

Biodiversity Offset Strategy & Biodiversity Assessment Report for a potential Biobank Site at Huskisson

The purpose of this Biodiversity Assessment Report is to provide the details for the Biodiversity Offset Strategy for the West Nowra Resource Recovery Park (Major Project SSD 15 _7015) at Mundamia

Environmental Services Section,
Environmental Planning and Assessment Unit
Shoalhaven City Council

Table of Contents

1.	Introduction and Potential Offset site identification.....	4
1.1	General Characteristics and Land Use of the potential Biobank Site	6
1.2	Summary of potential Biobank Site attributes and management regime (current and future)	8
1.3	Plant Community Type and Species Credits to be offset	13
1.4	Offset options including Supplementary measures	14
1.5	Detailed justification for supplementary measures for the required offsets .	16
2.	Potential Offset Site	18
2.1	The Potential Offset Site Location.....	19
2.2	The Potential Offset Site relative to the Development Site.....	20
2.3	Potential offset site description.....	21
3.	Biobank Assessment Report for Option 2 (preferred)	22
3.1	IBRA bioregions and subregions, NSW landscape region and area	22
3.2	Native vegetation extent in the outer assessment circle	23
3.3	Cleared areas.....	23
3.4	Wetlands	24
3.5	Landscape value score components.....	26
3.5.1	Percent native vegetation cover in the landscape (potential biobank site) 26	
3.5.2	Connectivity value of the potential Biobank site.....	26
3.5.3	Patch size	27
3.5.4	Strategic location	27
3.6	Landscape value score	27
3.7	Native Vegetation and ecosystem credits	27
3.7.1	Plant Community Types and Credit Report	29

3.7.2	Management zone scores	33
3.8	Threatened Species	34
3.8.1	Species credit species detected on the potential Biobank Site	36
4.	References.....	39
5.	Annexures	40
5.1	Eastern Pygmy-possum targeted survey report	40
Table 1	Cost estimates of options to secure required ecosystem and species credits for the development site at Mundamia	15
Table 2	Biometric vegetation types, area, and credits regenerated on the potential biobank site	29
Table 3	Current and future values and averted loss scores for each management zone within the PCTs.	33
Table 4	Predicted species based on PCTs and habitat.....	34
Table 5	Geographic and habitat features on the biobank site	35
Table 6	Species Credit species requiring survey on the potential biobank site	35
Figure 1	Potential Biobank Site within 235 Huskisson Road, Huskisson.....	6
Figure 2	Current land zonings for the subject land and surrounds (Shoalhaven LEP 2014)	8
Figure 3	Bush Fire Risk Management Plan mapping with Strategic Fire Advantage Zones marked in blue hatching	11
Figure 4	Potential Biobank Site Management Issues – weeds and tracks to be closed	12
Figure 5	Potential Biobank (Offset) site relative to development site both depicted by red polygons.....	20
Figure 6	Mitchell Landscapes of potential biobank site	22
Figure 7	Native vegetation within the Outer Assessment Circle	23

Figure 8 Potential Biobank site (boundaries in orange) and SEPP14 Wetland No 329 (Shoalhaven City Council GIS 25.2.16).....	24
Figure 9 Rivers and streams in and around the site (Huskisson 1:25000 topographic map).....	25
Figure 10 Native vegetation extent within the 100ha inner assessment circle	26
Figure 11 Vegetation community boundaries and plot data locations	30
Figure 12 Threatened species (mammals) and biometric vegetation types	36
Figure 13 Credit total for EPP from Biobank calculator	37
Figure 14 Eastern Pygmy Possum species polygons on the potential biobank site .	38
Figure 15 Post pack Pygmy-possum tube “trap” locations	40
Figure 16 Post Pack Eastern Pygmy-possum tube installed in a Banksia spinulosa	41
Figure 17 – Damaged (chewed) tube 75 on 24 July 2014.....	42
Figure 18 – Scats found in tube 28 on 10 October 2014 tentatively identified as those of EPP.....	43
Figure 19 Scats in tube 76 on 10 October 2014.....	43
Figure 20 – Scats in tube 84 on 10 October 2014	43
Figure 21 Eastern Pygmy-possum in tube 19 on 10.3.15.....	44
Figure 22 Brown Antechinus in tube 60 on 10.3.15.....	45
Figure 23 Leaves to the entrance hole in Tube 71	46
Figure 24 Brown Antechinus in Tube 72	46
Figure 25 Two Brown Antechinus in Tube 84.....	47
Figure 26 Brown Antechinus in Tube 97	47

1. Introduction and Potential Offset site identification

This assessment has been prepared by an accredited Biobanking assessor.

Assessor Name: Michael Smith

Assessor Number: 0099

Calculator Version: Biobanking Credit Calculator v2.0

The purpose of this Biodiversity Offset Strategy (BOS) and Biodiversity Assessment Report (BAR) is to identify suitable credits to enable the establishment of a Resource Recovery Park to be built next to the existing West Nowra R&WF in Mundamia some 22km to NNW of the potential Biobank Site (Figure 5). This strategy will outline options for a proposed offset which meets the required terms listed in the NSW Biodiversity Offsets Policy for Major Projects.

This BOS and BAR outlines the steps to be taken to secure offsets in accordance with the NSW Biodiversity Offsets Policy for Major Projects, and assesses a potential biobank site at Huskisson should supplementary measures be required. Should this option be pursued, a portion of the credits generated would be used for the retirement of credits from a development site (West Nowra Resource Recovery Park, State Significant Development – application number SDD 15_7015) at 114 Flatrock Road Mundamia).

The report contains a detailed description of the Biobanking Assessment process for the potential Biobank Site, including a justification of the landscape score, mapping of vegetation zones, and management zones. The credits generated by the proposal, and their credit profile, are also outlined.

The report is produced to also meet the “minimum information requirements for the Biodiversity Offset Strategy (BOS Stage 3)” as outlined in the “Framework for Biodiversity Assessment, NSW Biodiversity Offsets Policy for Major Projects” (OEH, 2014) for the West Nowra Resource Recovery Park (West Nowra RRP). It also contains a justification for a proposed variation to the credit source as outlined in the NSW Biodiversity Offsets Policy for Major Projects should supplementary measures be required.

The BAR subject property is 72.36ha and contains an operating waste facility (Huskisson Recycling and Waste Facility – R&WF). The potential Biobank site (the ‘site’) consists of 55.21ha within the subject property, basically the area outside the operating landfill facility known as Huskisson R&WF (Figure 1).

The Biobank Assessment Calculation and Credit Report was produced by Accredited Biobank Assessor Michael Smith (Accreditation number 0099) using the Biobanking Credit Calculator (version 2) on behalf of Shoalhaven City Council (Council).

Should Council identify another potential offset site as a result of following the “reasonable steps”, they will discuss it with NSW Office and Environment and Heritage.



Figure 1 Potential Biobank Site within 235 Huskisson Road, Huskisson

1.1 General Characteristics and Land Use of the potential Biobank Site

The vegetation on the site, outside the existing Huskisson R&WF area, is in “moderate to good” condition despite a history of logging and the continued used of informal tracks by recreational users. Weeds are generally confined to the boundary of Huskisson R&WF (Figure 4). Really large trees are scarce though hollow-bearing trees

are scattered throughout the site and these provide habitat for a range of hollow-dependant fauna including threatened species.

Huskisson R&WF currently occupies approximately 11ha of the subject land and has been in operation since 26 March 1963. There is evidence, in the form of rusty machinery, that a small number of items have been illegally dumped outside the R&WF area in the past.

There is also evidence of selective historical logging on the subject land with a number of old stumps scattered throughout the potential Biobank Site.

Currently the subject land outside the R&WF fence is unused for any formal purposes other than containing a stormwater detention basin for the adjoining Woollamia Industrial Estate to the north east and a communications tower near the south-east corner of the R&WF. The stormwater detention basin and Asset Protection Zones (APZ) for the Industrial Estate are not included in the potential Biobank Site.

Apart from maintenance along the R&WF fence line, there is little recent use or evidence of use by humans outside the R&WF. There are a small number of recreational tracks (Figure 4) through the Site which are used on occasion by unauthorised motor vehicles and motor bikes. There has also been a small number of trees felled in recent years around the stormwater detention basin.

Under the Shoalhaven Local Environment Plan 2014 (SLEP2014), the land use zoning of the potential Biobank site is:

- E2 – Environmental Conservation
- RU2 – Rural Landscape

Portions of the subject land outside the potential Biobank site are zoned IN1 General Industrial and RE1 Public Recreation. (Figure 2).

The eastern portions of the property are currently used as a Strategic Fire Advantage Zone (SFAZ- Figure 3).

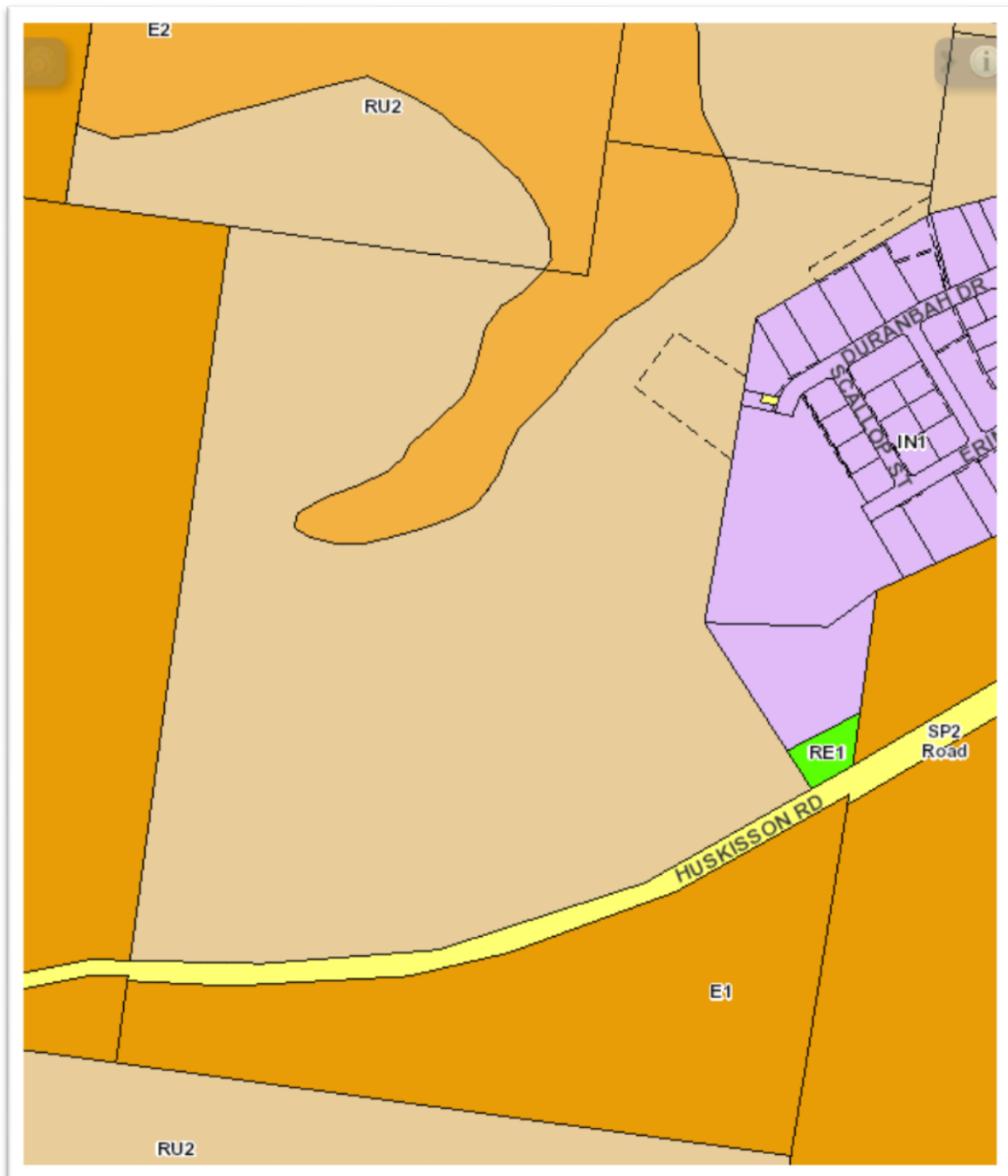


Figure 2 Current land zonings for the subject land and surrounds (Shoalhaven LEP 2014)

1.2 Summary of potential Biobank Site attributes and management regime (current and future)

The subject land is currently classified as “operational land” and there is no requirement, under any Act, to manage the site for biodiversity conservation. It currently contains Huskisson R&WF which covers approximately 11ha in the SE corner of the site with access from Huskisson Road. Leachate and sedimentation

dams for the Huskisson R&WF protect water quality for a SEPP 14 Wetland and Currumbene Creek downslope and to the north. There is also a communications tower near the SE corner of the Huskisson R&WF.

