting event then the site quality score would become zero. As stated in the Department's guidance "Risk of loss (%): This describes the chance that the habitat on the proposed offset site will be completely lost (i.e. no longer hold any value for the protected matter of concern) over the foreseeable future." We have taken a conservative approach in determining calculator inputs by selecting the future quality if the offset was not lost (20% chance).
			The offset start area to be entered into the Offset Assessment Guide calculator should be 34.2 as mentioned throughout the BOP (Table 16).	OK
			Please consider improving the quality of the offset areas by more than 1 point. If a future quality of 8 (start= 7) is expected to be achieved within 5 years, please justify not striving for a future quality of 9.	A 1 point increase in habitat quality within 5 years is what could be reasonably expected with active management. Again we are taking a conservative approach with calculator inputs.
			The start area for Boambee SF offset site was entered into the offset calculator as 54.5 ha for Koalas and GhFF. Throughout the BOP, 49 ha of suitable Koala and GhFF habitat is referred to. Please re-run the offset calculator with the correct start area.	The correct start area at the time of publication was 54.5 hectares. An additional 5.5 hectares of wet sclerophyll forest was added to the offset area late in the project timeline to accommodate Giant Barred Frog habitat. See Table 6. Some of the references to the area of habitat for Koalas and GHFF (49 hectares) in sections written earlier were not updated accordingly. The 5.5 hectares of Giant Barred Frog habitat has since been removed at the request of FCNSW and replaced with habitat at the xxxxx offset site. These numbers have now been amended.
			Please update the impact area to 106.6 ha as entered into the offsets calculator (Tables 17 and 18).	Done.

Condition Number	Condition	Has the condition been met?	Comments (Gaps in information, improvements, adequacy of technical/ scientific information and assumption/justifications, etc.)	Response by Proponent to comments/issues
			Please update Table 19 with the accurate impact area for Spotted-tail Quoll habitat (114.1 ha), and offset start area for Boambee SF offset site (49 ha).	As above the correct start area at the time of publication was 54.5 hectares. An additional 5.5 hectares of wet sclerophyll forest was added to the offset area late in the project timeline to accommodate Giant Barred Frog Habitat. See Table 6 Some of the references to the area of habitat for Koalas and GHFF (49 hectares) in sections written earlier were not updated accordingly. The 5.5 hectares of Giant Barred Frog habitat has since been removed at the request of FCNSW and replaced with habitat at the xxxxx offset site. These numbers have now been amended. The BOP has been updated with the latest clearing limit for Spotted-tail Quoll (114.1 ha).
	detail the offset attributes (including maps in electronic Geographic Information System (GIS) format with accompanying shapefiles), site descriptions, environmental values relevant to threatened species being offset, connectivity with other habitat and biodiversity corridors;	No	Shapefiles of the Boambee SF and Norton offset sites have been provided to the Department. Section 3 provides a description of the Norton offset site, with maps included as Figure 2 (location) and Figure 3 (vegetation type). Section 4 describes the Boambee SF offset site, with Figure 5 showing location and Figure 6 depicting vegetation types. Biodiversity corridors and connectivity for the Norton offset site and Boambee SF offset site are discussed in Sections 3.2 and 4.2, respectively.	

Condition Number	Condition	Has the condition been met?	Comments (Gaps in information, improvements, adequacy of technical/ scientific information and assumption/justifications, etc.)	Response by Proponent to comments/issues
			ACTION Section 1.1 states that 185 ha of the 484 ha Norton offset site will be offset under EPBC 2013/7101. The Norton and Griffin Offset Management Plan for EPBC 2013/6963 mentions that 484 ha will be offset under these approval conditions. Please clarify how the offsetting requirements for both projects are addressed by the Norton offset site.	The Norton and Griffin Offset Management Plan for EPBC 2013/6963 will be modified and resubmitted to reflect that 185 ha of the 484 ha Norton offset site will be offset under EPBC 2013/7101. A further 37.1 ha of the Norton property is being used to offset EPBC 2012/6518, as identified in the Oxley Highway to Kempsey Offset Management Plan that is currently awaiting approval. An appropriate alternative offset area will be identified for EPBC 2013/6963 to compensate for this 222 hectare reduction.
			Section 3.1 states that the Norton offset area is 489 ha (as with Table 3), whereas Section 1.1 says that it is 484 ha. Please clarify which is correct and justify the difference in numbers provided.	The difference in area is due to the 5 hectare 'house site and home paddocks' which is not part of the offset site or WC2NH Norton offset area but was mistakenly included in Table 4. The total area of the site has since changed with recent land acquisitions, exclusion of land to accommodate a section of the Pacific Highway upgrade and recognition of easements. The new area of the Norton offset site / biobank site is 495.9 ha. The WC2NH Norton offset area is 185 ha.
			Please provide a map showing access tracks, firebreaks, fences, gates and signs for the Norton offset site.	See Figure 12.
			Please provide a map or maps showing the EPBC listed threatened species habitat within the Norton offset.	See Figure 4.
			Sections 4.4.3 and 4.4.4 mention that Boambee SF offset area is 121 ha (49 + 72). However, Section 4.2 states it is 126.5 ha. Please use the correct area.	As above an additional 5.5 hectares of wet sclerophyll forest was added to the offset area late in the project timeline to accommodate Giant Barred Frog Habitat. Some references to areas were mistakenly not updated in sections that had been written weeks earlier.

Condition Number	Condition	Has the condition been met?	Comments (Gaps in information, improvements, adequacy of technical/ scientific information and assumption/justifications, etc.)	Response by Proponent to comments/issues
				The 5.5 hectares of Giant Barred Frog habitat has since been removed at the request of FCNSW and replaced with habitat at the xxxxx offset site.
	include detailed surveys and quantitative and qualitative descriptions of any proposed offset areas which clearly identify baseline conditions. This must include:	No	Details of the surveys undertaken at both the Norton and Boambee SF offset area are outlined in Section 1.5.3. Figures 3 and 6 show the vegetation types within the Norton and Boambee SF offset sites respectively.	
	a baseline description (prior to any management activities) of the current quality of the habitat for each relevant threatened species in each offset area, including the location of survey points (GPS reference);		Section 3.4 describes the quality and extent of habitat for significantly impacted listed species within the Norton WC2NH offset site, as per below. Koala: 185ha, quality= 9. GhFF: 185 ha, quality= ? Quoll: 185 ha, quality= ?	Noted. This section has been updated with a paragraph stating the habitat quality score for each species and cross-referencing the offset guide calculations.

Condition Number	Condition	Has the condition been met?	Comments (Gaps in information, improvements, adequacy of technical/ scientific information and assumption/justifications, etc.)	Response by Proponent to comments/issues
	the quantity (in hectares) of suitable habitat present within the offsets areas for the threatened species the quality of the habitat for the relevant threatened species found within the offset areas;		Section 4.4 describes the quality and extent of habitat for significantly impacted listed species within the Boambee SF WC2NH offset site, as per below. Plants (Milkvine/Twiner): 34.2 ha, quality= 7. Koala: 49 ha, quality= 8 GhFF: 49 ha, quality= 8 Quoll: 49 ha, quality= 8 GBF: 5 ha, quality= 8	
	vegetation condition mapping; and		ACTION Please commit to undertaking accurate targeted surveys (including at appropriate times) for Koalas, GhFF and Quolls as specified in the respective SPRAT profiles in order to achieve more accurate baseline conditions.	The surveys undertaken are consistent with the approval condition requirements regarding vegetation condition and a baseline description of the quality of habitat for each threatened species. The baseline condition described in the BOP is sufficient to manage the site to achieve improvements in habitat quality and an effective biodiversity offset for the affected threatened species. RMS does not intend to undertake any further baseline surveys of the offset sites, other than that required to enter into a BioBanking Agreement with OEH over the Norton and xxxxx sites.
			As the Phillips and Callaghan (2011) Koala SAT method was used, please provide a Table with the activity levels for each plot and strike rates by tree species (include 2014 and 2011 data) to provide a more accurate baseline.	Noted.
			Section 1.5.3 indicates that Koala SAT surveys were undertaken as described in Callaghan and Phillips (2011). According to this method, at each plot a minimum of	The surveys were undertaken with reference to Callaghan and Phillips (2011). At least 30 trees were searched in each plot and that was the standard however where the canopy tree plot