Portions of the property (including portions of the potential Biobank Site) are currently used as a Strategic Fire Advantage Zone (SFAZ - Figure 3) so are subject to fuel reduction activities (hazard reduction burns).

On the eastern side of the site and to the north is an industrial estate with a stormwater detention basin for the estate located in vegetation identified as an Endangered Ecological Community (EEC). The industrial estate provides informal access to the potential Biobank Site via tracks near the stormwater detention basin. Another informal track emanates from the Huskisson R&WF. These tracks are used by motor bikes, mountain bikes and 4x4 vehicles and it is proposed to close these tracks as a future management action.

Despite the current land use management practices and the land-use history described in section 1.3, the vegetation on the site is in moderate to good condition. It has excellent ecological connectivity being contiguous with a large tract of native vegetation incorporating Woollamia Nature Reserve, a portion of Jervis Bay National Park, a SEPP 14 wetland, and vegetated private lands. Targeted surveys have identified a number of threatened species within the potential Biobank Site; Yellow-bellied Glider, Glossy-black Cockatoo, Little Lorikeet and Eastern Pygmy-possum (EPP), with the EPP being a credit species generating 266 credits.

Management of the Biobank site to improve its condition will include closing off and rehabilitating the majority of the tracks through the site as well as stopping unauthorised access as described in section 1.3 through the installation of vehicle proof fencing. The track around the boundary of the R&WF site will be retained to allow maintenance of the R&WF fence (Figure 4).

Weeds along the fence line (mostly Mistflower *Ageratina riparia* along the northern R&WF boundary fence and Senna *Senna pendula* near the main gate) will be controlled with total eradication the medium-term goal. Eradication of other weeds depicted in Figure 4 (near the main gate off Huskisson Road and the Montbretia

Crocasmia crocosmiiflora patch) will be controlled and eradicated in the long-term as well.

Fox control (annual baiting, trapping and shooting) has been discussed with the responsible Nowra Area National Parks & Wildlife Service Ranger (Mr Noel Webster) and is proposed to be co-ordinated with the adjoining conservation reserves to reduce the threats to small mammals on the Biobank Site including the EPP. Foxes have been detected on the Biobank Site through the recent use of motion sensing and Infra-Red cameras. Feral cats, likely to be in the R&WF area, will also be targeted by the professional shooters.

Ecological burns using a mosaic approach within recommended fire interval thresholds for each vegetation formation will be undertaken across the site but in consultation with the land managers for the adjoining conservation reserves. The Plan of Management for Woollamia and Jervis Bay conservation reserves (DECCW, 2011) states ecological burns are to be conducted to produce habitat suitable for species with specific requirements such as eastern bristlebirds and chestnut mouse. It is envisaged, based on the threatened species so far detected and the tall wet nature of the majority of the vegetation within the Biobank Site, fire intervals will be in the order of 25 to 60 years for Blackbutt forest and 7 to 35 years for the Swamp Sclerophyll Forest. These fire intervals are in line with the Fire Management Strategy for Jervis Bay National Park and Woollamia Nature Reserve (NPWS, 2009). This is consistent with the Shoalhaven Bush Fire Management Committee “Bush Fire Risk Management Plan” of 2010 which states “management practices should aim to achieve mosaic fuel reduction patterns so that the majority of the SFAZ has an OFH of less than high” (page 17 of http://www.rfs.nsw.gov.au/_data/assets/pdf_file/0016/2527/Shoalhaven-BFRMP.pdf).

A BioBanking template for management actions with costings will be completed for the potential Biobank Site and be provided with a Biobank Application should the potential Biobank site be pursued.

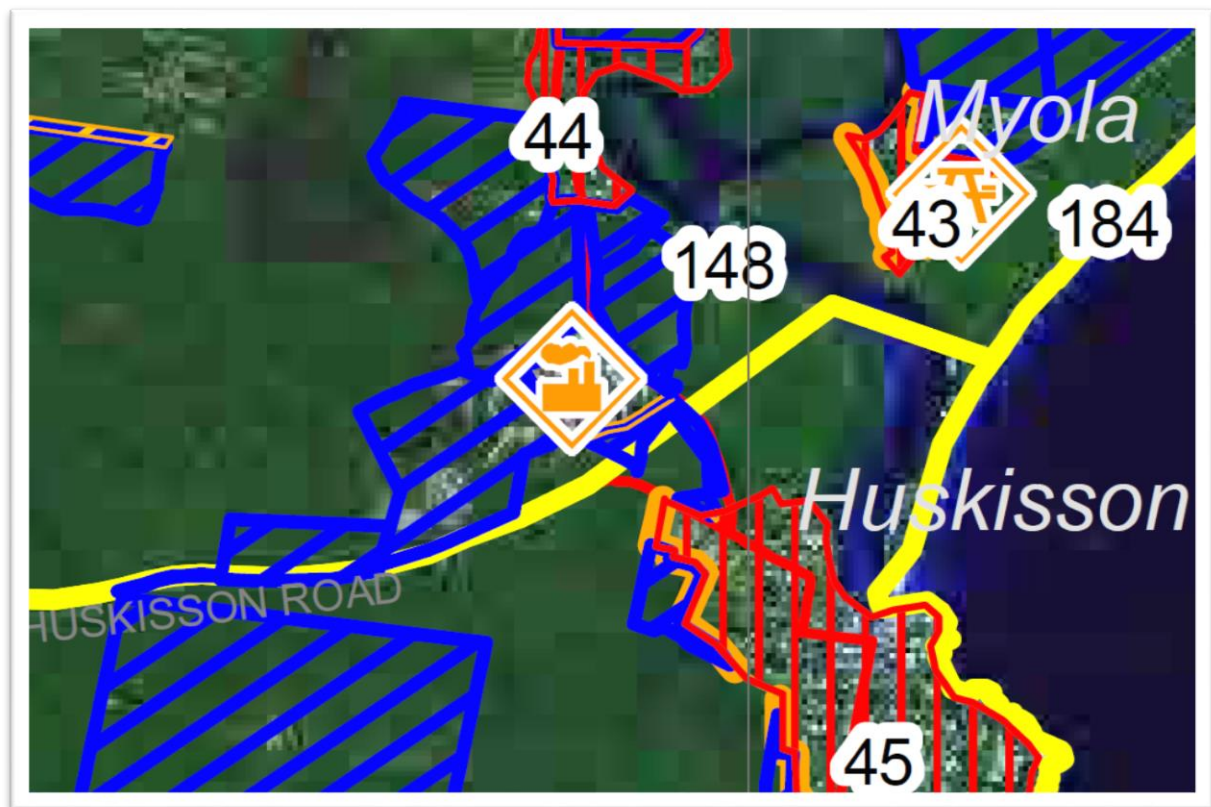


Figure 3 Bush Fire Risk Management Plan mapping with Strategic Fire Advantage Zones marked in blue hatching

Photographic points will be established within the Biobank Site to monitor changes to the vegetation on Biobank Site with points located in current areas of impact (tracks proposed to be closed) as well as areas unlikely to be disturbed except through fire.



Figure 4 Potential Biobank Site Management Issues – weeds and tracks to be closed

1.3 Plant Community Type and Species Credits to be offset

Ecosystem credits

The potential Biobank Site is to be used for the retirement of a portion (23 credits) of the 133 SR594 ecosystem credit requirement of the West Nowra Resource Recovery Park, (State Significant Development – application number SDD 15_7015) at 114 Flatrock Road Mundamia. Currently there are insufficient SR594 ecosystem credits available on the market to purchase a complete “like for like” offset for the development site. There is an Expression of Interest (EOI) on the Biobank Website public register for a biobank site containing SR594 that is yet to be registered.

Should the EOI biobank site with the SR594 credits not eventuate, the potential Huskisson Biobank Site is proposed to be used as another option for the retirement of the 133 ecosystem credits for 2.35ha of Plant Community Type (PCT) 1082 (Biometric Vegetation ID SR594; Bloodwood – Hard-leaved Scribbly Gum – Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin Bioregion).

Whilst the potential Biobank Site contains only 1.97ha of this PCT (SR594 worth 23 credits), vegetation adjoining (Biometric Vegetation ID SR516) has been 50% cleared in the Southern Rivers Catchment Management Area (SRCMA) and adjoins Woollamia Nature Reserve and a SEPP 14 Wetland (No. 329), and hence it could be argued is more valuable.

Species Credits

In terms of Species Credits, the RRP development site at Mundamia, requires the retirement of 52 Squirrel Glider credits to clear 2.35ha of known habitat. Squirrel Glider has not been detected at Huskisson so these are currently not available on the potential Biobank site. Options for the retirement of these species credits are discussed in the section below.

Council has been in discussion with the Department of Planning & Environment regarding a process whereby a conditional approval or deferred commencement approval could be granted to allow Council to pursue the EOI credit options and continue a search for Squirrel Gliders on Council land.

1.4 Offset options including Supplementary measures

Ecosystem Credits

Option 1 for the retirement of the 133 SR594 ecosystem credits is to retire 23 credits from the potential Huskisson Biobank site and purchase the remaining credits (110) from the market when they become available. In terms of a like for like offset, there is an EOI for SR594 Ecosystem credits to be added to the market, and Council has made contact with the listed contact person. The Biobank assessment for these credits is yet to be approved by OEH and a price for the credits is still to be negotiated. The cost of the limited number of ecosystem credits sold in the Jervis and Illawarra CMA subregions has been in the range of \$2528.41 to \$4559.73. The cost of securing these credits is estimated to be \$278125 to \$501570, and a price comparison for the retirement of credits obtained via two options proposed is shown in Table 1.