Condition Number	Condition	Has the condition been met?	Comments (Gaps in information, improvements, adequacy of technical/ scientific information and assumption/justifications, etc.)	Response by Proponent to comments/issues
			30 trees should be searched and the same number of trees should be searched at each plot . Please detail the actual Koala SAT methods used. Please ensure that future Koala SAT surveys are accurately undertaken as outlined in Phillips and Callaghan (2011). Please note that this technique is optimised for high density populations, so search time needs to be extended for less dense populations.	contained >30 trees and/or time permitted additional trees were searched.
			Please ensure that the Appendices contain all field survey results (as referenced on Page 7). Appendix A should include: Habitat assessments, BioBanking plots/transects, 'Canopy plots', Koala SAT surveys, Nocturnal surveys, tally of species seen on motion sensing cameras. Appendix B should contain results from at least: Braun-Blanquett cover-abundance, habitat assessment, Koala SAT surveys, weed mapping, targeted field surveys.	Noted. Appendix A has been updated to include additional detail from field surveys, where appropriate. Specific responses are as follows: Habitat assessments – this is not a technique that yields quantitative results that can be tabulated in an appendix. It has fed directly into the 'habitat quality' sections in the report. BioBanking plot/transects, were included in Appendix A. Note additional plot/transects have since been sampled at the Norton site and included in the updated Appendix A. 'Canopy plots', results were presented as Table 4 and Table 7 in the body of the report. Koala SAT surveys, results were summarised in Table 4 and Table 7 in the body of the report. Activity levels have been added as described above. Nocturnal surveys, results were included in the fauna species lists in Appendices A and B. Species captured on motion sensing cameras are included in the fauna species lists in Appendices A and B. None of the targeted threatened species were detected on cameras and so a tally of individuals is not appropriate.

Condition Number	Condition	Has the condition been met?	Comments (Gaps in information, improvements, adequacy of technical/ scientific information and assumption/justifications, etc.)	Response by Proponent to comments/issues
				Braun-Blanquett cover-abundance scores were included in Appendix B. Additional plot/transects have since been sampled at the Norton site and included in Appendix A. Weed mapping results are the weed polygons on the property action plan figures.
			The Boambee SF offset area flora species table in Appendix B does not show all of the results (Table too big for page). Please ensure that all tables and information within the BOP are visible within page margins.	Noted and corrected.
			Please specify when the GHD report on the May 2015 surveys in Boambee SF offset area is expected to be completed (Section 1.5.3). Please provide a copy to the Department once received, as this BOP will not be able to be approved without it.	This report is the Pacific Highway Upgrade, Nambucca Heads to Urunga Threatened Flora Offset Management Plan (TFOMP) which was also submitted to the Department and reviewed by this DoE officer in 2014. The TFOMP was submitted for approval to the Department in November 2016. This BOP includes all of the field survey results from that report in Appendix B and relies on the same set of primary data collected by the same ecologists. The reference to GHD (in prep b) has been removed from Section 1.5.3 accordingly.
			Section 1.5.3 (under the Boambee SF offset site sub-heading) – “note that these initial five plot transects are located outside of the WC2NH offset area that is the subject of this offset package and so these data have not been included in Appendix A. The results have been included in the general assessment of vegetation condition and habitat quality at the site”. If the data collected outside of the WC2NH offset area has been used to determine the habitat quality within the	These data have been included in Appendix B. Please note that they will be in a separate table to the plots within the WC2NH offset area because they will not be sampled as part of the ongoing monitoring etc under this BOP.

Condition Number	Condition	Has the condition been met?	Comments (Gaps in information, improvements, adequacy of technical/ scientific information and assumption/justifications, etc.)	Response by Proponent to comments/issues
			offset area, then it needs to be included in Appendix A.	
			Please justify treating WC2NH area is being of the same quality as where the plots were undertaken (Boambee SF).	The WCNH offset area is located in the same overall patch of vegetation and habitat as where these plots were undertaken within the Boambee SF. There is an arbitrary 'paper boundary' between the two areas which reflects the allocation of offset areas to individual projects. The quality of habitat does not vary across this paper boundary.
			Please clarify how targeted surveys were undertaken for Spotted-tailed Quolls and GhFF.	Camera trapping and spotlighting were undertaken for Spotted-tailed Quolls. Spotlighting was undertaken for GHFF. Section 1.5.3 has been updated to make this clearer.
			Figure 4 shows the locations of habitat type surveys, canopy plots and koala SAT surveys undertaken. Section 1.5.3 refers to Habitat assessments, BioBanking plots/transects, 'Canopy plots', Koala SAT surveys, Nocturnal surveys, tally of species seen on motion sensing cameras. Boambee- Braun-Blanquett cover-abundance, habitat assessment, weed mapping, targeted field surveys (Koala, GhFF, GBF, Quoll). Please ensure that the location of all surveys are included in maps and co-ordinates have been provided in a Table.	Survey effort is shown on Figures 3, 4, 6, 7, 8, 10 and 11. These figures have been updated to include additional detail from field surveys, where appropriate. Specific response are as follows: Habitat assessments – this technique was applied across the entire are of the sites during all time spent on site. It cannot be mapped or ascribed coordinates. BioBanking plots/transects are shown on Figures 3, 6 and 10. Coordinates are in appendices A, B and C. Canopy plots and Koala SAT surveys are shown on Figures 4 and 8. Coordinates are in appendices A, B (same locations as plot/transects). Nocturnal surveys cannot be readily mapped or ascribed coordinates because they were conducted along long, informal transects and included identification of distant animal calls (several hundred metres in the case of the Koala). Motion sensing camera locations have been added to Figures 4 and 8. Coordinates have been added to Appendices A and B. Braun-Blanquett cover-abundance scores were measured in plot/transects. They are not a separate field survey technique.