Option 2 is to use the additional ecosystem credits from the potential Biobank site at Huskisson. Whilst not strictly meeting the requirements of the Offsets Policy, which allows for a variation (Appendix A of the Major Projects Policy) with “vegetation to be offset with vegetation from the same vegetation formation that has undergone an equal or greater amount of clearing since European inhabitation”, it is proposed to make up the shortfall in credits (110) by retiring ecosystem credits generated from the adjoining SR516 Biometric vegetation type by way of supplementary measures. SR516 is within the Wet Sclerophyll Forests (shrubby sub formation) and is 50% cleared within the Southern Rivers Catchment area whilst SR594 is within the Dry Sclerophyll Forest (shrubby sub-formation) and only 20% cleared within the Southern Rivers Catchment area. The two vegetation communities (and hence formations) adjoin each other. This option for securing an offset is considerably more cost effective than option 1.

Squirrel Glider species credits

The development at Mundamia requires the retirement of 52 Species Credits for Squirrel Glider. Whilst Squirrel Glider credits are currently available from one source and Council has been approached about another possible future source of credits, Council's first preference is to locate a source of credits for the species on a Biobank

Site within the Shoalhaven Local Government Area. Council has surveyed for Squirrel Gliders on the potential Huskisson Biobank Site for no result and is currently surveying at the established Garrad Reserve Biobank Site at Narrawallee and Council owned land around Bamarang Dam approximately 15km west of Nowra. Council proposes to continue to try and find a source of credits locally as a first option with purchasing the Squirrel Glider credits currently available as the second option should Council not be available to secure credits for the Squirrel Glider locally. The estimated cost of the two offset options are provided in Table 1

Table 1 Cost estimates of options to secure required ecosystem and species credits for the development site at Mundamia

Credit type	Option 1	Cost	Option 2 (preferred)	Cost
133 required SR594 ecosystem credits	Purchase 110 credits from the market (estimated cost \$2530 - \$4559.73 per credit)	\$278300 to \$501570	Retire credits (23 SR594 and 110 SR516/SR648) from Huskisson	~ \$336490 (estimated \$2530 / credit to cover management costs)
	Retire 23 credits from Council biobank site at \$2530 per credit	\$58190 + est. of biobank site application fee \$709		Est. of biobank site application fee \$709
Squirrel Glider species credits 52	Purchase on market	~\$182000 (52 x estimated \$3500 for credits becoming available)	Locate on council owned biobank site	~ \$131560 (52 x \$2530)
	Total	\$519,199.00 - \$742,469.00		Total \$468,759.00

1.5 Detailed justification for supplementary measures for the required offsets

The Offsets Policy requires proponents to consider “reasonable steps to locate like-for-like offsets” (page 23, Appendix A) in addition to considering feasible known sites. Council will undertake this process, which includes:

- Checking the biobanking public register and having an expression of interest (EOI) for the credits for at least six months
- Liaising with OEH for a list of potential sites that meet offsetting requirements
- Considering properties for sale in the required area
- Providing evidence of why offset sites are not feasible, which includes –
 - Unwillingness of landowner to sell or establish a biobank site
 - Instances where a landowner is demonstrably charging significantly above market rates

Should “like-for-like” offsets not be located or prove feasible under the reasonable steps, Council could consider a potential supplementary measure option to retire the required credits for the RRP Major Project at Mundamia. This is based on a comparison of the perceived benefits in the Offsets Policy when compared to the treatment of threatened species via the NSW EP&A Act s5A “assessment of significance”. The ecosystem credits, as described in section 1.3, are a better environmental outcome than is required by the “like for like” rules in the Offsets Policy. The proposed supplementary measures are also a more cost effective alternative to Council as it would only be seeking to cover the set up and ongoing management costs of the biobank site.

NSW Biodiversity Offsets Policy versus the NSW EP&A Act s5A “assessment of significance”

The objectives of the NSW Biodiversity Offsets Policy for Major Projects are;

1. To provide clear, efficient and certain guidance for stakeholders
2. To improve outcomes for the environment and communities
3. To provide a practical and achievable offset scheme for proponents.

In terms of improving outcomes for the environment and communities, Council has selected a disturbed site that adjoins an existing waste facility to construct and operate

a Resource Recovery Park (RRP). The facility has the potential to redirect between 60 – 70% of current and future waste from landfill using alternate waste technology for processing, reuse or recycling. The reduction in the amount of waste going to landfill will extend the life of current landfill site and reduce the need to find an additional landfill site in the future. With the population of the region set to increase from 384144 (in 2011) to 465400 by 2031 (Illawarra Shoalhaven Regional Plan, NSW Department of Planning & Environment, 2015) and the potential of the RRP becoming a regional facility, having a RRP will enable the community to deal with waste in a more sustainable way that reduces the impact on the local environment. Offsetting the 2.35ha of vegetation to be cleared within the Shoalhaven Local Government Area (LGA) as proposed also provides an improved outcome and benefits the local environment. The proposed RRP therefore meets objective 2 of the Offsets Policy for Major Projects.

In terms of providing a practical and achievable offset scheme for proponents (objective 3), Council has tried to identify offsets that protect valuable ecosystems and threatened species in the Shoalhaven LGA on land that would otherwise not be managed for biodiversity whilst reducing the cost of the development project to ratepayers.

The above point is also of relevance when considering the second dot point in the “reasonable steps to locate like-for-like offsets” section of the NSW Biodiversity Offsets Policy of Major Projects. With the Shoalhaven Local Government Area home to over 200 threatened species and 22 threatened ecological communities, these are seen as an asset given importance of tourism to the economy of the Shoalhaven. Council’s proposed offset protects and improves a valuable natural resource that adjoins existing conservation reserves along the coast, the area facing the most impacts and threats from development. With the loss of habitat being the major threat to the vast majority of threatened species and impacts at the local level and the focus of the EP&A Act s5A “assessment of significance” guidelines, allowing impacts to be “offset” in areas well away from the local populations being impacted by the development will lead to a loss of the Shoalhaven’s natural assets to the long-term detriment of its valuable tourist industry. Subject to Council finding Squirrel Glider credits locally, Council’s preference is to retire the 52 Squirrel Glider credits within the Shoalhaven

LGA with the purchase of credits of available credits in other bioregions seen as a last option.

Supplementary measures requires a justification using a hierarchy of four tiers under the Offsets Policy for Major Projects and taking “reasonable steps” to locate “like for like” offsets.

In terms of the reasonable steps Council has placed an EOI on the public register for both ecosystem and species credits and contacted possible sources of credits, though the majority of credits offered are yet to be registered. Council has also been in contact with OEH regarding potential sites within the Shoalhaven LGA and none are currently available other than sites Council are currently assessing as potential Biobank sites. No properties advertising the required vegetation types are currently listed for sale and advertising of properties generally does not include this level of vegetation detail. For the last “step”, Council’s potential offset is likely to provide a more cost effective alternate to residents and rate payers on environmentally valuable land because, in part, ecosystem credits of the type required are currently not available (though there is an EOI for future availability) and it will benefit land with excellent biodiversity values that is currently not managed, nor is required to be managed, for improved environmental outcomes.

The potential Biobank site and offsets are described in the Potential Offset Site and Biodiversity Assessment sections following.

2. Potential Offset Site

Should the potential Biobank Site option be pursued, Council will enter into a Biobanking agreement to offset the impact of the proposed West Nowra Resource Recovery Park (Major Project SSD 15 _7015). This will form an in-perpetuity, on-title arrangement to ensure the preservation of the Site for its conservation values.

The potential Biobank Site has been the subject of field surveys by Council since early to mid-2014. The methods used and results of these surveys in relation to targeted threatened species can be found in section 5.1.

The NSW Biodiversity Offsets Policy for Major Projects came into effect on 1 October 2014. The Policy has three key principles:

1. Before offsets are considered, impacts must first be avoided and unavoidable impacts minimised through mitigation measures. Only then should offsets be considered for the remaining impacts.
2. Offset requirements should be based on a reliable and transparent assessment of losses and gains.
3. Offsets must be targeted to the biodiversity values being lost or to higher conservation priorities.

Under the terms outlined in this policy, an applicant can offset the impact of their project by:

- securing a similar site in perpetuity under a legally binding agreement; and/or
- providing funds for supplementary measures where offsets are not available.

The policy also states that where an offset of the same vegetation type cannot be provided, a variation in the 'like-for-like' requirement can be made. This means that offsets do not always need to be strictly matched to the biodiversity impacted on, but can be targeted to relevant equal or higher conservation priorities. The policy also allows for other offsetting mechanisms to be used as supplementary measures to offset the impacts upon biodiversity as a result of development.

2.1 The Potential Offset Site Location

The potential Biobank Site is located on the NSW South Coast on the western approaches to Huskisson within the Shoalhaven Local Government Area. Land opposite the site (southern side of Huskisson Rd) is Jervis Bay National Park. Woollamia Nature Reserve adjoins the western boundary of the Site (refer to E1 zoned land on Figure 2). Land adjoining the northern boundaries of the Site is in private ownership with one of the lots containing SEPP14 Wetland No. 329.

2.2 The Potential Offset Site relative to the Development Site

The Development site at Flatrock Road Mundamia is approximately 22km to the north-northwest of the potential Biobank site at Huskisson. The potential Biobank (offset) Site relative to the development site is depicted in Figure 5.



Figure 5 Potential Biobank (Offset) site relative to development site both depicted by red polygons

2.3 Potential offset site description

The Subject land is located on the NSW South Coast on the western side and within 2km of Jervis Bay. The potential Biobank (Offset) Site is low lying and relatively flat with elevations of 1.5m to 25m above sea level. A drainage line and floodplain flows through the centre of the Site from the west curving to the north and into a SEPP 14 wetland on the adjoining property.

Two low ridges and slopes extend into the Site; one along the southern boundary and another protruding into the NW corner of the site from the Woollamia Nature Reserve. Soils along the ridges are sandy clay loams with fine silty loam along the drainage line and floodplain.

The potential Biobank (Offset) Site is a large patch of native vegetation comprising of a patch of Dry Sclerophyll Forest in the NW corner, Wet Sclerophyll Forest either side of a drainage line and low-lying swamp (Forested Wetland) in the central portion of the site. The vegetation is described in more detail in section 3.7).

3. Biobank Assessment Report for Option 2 (preferred)

3.1 IBRA bioregions and subregions, NSW landscape region and area

The potential site is within the Sydney Basin bioregion and the Jervis IBRA subregion (OEH Bionet mapping accessed November 2015)

The majority of the subject site is within the Mitchell landscape; Wandandian Coastal Plains. The area approximately equal to the SR648 Vegetation Community is mapped as Bherwhere Barrier Mitchell Landscape (Figure 6).