Condition Number	Condition	Has the condition been met?	Comments (Gaps in information, improvements, adequacy of technical/ scientific information and assumption/justifications, etc.)	Response by Proponent to comments/issues
				Weed mapping – this technique was applied across the entire area of the sites during all time spent conducting surveys. Weed mapping survey effort cannot be mapped or ascribed coordinates. The results are the weed polygons on the property action plan Figures 12, 13 and 14. "targeted field surveys (Koala, GHFF, GBF, Quoll)" refers to the above techniques. They are not separate field survey techniques.
			Figure 4 shows a koala observation and koala scats that have not been included in Appendix 4 ('Norton offset site fauna observations'). Please justify this and provide the ecologists' report from the surveys.	Amended.
			Section 3.4.1 describes the extent of koala habitat at the Norton offset site as: - 197 ha of Secondary Class A habitat (147 moist sclerophyll forest, 50 ha dry sclerophyll), and -337 ha of Secondary Class B habitat. This totals 534 ha of koala habitat. This differs vastly from the size of the Norton offset site as mentioned in Sections 1.1 and 3.1 (489 ha). Please clarify which is correct and justify.	No - Section 3.4.1 describes the extent of koala habitat at the Norton offset site as: - 197 ha of Secondary Class A habitat comprising 147 moist sclerophyll forest mapped by KSC (2011) and 50 ha of dry sclerophyll that was reclassified by Lewis and James (2011), and -337 ha of Secondary Class B habitat mapped by KSC (2011) of which 50 ha was reclassified by Lewis and James (2011). So the total is 147 ha class A plus 337 ha class B as mapped by KSC (2011) OR 197 ha class A plus 287 ha class B as mapped by Lewis and James (2011) both of which = 484 ha which along with 5 hectares of cleared land = the 489 ha area of the Norton site mentioned in Sections 1.1 and 3.1. The updated BOP includes revised mapping and calculations based on the new site boundary and the results of GHD surveys. The KSC (2011) mapping has been summarised in more general terms.

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			Section 3.4.2 (GhFF) states that the Norton site is "likely to support at least one continuously occupied roost camp". Please clarify the uncertainty behind this and explain if appropriate targeted surveys have been conducted.	'Support' means to provide foraging resources for a roost camp that is within the commuting distance of its resident flying foxes. It does not mean that the roost camp is at the site. There are three known camps within the vicinity of the Norton offset site (see Section 3.5.2) and flying foxes from at least one of these camps would forage at the site given previous observations of the species at the site and sampling of food tree species in the present study. Sufficient targeted surveys have been conducted to confirm that the site contains foraging habitat critical to the survival of the species.
			Sections 3.4.2 and 3.4.3 require a habitat quality score for the GHFF and the quoll.	Amended.
			Section 3.5.1 – Please justify not mentioning the 2014 Koala surveys in this section, or include them (currently only refers to 2010 findings).	The 2014 surveys are mentioned in this section. See the first line 'The Koala was recorded at the Norton site during the GHD survey…' and the results throughout.
			Please provide the 'detailed ecological assessment' report for the Boambee SF offset site as referred to in Section 4.1.	The BOP is the detailed ecological assessment. Section 4.1 is stating that the ecological assessment was conducted for this project and that a separate but overlapping assessment was also conducted at the site for the NH2U project.
			Figure 5 shows the Boambee SF offset site. Please justify how fragmentation/dispersal issues would not be intensified by an approximate 650m gap between the 2 areas and logging occurring in between.	As described above, a 5.5 hectare area was added to accommodate the Giant Barred Frog comparatively late in the project timeline (the separate area located to the north). At the time of publication, RMS and FCNSW were negotiating to include an additional parcel of land in the WC2NH offset area that would connect these two areas and avert fragmentation/dispersal issues associated with the gap. The 5.5 hectares of Giant Barred Frog habitat has since been removed at the request of FCNSW and replaced with habitat at the xxxxx offset site.
			Figure 6 shows that Plot W7 is outside of the offset area and that no plots were	W7 fell outside the WC2NH offset area because the 5.5 hectare area that was added to accommodate the Giant Barred Frog was