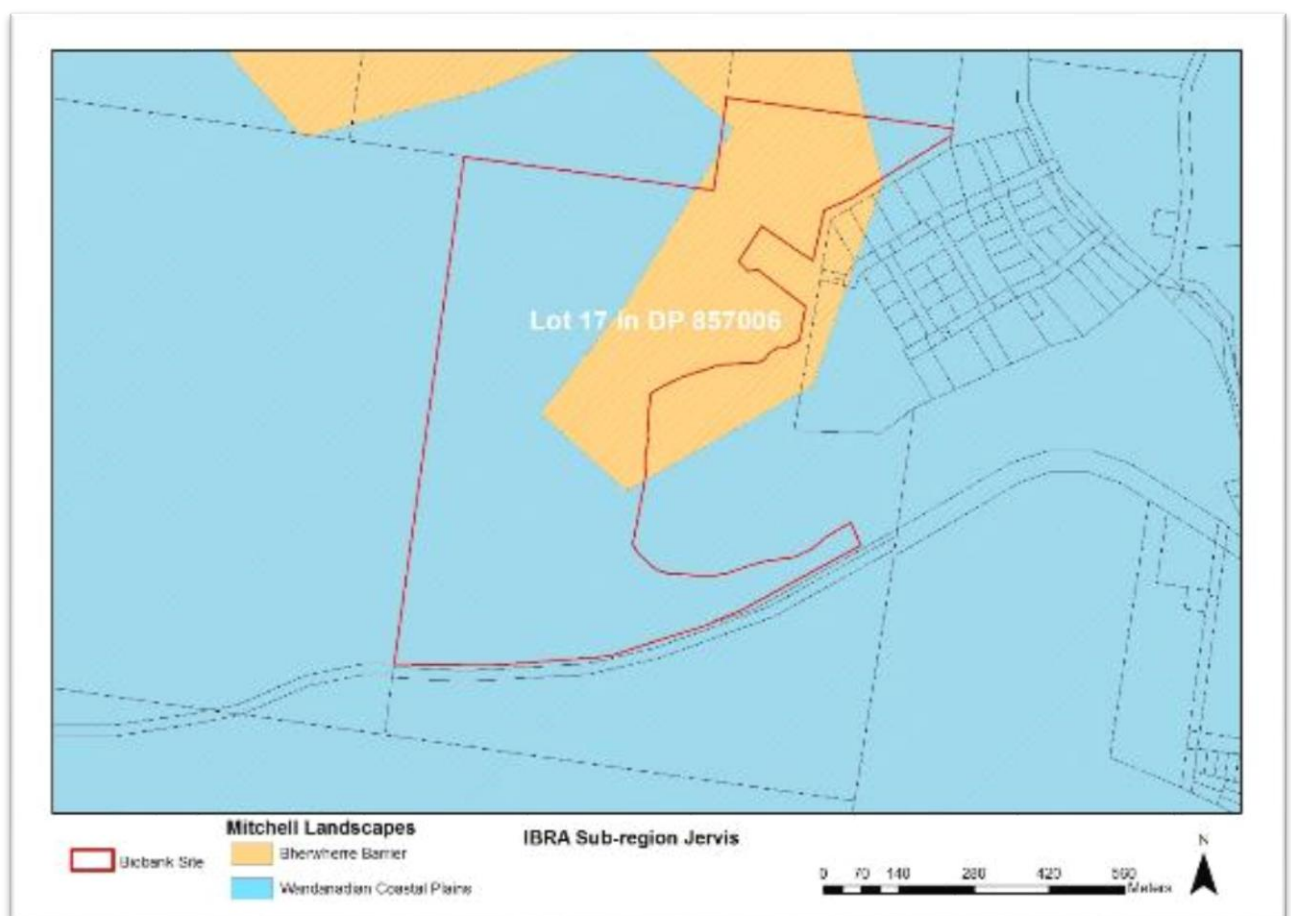


Figure 6 Mitchell Landscapes of potential biobank site

3.2 Native vegetation extent in the outer assessment circle

The percentage of native vegetation before and after management actions is depicted in (Figure 7). The area was calculated using ArcGIS software and totalled 861.8ha (Figure 7). The percentage native cover is within the 86-90% class which will not change with the management actions proposed.

The percentage Native Vegetation Score from the Biobank Calculator is 0.00.



Figure 7 Native vegetation within the Outer Assessment Circle

3.3 Cleared areas

Within the potential Biobank site, the areas currently cleared comprise the existing Huskisson R&WF with no additional areas to be cleared proposed in the foreseeable future.

On the NSW Department of Lands “Huskisson” 1:25000 Topographic map (9027-4N third edition), a second order “intermittent stream” flows in a northerly direction through the biobank site to join SEPP 14 Wetland No.329 partially on the site but mostly on

the adjoining property to the north. The creek then drains the wetland into Currambene Creek (Figure 9).

To the east and as close as 1km away is Currambene Creek which flows into Jervis Bay approximately 2km from the site. Moona Moona Creek, which also flows into Jervis Bay, is approximately 2km south of the site (Figure 9).

3.4 Wetlands

The potential biobank site contains a small southern portion of SEPP Wetland No 329 with the majority of the wetland on private land adjoining the site to the north (Figure 8).

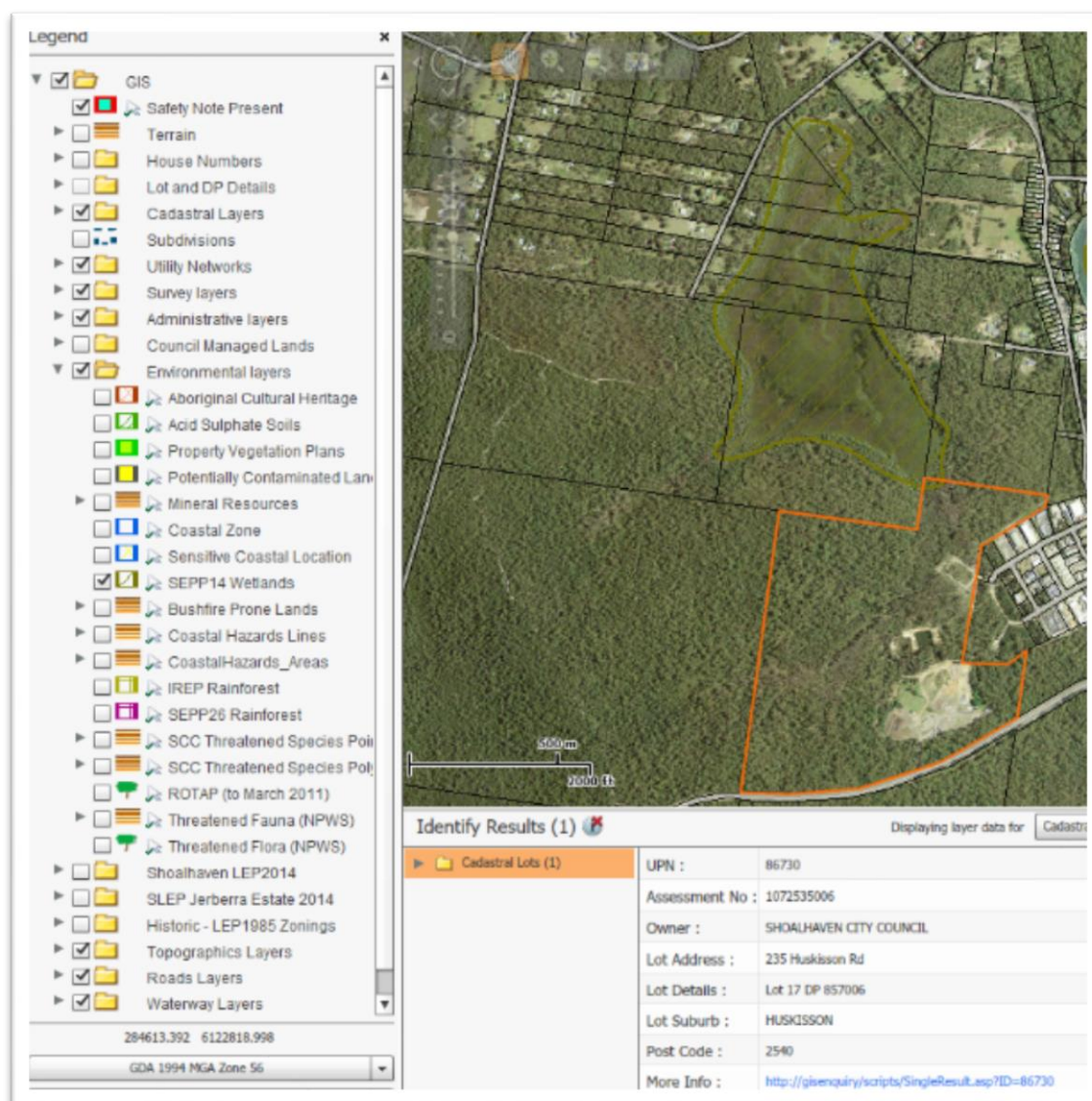


Figure 8 Potential Biobank site (boundaries in orange) and SEPP14 Wetland No 329 (Shoalhaven City Council GIS 25.2.16).

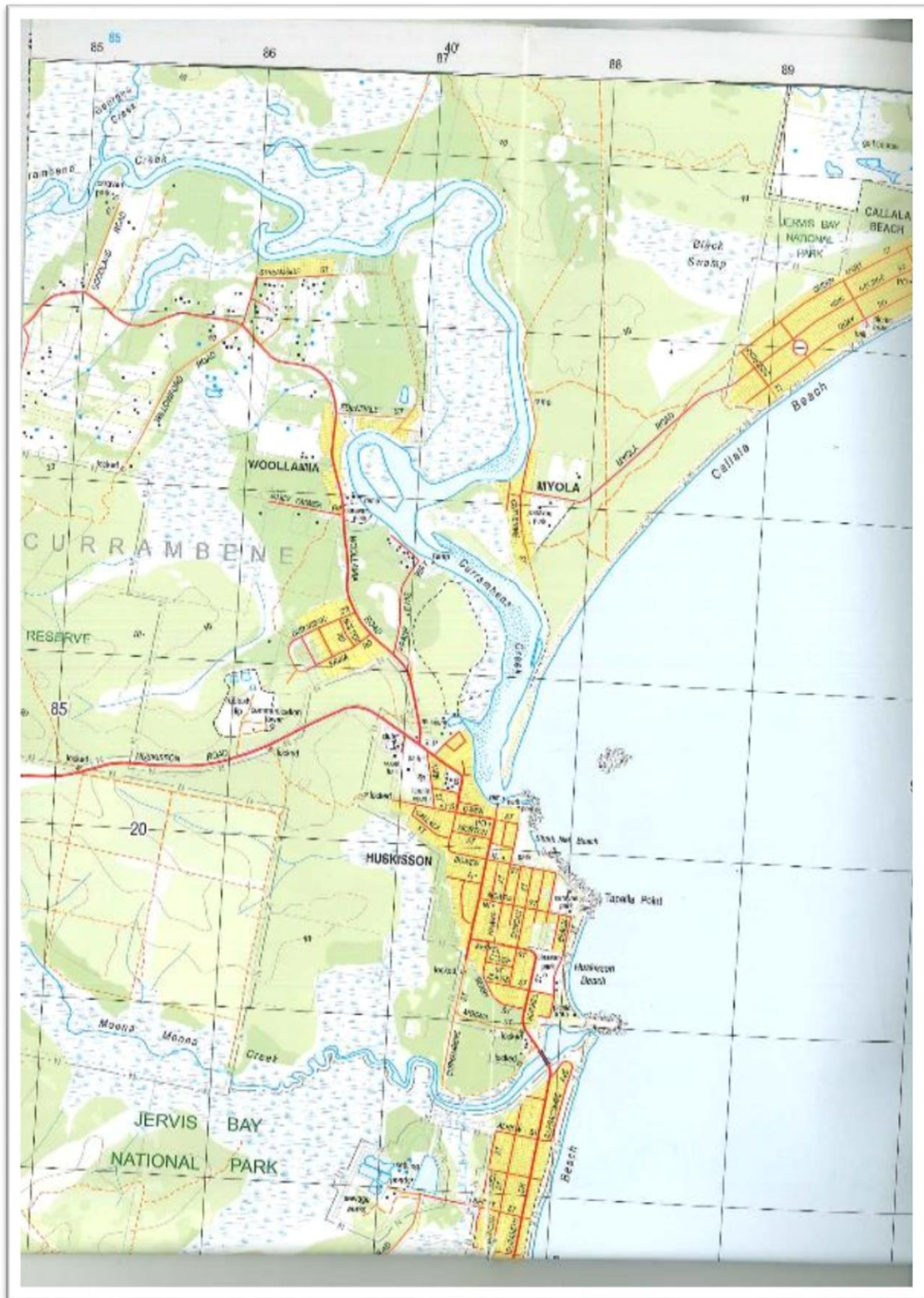


Figure 9 Rivers and streams in and around the site (Huskisson 1:25000 topographic map)

3.5 Landscape value score components

Identification of method applied (i.e. linear or site-based).

The subject site is approximately rectangular in shape (refer to Figure 1), that is, site-based, for the purpose of calculating the landscape score of 30.

3.5.1 Percent native vegetation cover in the landscape (potential biobank site)

The subject site is 72.36ha of which 55.21ha comprises native vegetation which would be protected and managed in perpetuity at the potential biobank site. This native vegetation is included in the total of 861.8ha identified within the 1000ha outer assessment circle (86-90% native vegetation cover - Figure 7) and the 82.6ha within the 100ha inner assessment circle (81-85% native vegetation cover - Figure 10).

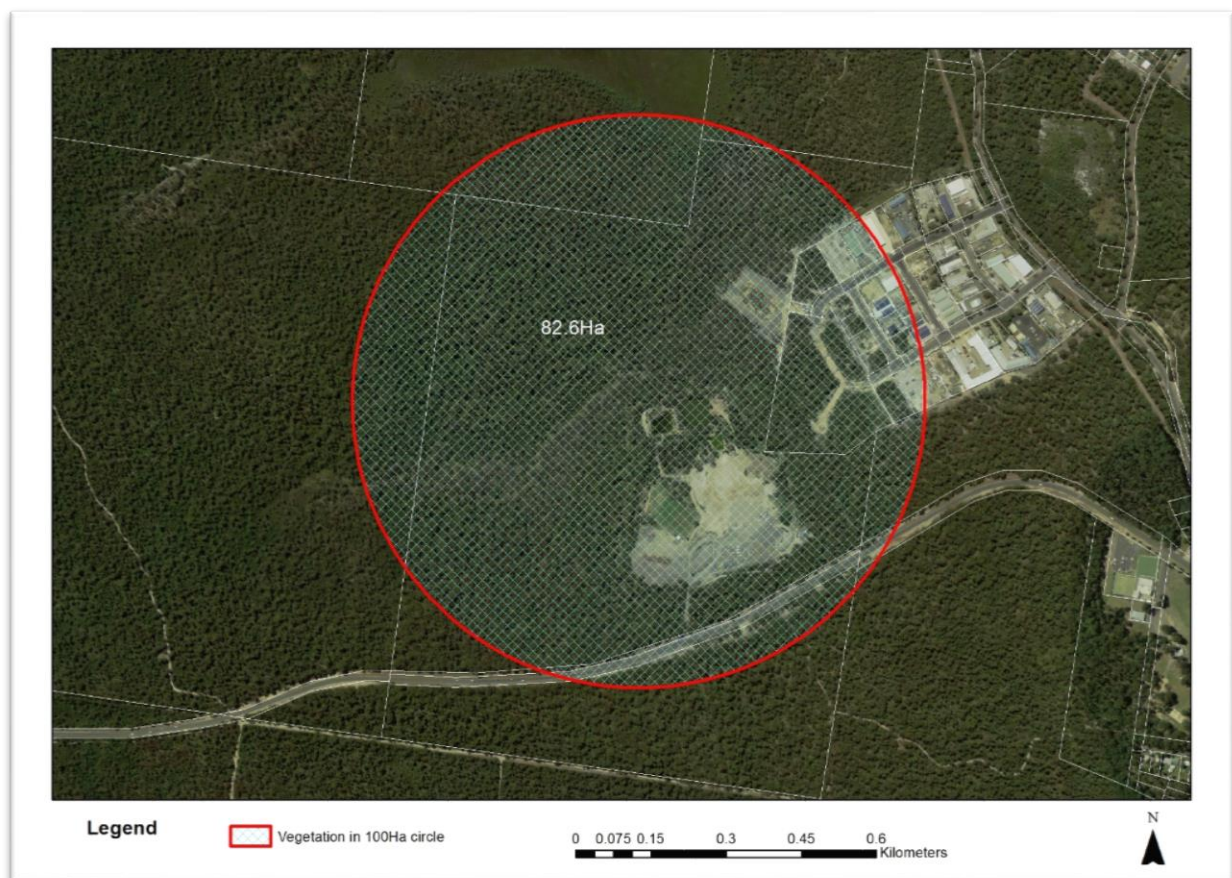


Figure 10 Native vegetation extent within the 100ha inner assessment circle

3.5.2 Connectivity value of the potential Biobank site

The potential Biobank site, as per the Biobank methodology (OEH, 2014), is in a strategic location being a “Riparian buffer area of an important wetland” and therefore

“does not require further assessment in connectivity value”. The strategic location gives the site a strategic value score of 18.

3.5.3 Patch size

The percent native vegetation cleared in the Wandandian Coastal Plains (which covers the majority of the Site) is 11% (VIS OCL report extract below) with a Patch size class of “extra large” (1001ha) giving a patch size score of 12.

VIS Classification (Over cleared Landscapes Report)

Landscape: Wandanadian Coastal Plains

OCL Percentage Cleared Estimate: 11.00

Total Area of NSW Landscape: 87,362.93

Area of NSW Landscape Cleared: Not assessed

Landscape Clearing Comments: Not Assessed

Status Of Landscape Clearing Estimate: Not Assessed

Accuray of Landscape Clearing Estimate: Not Assessed

Method of Landscape Clearing Estimate: Not Assessed

DataSource: Approved

3.5.4 Strategic location

SEPP 14 Wetland No 329 is partly within and downstream of the biobank site (Figure 8).

3.6 Landscape value score

The landscape value score components (sections 3.5) add up to give a score of 30.

3.7 Native Vegetation and ecosystem credits

The extent of native vegetation within the potential biobank site is depicted in Figure 1 and comprises three different plant communities (Figure 11). The three plant communities within the potential Biobank site, identified by Biometric code as required for input into the Biobank Calculator, are;

- SR594 Red Bloodwood – Hard-leaved Scribbly Gum – Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin
- SR516 Blackbutt – Turpentine – Bangalay moist open forest on sheltered slopes and gullies, southern Sydney Basin
- SR648 Swamp Mahogany swamp sclerophyll forest on coastal lowlands, Sydney Basin and South East Corner

SR594 is within the NSW Formation: Dry Sclerophyll Forests (shrubby sub-formation) and NSW Class: Sydney Coastal Dry Sclerophyll Forests (OEH, 2013).

SR516 is within the NSW Formation: Wet Sclerophyll Forests (shrubby sub-formation) and NSW Class: North Coast Wet Sclerophyll Forests (OEH, 2013).

SR648 is within the NSW Formation: Forested Wetlands and NSW Class: Coastal Swamp Forest (OEH, 2013).

The area for each vegetation type is depicted in Table 2.

Table 2 Biometric vegetation types, area, and credits regenerated on the potential biobank site

BIOMETRIC VEGETATION TYPE	AREA (Ha)	CREDITS GENERATED	CREDITS/Ha
SR594 Red Bloodwood – Hard-leaved Scribbly Gum – Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley, Sydney Basin	1.97	23	11.68
SR516 Blackbutt – Turpentine – Bangalay moist open forest on sheltered slopes and gullies, southern Sydney Basin	35.56	459	12.91
SR648 Swamp Mahogany swamp sclerophyll forest on coastal lowlands, Sydney Basin and South East Corner	17.68	184	10.41
Totals	55.21	666	

3.7.1 Plant Community Types and Credit Report

The existing Vegetation Mapping (OEH, 2013) was reviewed with ground-truthing of the mapping confirming three different vegetation types / PCT on the potential Biobank Site (Table 2). Ground-truthing of the vegetation mapping involved traversing community boundaries and collecting data from vegetation plots. Boundaries were mapped by ecologists using hand-held GPS units. The resulting vegetation map is provided as Figure 11 and changes slightly the boundaries in the Biometric mapping shapefiles (OEH, 2013).

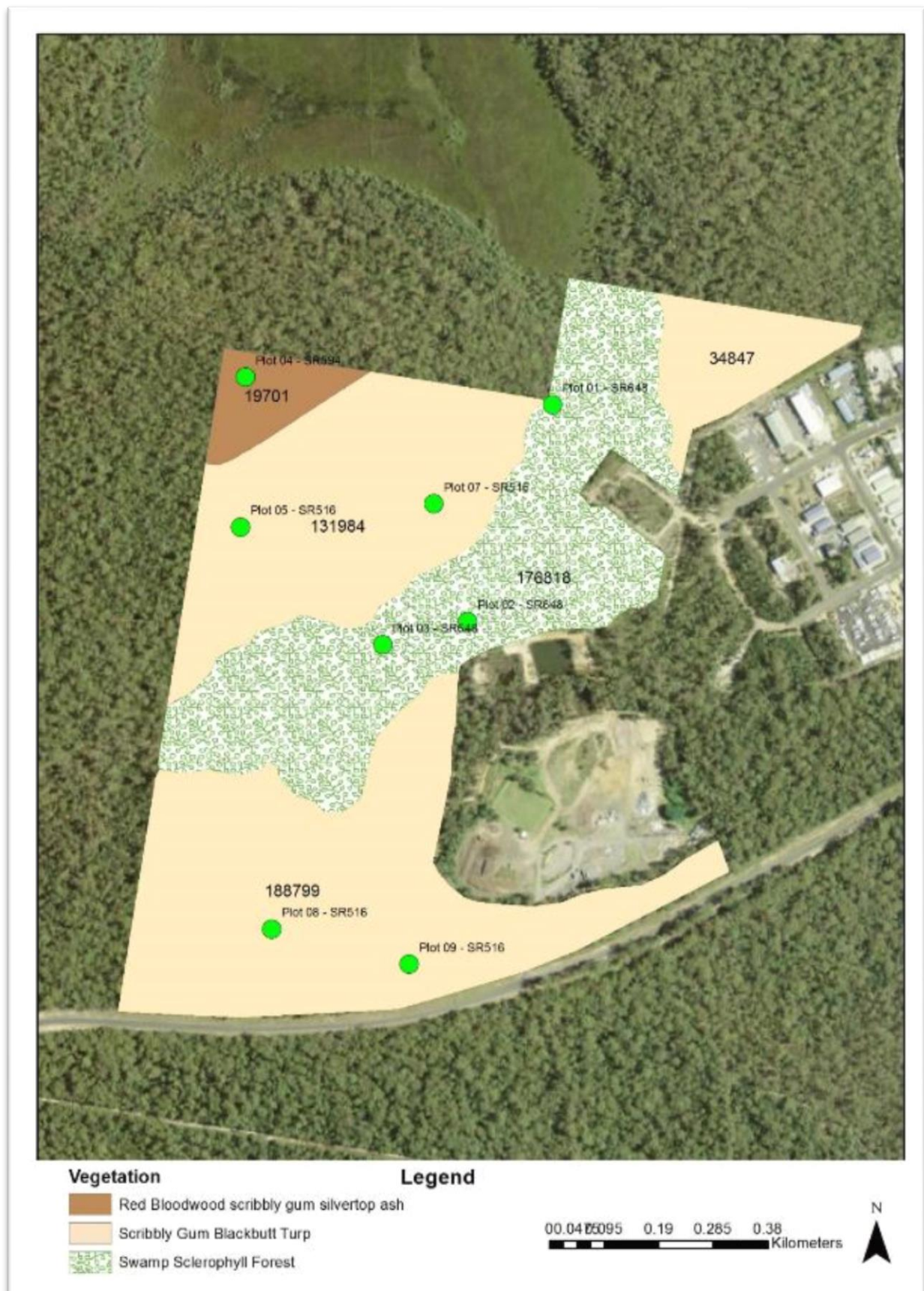


Figure 11 Vegetation community boundaries and plot data locations

SR594 Red Bloodwood – Hard-leaved Scribbly Gum – Silvertop Ash heathy open forest on sandstone plateaux of the lower Shoalhaven Valley (PCT ID: 1082)

This PCT is 20% cleared within the Southern Rivers Catchment Management Area (VIS plant community information accessed 29.2.2016).