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			surveyed in the north-western fragment of the offset. Please justify not requiring a plot in that section of the offset area.	initially identified during a field survey and then had to be clipped around an easement that could not be included in the offset area. This restriction on title was not apparent on the ground at the time that the field survey was undertaken. As above, the 5.5 hectares of Giant Barred Frog habitat has since been removed at the request of FCNSW and replaced with habitat at the xxxxx offset site.
			Section 4.5.1 –"Based on the above assessment of the populations of threatened plants at the site the species stocking rate component of the current habitat quality of the NH2U offset area was scored as 8/10 (see Section 7)." This BOP is WC2NH offsets. Please correct.	Done
			Section 4.5.2 states that there are 900 records of Koalas in the locality of the Boambee SF offset site, however only 3 koala records were obtained during surveys. Please explain this disparity and elaborate on search effort and timing as 900 records indicate a high-density population, yet the search results suggest a very low population density. This suggests that survey efforts and intensity may not be appropriate.	900 records in an area of 31,400 hectares = approx. 1 record per 34.8 hectares. 3 records in an area of 126 hectares is approx. 1 record per 42 hectares. These figures are comparable. Further the 900 records in the locality are the product of all surveys by ecologists holding scientific licences over a 10 year period, including re-counts, so cannot really be equated to 'density' when compared with the results of a single round of survey. The current surveys undertaken are consistent with the approval condition requirements regarding confirmation of occupied Koala habitat, vegetation condition and a baseline description of habitat quality. The baseline condition described in the BOP is sufficient to manage the site to achieve improvements in habitat quality and an effective biodiversity offset for the Koala.

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			Please clarify where the photo reference points are located in both offset sites. Were photos of baseline condition taken during the most recent surveys?	Baseline condition photos were taken in the most recent surveys. See Appendix A, B and C.
			More detail is required on baseline presence of feral animals and weeds, including types and abundance within both offset areas.	Weed types and areas of infestations are shown on Figures 12, 13 and 14. Feral animals recorded at the sites are listed in Appendices A, B and C. Feral animals that are known or predicted to occur and which require management are discussed in Sections 6, 7 and 8. The current surveys undertaken are consistent with the approval condition requirements regarding the presence of weeds and pest animals and a baseline description of habitat quality for each threatened species. The baseline condition described in the BOP is sufficient to manage the site to achieve improvements in habitat quality and an effective biodiversity offset for the affected threatened species.
	be prepared by a suitably qualified ecologist;	Yes	Section 1.6 and Table 2 discuss the suitably qualified ecologists that assisted with preparing this plan.	
	include conservation and management measures for long-term protection and adaptive management of the offsets to improve habitat for threatened species within the			

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	offset areas from baseline conditions, including but not limited to:			
	a map showing offset areas to be managed;	Yes	Figure one shows the location of the offset areas in respect to the project area. Figures 2 and 5 depict the Norton and Boambee SF offset areas respectively.	
	conservation management actions for each offset area and the details of methods to be used;	No	Management actions and monitoring are discussed in Section 5 (Norton offset site) and Section 6 (Boambee SF offset site).	
			ACTION In Sections 5.2.1 and 6.2.1, consider rewording “maintenance of native vegetation” as the condition requires improvement of the offset area.	Noted.
			Please discuss why no fences or signs are proposed on the eastern border of the Norton offset site, particularly near the roads (Figure 9).	The eastern border of the Norton offset site adjoins the main north-south railway line. There is no public access. A sign is proposed at the south-eastern corner of the site where it adjoins a public road (see Figure 12).
			Figure 9 shows a proposed development adjacent to the offset area. Is this likely to affect the condition of the offset (e.g. increased edge effects)? Please justify not including more signs along the western edge of the offset area,	Edge effects would be managed in the same way as they are proposed to be managed along the southern, south-western and eastern boundaries as well as along easements and access tracks. Signs have been proposed at each of the potential vehicle access points to the site. It would not be practical to have signs at every point of potential pedestrian access around the boundary of the