This vegetation community was predicted to occur within the potential Biobank site based on the existing Biometric mapping (OEH, 2013). It is confined to 1.97ha in the north-west corner of the site (Figure 11) and extends into the adjoining Woollamia Nature Reserve to the west and private land to the north.

The vegetation community was delineated on the ground as the boundary where Blackbutt (*Eucalyptus pilularis*) were no longer present. Both Red Bloodwood (*Corymbia gummifera*) and Hard-leaved Scribbly Gum (*E. sclerophylla*) are found scattered through the adjoining Blackbutt – Turpentine – Bangalay PCT but are dominant in the north-west corner of the site.

Species highlighted in bold text are characteristic species of the community as listed in OEH (2013). Data from one vegetation plot found Red Bloodwood (***Corymbia gummifera***) and Hard-leaved Scribbly Gum (***Eucalyptus sclerophylla***) in the canopy along with Blue-leaved Stringybark (***E. agglomerata***). Turpentine (*Syncarpia glomulifera*) is present in the mid canopy along with characteristic species ***Lambertia formosa***, ***Persoonia levis***, ***Lomatia ilicifolia***, ***Banksia spinulosa***, and ***Platysace linearifolia***. Characteristic groundcover species identified included ***Patersonia sericea***, and ***Entolasia stricta***.

The PCT is in moderate to good condition.

SR516 Blackbutt – Turpentine – Bangalay moist open forest on sheltered slopes and gullies, southern Sydney Basin (PCT ID: 694)

This PCT is 50% cleared within the Southern Rivers Catchment Management Area (VIS plant community information accessed 29.2.2016).

This vegetation community was predicted to occur within the potential Biobank site based on the existing Biometric mapping (OEH, 2013) and covers 35.56ha of the Biobank site either side of the SR648 Swamp Mahogany swamp sclerophyll forest.

The community is in three discreet zones (Management zones). Data from four vegetation plots across the site confirmed the PCT. Species highlighted in bold text are characteristic species of the community as listed in OEH (2013).

Figure 11 depicts the extent of the PCT on the site and the locations of Vegetation Plots.

The canopy is dominated by Blackbutt (***Eucalyptus pilularis***) with Blue-leaved Stringybark (*Eucalyptus agglomerata*), Hard-leaved Scribbly Gum (*Eucalyptus sclerophylla*) and Red Bloodwood (*Corymbia gummifera*) scattered throughout the community. Turpentine (***Syncarpia glomulifera***) occurs at low densities and most specimens are small to medium (10m tall), possibly due to the history of fires and logging on the site.

The shrub layer is mostly sparse with *Banksia spinulosa* being common. Along drainage lines and depressions the shrub layer is thicker but generally the community has a grassy understorey with the following species characteristic of the community; ***Lomandra longifolia***, ***Pteridium esculentum***, ***Dianella caerulea*** and ***Entolasia stricta***.

The PCT is in moderate to good condition.

SR648 Swamp Mahogany swamp sclerophyll forest on coastal lowlands, Sydney Basin and South East Corner (PCT ID: 1231)

This PCT is 50% cleared within the Southern Rivers Catchment Management Area (VIS plant community information accessed 29.2.2016).

This community is recognised as Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions Endangered Ecological Community under the *NSW Threatened Species Conservation Act 1995*. The community on the site occupies the lowest areas either side of an ephemeral drainage line and within a swamp area in the central portions of the site. This drains to a SEPP14 wetland on adjoining property to the north.

The community has been subjected to logging in the past and modification on the north east boundary of the site where a stormwater detention basin has been constructed

for the Woollamia Industrial Estate. The detention basin and other tracks have provided unauthorised access to the community by recreational users such as 4x4 vehicles and motorbikes which have at times become bogged and widening tracks.

Species highlighted in bold text are characteristic species of the community as listed in OEH (2013). The canopy of this community is dominated by the paperbark *Melaleuca decora* with Woollybutt (*Eucalyptus longifolia*) a co-dominant, particularly on the edges of the community. Small swamp mahogany (***Eucalyptus robusta***) occur, mostly in the northern portion of the community. In places the understorey is very open but thick in other areas with various ***Leptospermum*** spp. and *Callistemon rigidis* dominating. The characteristic groundcover species used to identify the community was ***Gahnia*** sp.

The PCT is in moderate to good condition.

3.7.2 Management zone scores

Both SR648 and SR594 have only one management zone each. SR516 has 3 separate management zones based on the community being in three distinct locations across the potential biobank site (Figure 11).

The current and future site values and averted loss scores are provided in (Table 3).

Table 3 Current and future values and averted loss scores for each management zone within the PCTs.

Management Zone	Current Site Value	Future Site Value	Averted Loss in Site Value
SR516 east	80.21	94.79	7.03
SR516 north	80.21	94.79	7.03
SR516 south	80.21	94.79	7.03
SR648	96.00	98.00	9.66
SR594	80.73	90.62	5.86

3.8 Threatened Species

A number of ecosystem credit species are predicted / associated with the PCTs on the potential Biobank Site (Table 4).

Table 4 Predicted species based on PCTs and habitat

Predicted threatened species			
Common name	Scientific name *	TS offset multiplier	On site *
Barking Owl	<i>Ninox connivens</i>	3.0	Yes
Eastern False Pipistrelle	<i>Falsistrellus tasmaniensis</i>	2.2	Yes
Eastern Freetail-bat	<i>Mormopterus norfolkensis</i>	2.2	Yes
Gang-gang Cockatoo	<i>Callocephalon fimbriatum</i>	2.0	Yes
Glossy Black-Cockatoo	<i>Calyptorhynchus lathami</i>	1.8	Yes
Golden-tipped Bat	<i>Kerivoula papuensis</i>	1.3	Yes
Greater Broad-nosed Bat	<i>Scoteanax rueppellii</i>	2.2	Yes
Little Eagle	<i>Hieraaetus morphnoides</i>	1.4	Yes
Little Lorikeet	<i>Glossopsitta pusilla</i>	1.8	Yes
Long-nosed Potoroo	<i>Potorous tridactylus</i>	1.3	Yes
Masked Owl	<i>Tyto novaehollandiae</i>	3.0	Yes
New Holland Mouse	<i>Pseudomys novaehollandiae</i>	2.6	Yes
Olive Whistler	<i>Pachycephala olivacea</i>	1.3	Yes
Powerful Owl	<i>Ninox strenua</i>	3.0	Yes
Scarlet Robin	<i>Petroica boodang</i>	1.3	Yes
Sooty Owl	<i>Tyto tenebricosa</i>	3.0	Yes
Spotted-tailed Quoll	<i>Dasyurus maculatus</i>	2.6	Yes
Square-tailed Kite	<i>Lophoictinia isura</i>	1.4	Yes
Swift Parrot	<i>Lathamus discolor</i>	1.3	Yes
Turquoise Parrot	<i>Neophema pulchella</i>	1.8	Yes
Varied Sittella	<i>Daphoenositta chrysoptera</i>	1.3	Yes
Yellow-bellied Glider	<i>Petaurus australis</i>	2.3	Yes
Yellow-bellied Sheath-tail-bat	<i>Saccolaimus flaviventris</i>	2.2	Yes

Of the predicted ecosystem threatened species listed in Table 4 Glossy Black-cockatoo (GBC), Little Lorikeet, Square-tailed Kite and Yellow-bellied Glider (YBG) have been observed on the site during diurnal and nocturnal surveys. GBC feed trees (chewed cones beneath *Allocasuarina littoralis*) and birds have been observed opportunistically within the SR516 vegetation during trapping and vegetation plot surveys. Little Lorikeets have also been observed opportunistically across the Site on a number of occasions along with a Square-tailed Kite on one occasion. A pair of YBG were detected during nocturnal surveys on the site.

The following “geographic and habitat features” (identified with a tick) are present on the Site (Table 5).

Table 5 Geographic and habitat features on the biobank site

Assessment of geographic / habitat features			
Do any of the following features occur on the area to be assessed? Tick the box wherever the feature occurs, or is likely to occur in the area to be assessed. Leave blank if the feature does not occur.			
Impact?	Common name	Scientific name	Feature
☒	Tangled Bedstraw	Galium australe	land not based on hawkesbury sandstone in Ettrema CMA subregion
☒	Giant Burrowing Frog	Heleioporus australiacus	land within 40 m of heath, woodland or forest with sandy or friable soils
☐	Stuttering Frog	Mixophyes balbus	rainforest or tall open wet forest with understorey and/or leaf litter and within 100 m of streams
☐	Large-eared Pied Bat	Chalinolobus dwyeri	land north of Batemans Bay in Bateman CMA subregion
☐	Pink Robin	Petroica rodinogaster	land within 40 m of gullies in eucalypt forests
☒	Black Bittern	Ixobrychus flavicollis	land within 40 m of freshwater and estuarine wetlands, in areas of permanent water and dense vegetation or emergent aquatic vegetation
☒	Nowra Heath Myrtle	Triplarina nowraensis	land within 20 km of Nowra in Jervis CMA subregion
☐	Bauers Midge Orchid	Genoplesium baueri	land within 20 km of Nowra in Ettrema CMA subregion
☐	Albatross Mallee	Eucalyptus langleyi	land north of Conjola and west of Princes Highway in Jervis CMA subregion
☐	Ettrema Mallee	Eucalyptus sturgissiana	land west of Princes Highway in Jervis CMA subregion
☐	Littlejohns Tree Frog	Litoria littlejohni	land within 100 m of permanent rocky streams with thick fringing vegetation

Based on these “geographic and habitat features” the following “species credit species” potentially occur on the potential biobank site but require survey and detection in order to be eligible for credit generation (Table 6).

Table 6 Species Credit species requiring survey on the potential biobank site

Survey time matrix	
Common name	Scientific name
Black Bittern	Ixobrychus flavicollis
Brush-tailed Phascogale	Phascogale tapoatafa
Bynoes Wattle	Acacia bynoeana
Eastern Pygmy-possum	Cercartetus nanus
Giant Burrowing Frog	Heleioporus australiacus
Hibbertia puberula	Hibbertia puberula
Hibbertia stricta subsp. furcatula	Hibbertia stricta subsp. furcatula
Koala	Phascolarctos cinereus
Nowra Heath Myrtle	Triplarina nowraensis
Pretty Beard Orchid	Calochilus pulchellus
Pterostylis ventricosa	Pterostylis ventricosa
Regent Honeyeater	Anthochaera phrygia
Southern Brown Bandicoot (eastern)	Isodon obesulus subsp. obesulus
Squirrel Glider	Petaurus norfolcensis
Tangled Bedstraw	Galium australe
White-footed Dunnart	Sminthopsis leucopus

3.8.1 Species credit species detected on the potential Biobank Site

To date targeted surveys for Brush-tailed Phascogale, Eastern Pygmy-possum (EPP), Southern Brown Bandicoot, Squirrel Glider and White-footed Dunnart have been conducted on the potential Biobank Site. Only EPP has been detected within SR516 vegetation community (Figure 12).

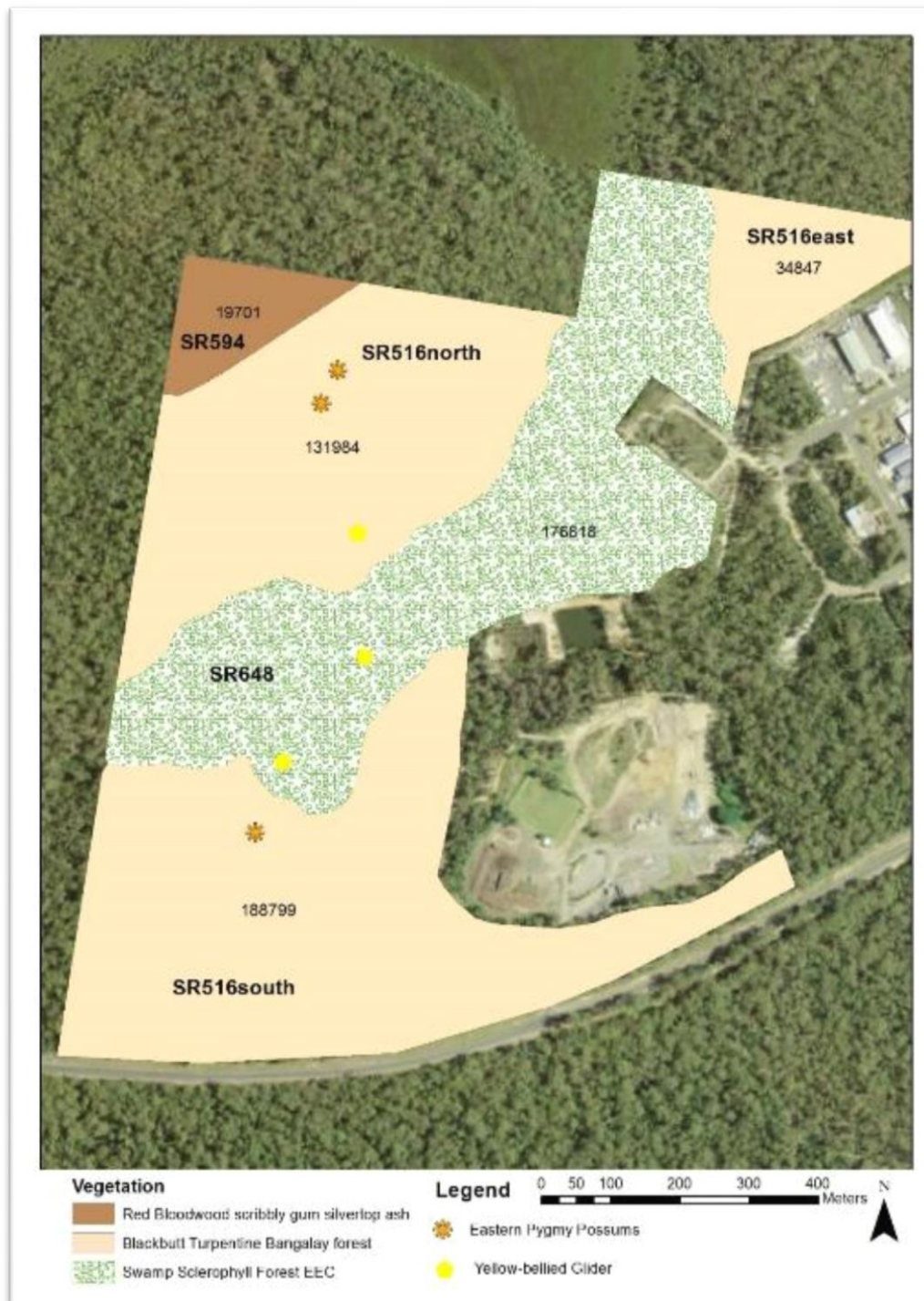


Figure 12 Threatened species (mammals) and biometric vegetation types

3.8.1.1 Targeted Eastern Pygmy-possum survey details

Eastern Pygmy-possum (EPP) were targeted for survey using artificial “post pack” nest tubes. Five EPP were detected in total utilising the tubes; one on 22.1.2015, one on 10.3.15 and three in one tube on 30.6.15. Full details of the detection method is provided in Annexure 5.1.

3.8.1.2 EPP threatened species polygon

EPP were detected in Biometric vegetation type SR516 (Figure 12) which contains in the understorey a mix of Proteaceae shrubs such as *Banksia spinulosa* and *Lambertia formosa*. Proteaceae species, particularly Banksia species, are an important food source for EPP (profile on OEH threatened species website accessed March 2016). Detections were in zones “SR516 north” and “SR516 south” but with Biometric vegetation type SR594 containing an understorey where Proteaceae shrubs are common and in close proximity to two EPP detections, the threatened species polygon (Figure 14) on the biobank site encompasses the three SR516 zones and the SR594 vegetation type and totals 37.53ha (refer to Figure 11). The 37.53ha equates to 266 credits for EPP in the Biobank calculator (Figure 13).

species credits			Management actions
Scientific name	Common name	Number of species credits created	
☐ <i>Cercartetus nanus</i>	Eastern Pygmy-possum	266	

Figure 13 Credit total for EPP from Biobank calculator

Whilst the swampy areas of the site are unlikely to be core habitat for EPP, SR648 would not be a barrier to EPP travelling between the three SR516 zones on the site.

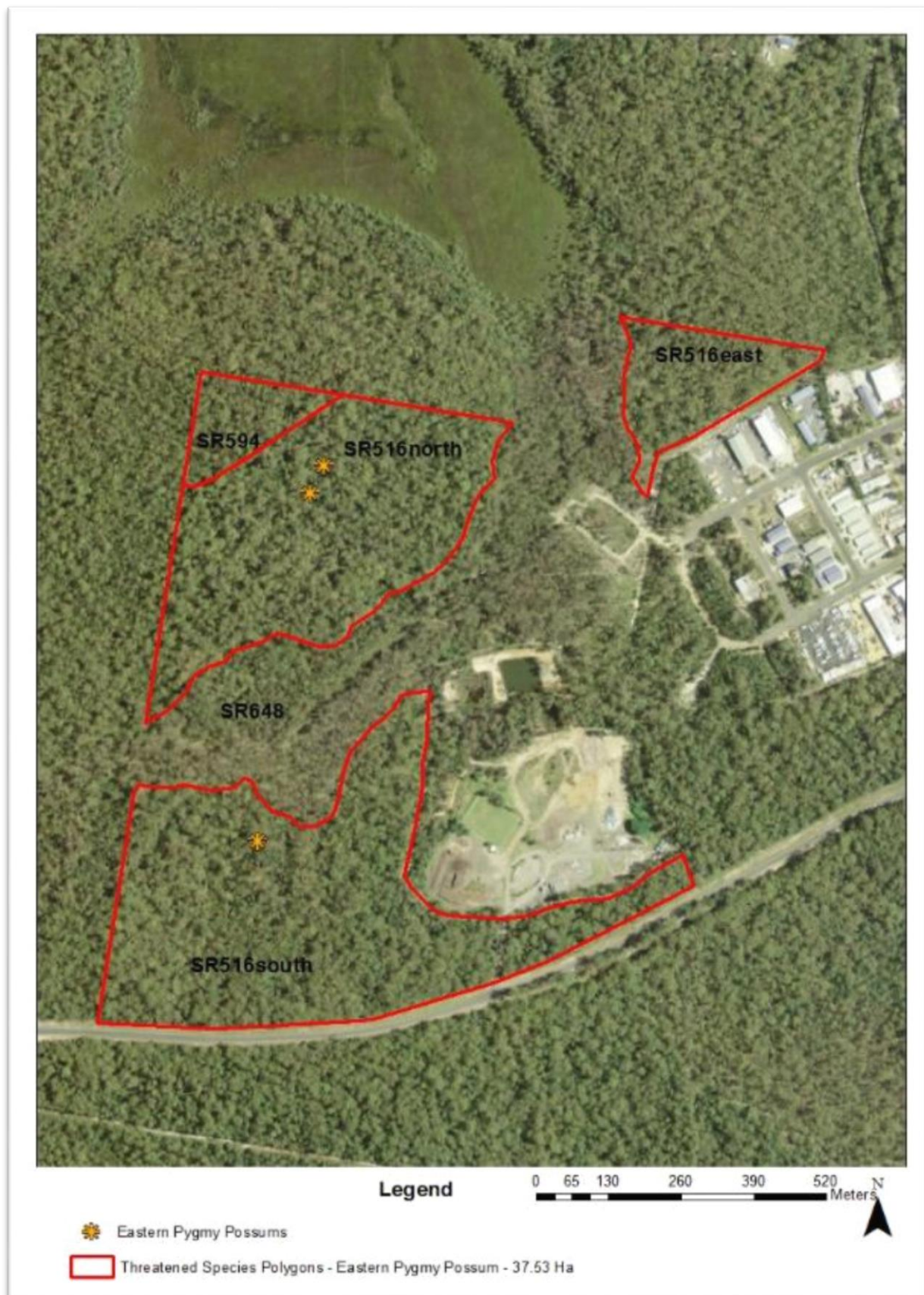


Figure 14 Eastern Pygmy Possum species polygons on the potential biobank site

4. References

Australian Museum website accessed on 7.1.16
<http://australianmuseum.net.au/squirrel-glider> and

<http://australianmuseum.net.au/eastern-pygmy-possum>

Department of Environment, Climate Change and Water, 2011. *Jervis Bay National Park & Woollamia Nature Reserve Plan of Management*. NSW DECCW / NPWS.

NPWS, 2009. *Fire management strategy of Jervis Bay National Park and Woollamia Nature Reserve and Corramy State Conservation Area (North)*. NSW National Parks & Wildlife Service, South Coast Region, Nowra.

OEH, 2013. *Compilation map: Biometric vegetation types and endangered ecological communities of the Shoalhaven, Eurobodalla & Bega Valley local government areas. A living map. Version 2.0*. Technical Report, NSW Office of Environment & Heritage, Queanbeyan.