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			particularly near the proposed development.	site. Further the developments in question (a freeway and a quarry) will feature security fencing and very limited pedestrian or vehicle access and so the risk of unauthorised access from these directions is low. Koala fencing has been installed on the Pacific Highway boundary, adjacent to the Norton offset site as part of the Pacific highway upgrade.
			Please make Table 9 more similar to Table 13, particularly in relation to the activities listed.	Noted.
			More information is required on pest fauna control in Sections 5.2.1 and 6.2.1. Please include control of all feral animals in the area, including ungulates such as pigs.	The Norton pest management plan developed under the BioBanking Agreement will cover pest species known or likely to occur on the property, including pigs. FCNSW have committed to an annual pest control program in the Boambee SF Flora Reserve.
			Please include under the 'Conservation and improvement of habitat' subheading (Section 6.2.1) information on all the points listed at the start of the section.	Noted
			Please exclude the use of baiting for pest animal control in Boambee SF offset site to eliminate the risk to Quolls (Section 6.2.1).	Noted
	offset management must be consistent with threat abatement plans for threatened species;	No	ACTION Please ensure that Sections 5.2 and 5.3 are consistent with relevant and current threat abatement plans and conservation advice. For example, managing vehicle strike, disease, etc for Koalas (see Threat Abatement and Recovery in the SPRAT profile- http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id	The relevant management actions sections are consistent with relevant Threat abatement plan (TAP) and recovery plans (noting that the majority of the threat abatement and recovery actions identified by DoEE apply to conservation and management activities of Government agencies and not specific actions that could be undertaken at offset sites). TAPs and conservation advice were considered in identification of management actions as stated in Sections 2.2.4, 2.3.4, 2.3.3, 2.5.4 and 2.6.4. To make this clearer additional tables have been added to Section 9.3 –'Contribution of management actions to the

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			=85104) is required. Ensure that species-specific management actions are to be implemented for each species being offset for.	offset' stating explicitly the link between TAPs and management actions.
			Tables 9 and 13 need to include management actions that are consistent with threat abatement for each species.	The management actions tables do include actions that are consistent with threat abatement for each species. Additional tables have been added to Section 9.3 -Contribution of management actions to the offset stating explicitly the link between TAPs and management actions.
	the timing of management activity for each offset area and anticipated timeframes for achieving performance objectives;	No	ACTION Please specify how often the condition of fences, gates and signs will be inspected (Tables 9 and 13).	Noted
			Please update the 'Timeframe' column in Table 9 to be more descriptive and specific, as in Table 13.	Noted
			Information is required regarding on ongoing rubbish removal in case illegal dumping occurs on the offset sites. Appropriate timeframes are required for rubbish removal and fence strand removal (ie. "completed by end" is not sufficient).	Noted
			Table 9 has the timeframe for some management/monitoring actions as 'until 2035'. However, Tables 10 and 11	Noted. It will be 2036 for the purpose of this table and offset assessment guide calculations. In practice most management actions will be implemented in perpetuity.

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			mention 2036. Please clarify which is correct.	
			Tables 9 and 13 require anticipated timeframes for achieving performance objectives.	The anticipated timeframe for achieving performance objectives is the date for completion set in the 'Timeframe' column.
			The Table (Table 14?) with the management actions program for the Boambee SF offset site is referred to as Section 6.2.1 (a Section 6.2.1 already exists). Please amend.	Noted and updated.
	clear performance measures and performance indicators for each offset area including contingency actions, criteria for triggering contingency actions and a commitment to the implementation of these actions in the event that performance objectives are not met that will enable maintenance and enhancement of habitat within the	No	ACTION Please provide specific triggers for the corrective actions in Tables 9 and 13, and provide appropriate timeframes for implementing corrective actions once a trigger has been reached (eg. If a fence has been broken, how long until it will be fixed?). Measurable and specific performance targets are required where possible, such as with weeds and feral animals.	Tables 12 (formerly 9), 15 (formerly 13) and 17 provide the framework for monitoring and adaptive management at the offset sites. The performance targets that have been set are outcomes based, as is appropriate for an adaptive management framework. It is not appropriate to set specific, quantifiable targets in this context e.g. if a fence is broken the time taken to fix it will depend on the length of fence requiring repair, topography, magnitude of damage (which could range from a few metres of broken strands to an entire fence line being burnt out in a wildfire) etc. Repairs and other corrective actions will be undertaken as soon as is practicable to ensure performance targets are met.

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	offset area, as well as contribute to the better protection of individuals and/or populations of threatened species and their habitat;			
			Fire management (for ecological burns and wildfires) needs to be included in Table 9.	Noted and added.
			Triggers and corrective actions are required for habitat quality and threatened species abundance.	The triggers and corrective actions identified in Tables 12, 15 and 17 are consistent with the approval condition requirement to enable maintenance and enhancement of habitat within the offset area, as well as contribute to the better protection of individuals and/or populations of threatened species and their habitat . RMS does not intend to set trigger levels based on threatened species abundance because that would impose monitoring and management requirements on FCNSW and biobank site owners that are not practical or achievable. The affected threatened biota are each cryptic and/or prone to population fluctuations and/or mobile and transitory in their use of habitat as clearly stated and referenced in Section 2 of the BOP. The link between management actions and improvements in habitat quality and protection of populations is demonstrated in Section 9.3. The offset calculations rely on a modest increase in habitat quality (typically one point out of 10) and modest confidence in the effectiveness of management actions (75%). The proposed adaptive management and monitoring framework is sufficient to support these offset calculations and comply with this condition.

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	a monitoring program to assess the effectiveness of the management actions measured against the baseline condition. This must include, but not be limited to, control sites and periodic ecological surveys to be undertaken by a suitably qualified ecologist;	No	Suitably qualified ecologists will undertake vegetation/habitat condition surveys every 5 years until at least 2036. ACTION Please justify not monitoring threatened species in the offset areas through targeted fauna surveys.	The proposed monitoring program is consistent with the approval condition requirement a monitoring program to assess the effectiveness of the management actions measured against the baseline condition. The BOP does not include a requirement for ongoing monitoring of threatened fauna because that would impose monitoring and management requirements on FCNSW and biobank site owners that are not practical or achievable. The affected threatened fauna are each cryptic and/or prone to population fluctuations and/or mobile and transitory in their use of habitat as clearly stated and referenced in Section 2 of the BOP. The link between management actions and improvements in habitat quality and protection of populations is demonstrated in Section 9.3. RMS have committed to a full ecological survey of the offset sites at Year 5 to further confirm the link between the proposed management actions and habitat quality and the security of threatened species populations. Ongoing monitoring of ecological condition will be undertaken by biobank site owners (supported and enforced by OEH) and FCNSW.
			Section 5.3.3 mentions “baseline survey and establishment of monitoring by end”. Please clarify when this will occur and justify why the initial surveys of the offset area are not considered baseline.	Baseline condition for monitoring is as presented in this BOP. This originally referred to baseline monitoring plots that would have been established by NCT in 2015 and accordance with their governance systems. The Norton site will now be set aside as a biobank site. A BioBanking assessment has been included and formal photo points have been established. Photo points have now been included in Appendices A to C.
			Please clarify if the recommended monitoring locations for the Norton offset site (Table 12) will be used for ongoing monitoring.	Confirmed and updated.
			Please consider monitoring vegetation/habitat quality more often than every 5 years so that a decline in	Vegetation/habitat quality will be monitored annually at photo points as part of the annual report required under the BioBanking methodology at the Norton and xxxxx offset sites and as part of

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			condition can be detected before a large change occurs.	FCNSW's monitoring of the Boambee SF offset site. This would be sufficient to detect a decline in condition before a large change occurs that would be addressed in the following years' management actions. A full ecological survey at Year 5 will detect more subtle changes in condition and will be used to confirm the improvement in habitat quality.
			More information is required on photo point monitoring. Will photos be taken in north, east, south and west directions?	They will be taken in a single direction at the bearing specified for each photo point. See Appendix A, B and C.
			Please provide more information on the control sites that will be monitored for each offset area.	Control sites are not relevant in these instances as management actions are being applied to the entire area of the offset properties. Improvements in vegetation condition and habitat quality from baseline will be measured by annual photo point monitoring and an ecological survey in Year 5
			Please justify not having a photo point in the north-western fragment of the Boambee SF offset site (Figure 10). Will the ongoing habitat condition assessments occur at these locations?	The Giant Barred Frog habitat in the north west of the offset site was a late addition to the BOP and will not be included in the final BOP as described above.
			Please include the locations of gates on the map in Figure 10	No gates were proposed for the Boambee SF offset site given public access to the State forest. Given the limited network of tracks, dense vegetation and steep topography this is not considered to represent a substantial risk to biodiversity values. If monitoring detects problematic human visitation then gates will be considered as an adaptive management response.
	a risk assessment and a description of the contingency measures that would be implemented to	No	ACTION A risk assessment is required, along with measurable triggers and timely contingency measures.	A risk assessment has been included. See Section 9.4 and Table 21.

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	mitigate these risks;			
	details of the various parties responsible for the management, monitoring and implementing the management activities, including their experience and qualifications and employment or engagement status;	No	ACTION Please clarify where in the BOP that this condition has been met.	As management actions are proposed on the offset sites in-perpetuity it is not possible to provide details on every landowner/contractor/consultant that will be engaged to undertake these activities in this BOP. A responsibilities sub-section has been added to Sections 6, 7 and 8 to specify the parties responsible for overseeing the management and monitoring and the standard of qualifications and experience required for the contractors who will be implementing the actions. RMS (Pacific Highway Offset Team) will be responsible for implementing management activities on the Norton site until such time it is sold to a private owner. OEH will assume responsibility for on-going monitoring and compliance of the Norton and xxxxx biobank sites. The implementation of management actions will be coordinated by the private landowner. Any management actions would be performed by suitably qualified contractors in accordance with this BOP. FCNSW will be responsible for implementing the management actions and on-going monitoring and compliance of the Boambee SF flora reserve.
	details of qualifications and experience of persons responsible for undertaking monitoring, review, and implementation of the Biodiversity	No	Table 2 provides information on the qualifications and experience (in years) of people who undertook previous surveys and prepared and reviewed the BOP. ACTION Please provide details of who (organisation and role) will be implementing the BOP, including	As above, the management actions are proposed on the offset sites in-perpetuity and so it is not possible to provide details on every landowner/contractor/consultant that will be engaged to undertake these activities in this BOP. RMS (Pacific Highway Offset Team) will be responsible for implementing management activities on the Norton site until such time it is sold to a private owner. OEH will assume responsibility for on-going monitoring and compliance of the Norton and xxxxx biobank sites. The implementation of management actions will be coordinated by the private landowner. Any management actions

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	Offset Package, including the role of the independent expert in preparing, reviewing, and implementing the Biodiversity Offset Package; and		undertaking management, monitoring and corrective actions.	would be performed by suitably qualified contractors in accordance with this BOP. FCNSW will be responsible for implementing the management actions and on-going monitoring and compliance of the Boambee SF flora reserve.
	a description of protection and funding arrangements or agreements including work programs and responsible entities.	No	The Norton offset site will be secured via a BioBanking Agreement (Section 5.1.1) or Nature Conservation Trust Agreement (Section 5.1.2).	
			The Boambee SF offset site will be legally secured in perpetuity as a Flora Reserve. Funding to FCNSW for managing the Flora Reserve will be provided for 20 years (Section 6.1).	
			ACTION Please specify when the offset areas will be legally secured. What will determine if BioBanking or NCT agreement will be used for Norton offset site?	The offset areas will be legally secured (assuming DoEE approval of this BOP and OEH processing of the BioBanking agreement applications). A BioBanking agreement will be used to legally secure the Norton site.
			Please discuss the funding arrangements for the Norton offset site	As above, a BioBanking agreement will be used to legally secure the Norton site. Roads and Maritime will purchase and retire all of the biodiversity credits associated with the WC2NH Norton offset

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				area. This will secure the conservation covenant over the area of land, ensure that the credits cannot be used to offset the impacts of another development and provide funds for the management of the site in perpetuity (see Section 6.1).

GHD

133 Castlereagh St Sydney NSW 2000

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T: +61 2 9239 7100 F: +61 2 9239 7199 E: sydmail@ghd.com.au

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Document Status

Rev No.	Author	Reviewer		Approved for Issue		
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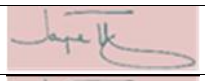
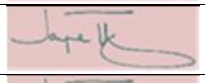
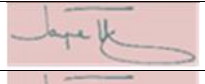
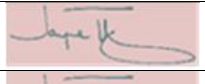
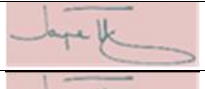
A	B Harrington	J Tipping				
B	B Harrington	J Tipping				
0	B Harrington	J Tipping		J Tipping		11/12/15
1	B Harrington	J Tipping		J Tipping		2/9/16
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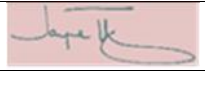
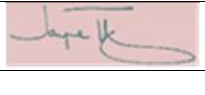
3	B Harrington	J Tipping		J Tipping		28/11/16

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