OEH, 2014. *Framework for Biodiversity Assessment, NSW Biodiversity Offsets Policy for Major Projects*. Technical Report, NSW Office of Environment & Heritage, Sydney.

OEH, 2014 (b). *Biobank Assessment Methodology September 2014*. Office of Environment and Heritage for the NSW Government, 59 Goulburn Street, Sydney NSW.

Shoalhaven Bush Fire Management Committee (2010). *Bush Fire Risk Management Plan*. Plan approved by the NSW Bush Fire Coordinating Committee.

5. Annexures

5.1 Eastern Pygmy-possum targeted survey report

Eastern Pygmy-possum (EPP) nest tubes monitoring – land surrounding Huskisson R&WF site

One hundred “post pack” nest tubes were set out on the subject land on 19 May 2014. The tubes were set out approximately 20m apart but thick vegetation in parts meant some flexibility in site selection was required. Tubes covered an area of approximately 8ha in two separate portions of the site (Figure 15).

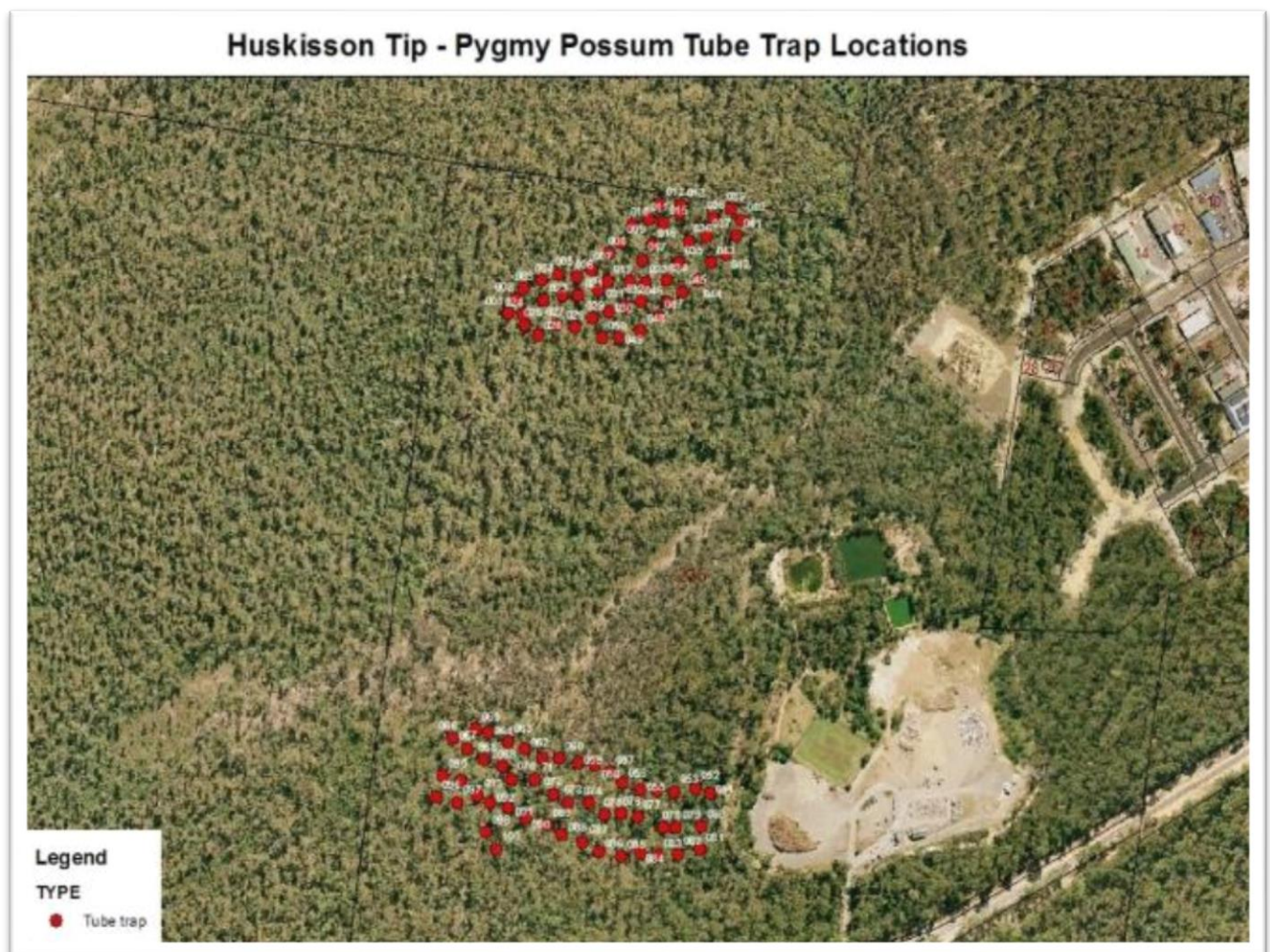


Figure 15 Post pack Pygmy-possum tube “trap” locations

Tubes were set at approximately 1 m above the ground, mostly in flowering *Banksia spinulosa* (Figure 16) targeting EPP. A small number of tubes were placed in flowering *Lambertia formosa*.

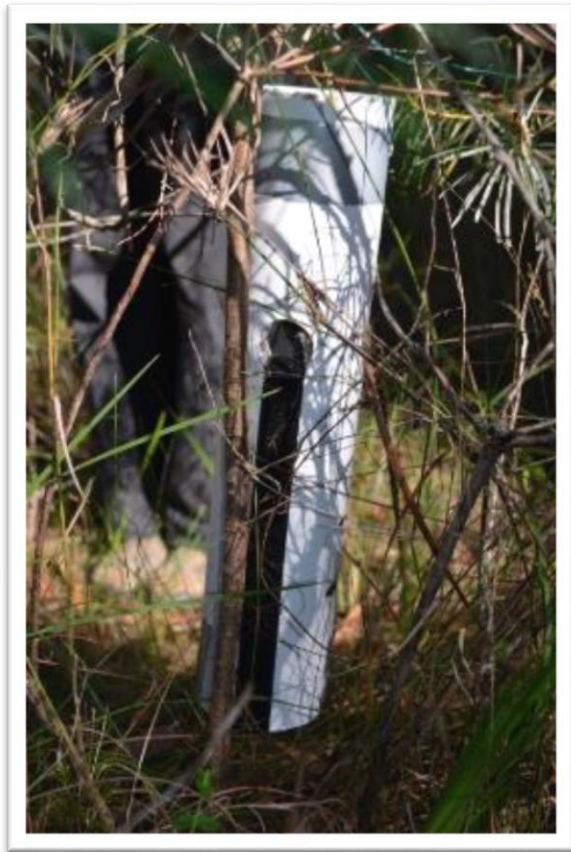


Figure 16 Post Pack Eastern Pygmy-possum tube installed in a *Banksia spinulosa*

Monitoring

Monitoring involved visual inspections of all the tubes on the following dates, approximately at monthly intervals. All vertebrate fauna and signs within and on the tubes were recorded.

12 June 2014; No vertebrate fauna were detected in any of the tubes. Tube 100 had 2 scats sitting on the lid which was also full of water. The scats could not be positively attributed to a species but were possibly *Antechinus* based on size.

24 July 2014; No vertebrate fauna were detected in any of the tubes. Tube 25 had a scat on the lid tentatively identified as that of a Bush Rat (*Rattus fuscipes*). Tube 75 appeared to have been chewed on by an animal (Figure 17) and Tube 77 appeared

to have been damaged by a kangaroo hopping through the site. Both Tubes were assessed to still be functional and left in place.

9 September 2014; No vertebrate fauna were detected in any of the tubes. Some tubes contained water up to 2cm deep and the majority were felt damp following approximately 300mm of rain in the two weeks preceding the inspection week. Tubes were emptied of water and some repositioned.

10 October 2014; Four tubes (28, 76, 83 & 84 - Figure 19 & Figure 20) contained scats. Scats were sent to Barbara Triggs for identification. Triggs identified the scats in tubes 76, 83 & 84 as being from a small dasyurid (*Antechinus* sp.) with the Scat in 28 being tentatively identified as a possum scat fragment (Figure 18).



Figure 17 – Damaged (chewed) tube 75 on 24 July 2014



Figure 18 – Scats found in tube 28 on 10 October 2014 tentatively identified as those of EPP.



Figure 19 Scats in tube 76 on 10 October 2014



Figure 20 – Scats in tube 84 on 10 October 2014

25 November 2014; No vertebrate fauna were detected in any of the tubes. Approximately 6 tubes were repositioned within shrubs or into flowering nearby shrubs (*Lambertia formosa*).

22 January 2015; One Eastern Pygmy-possum (*Cercartetus nanus*) was found in tube 29 along with a Bleating Tree Frog (*Litoria dentata*). Tube 29 was positioned in a *Banksia spinulosa*. Tube 4 and tube 19 contained Peron's Tree Frog (*Litoria peronii*); tube 4 contained one individual, while tube 19 contained two *L. peronii*. Tube 35 contained one *Litoria dentata*. Tube 65 and 76 contained scats belonging to an insect and *Antechinus* sp. respectively. Approximately 4 tubes were found with their caps off, while approximately 10 tubes were repositioned. Many of the tubes were moist and soft due to rain events during the week.

10 March 2015; One Eastern Pygmy-possum (*Cercartetus nanus*) was found in tube 19 (Figure 21). Tube 19 was positioned in a *Banksia spinulosa*. Nesting material attributed to Eastern Pygmy-possums was found in tubes 58 and 96. One Brown Antechinus (*Antechinus stuartii*) was found in tube 60 (Figure 22).



Figure 21 Eastern Pygmy-possum in tube 19 on 10.3.15



Figure 22 Brown Antechinus in tube 60 on 10.3.15

9 April 2015; Scats were found in tubes 59, 71, 76, 80 and 83. The scats in tube 76 were water affected and un-attributable to a fauna species whilst the scats in the other tubes were identified as those belonging to *Antechinus* sp. (friable and consisted entirely of insect remains – Triggs, 1996).

Tubes 3 and 41 were brought in for repairs.

14 May 2015; Tubes 3 and 41 were returned after repair. Tube 71 contained a large amount of vegetation being the stem tips and leaves of *Banksia*, *Tea tree*, *Lambertia* and grass. The vegetation filled the tube to the level of the entrance hole (Figure 23).

Tube 72 contained 1 Brown Antechinus (*Antechinus stuartii*) (Figure 24), Tube 84 contained 2 Brown Antechinus (Figure 25), and Tube 97 contained 1 Brown Antechinus (Figure 26).

Tubes 76 and 82 were brought in for repairs.



Figure 23 Leaves to the entrance hole in Tube 71



Figure 24 Brown Antechinus in Tube 72



Figure 25 Two Brown Antechinus in Tube 84



Figure 26 Brown Antechinus in Tube 97

30 June 2015; three Eastern Pygmy Possums (*Cercartetus nanus*) were found in tube 71 though no camera was available to capture an image. Tube 71 was positioned in a *Banksia spinulosa*. The vegetation found within this tube on the 14th May was still within the tube, however the vegetation had browned. The vegetation still filled the tube to the level of the entrance hole.

Tube 72 contained a very similar nest to that of Tube 71; however the tube had fallen down. There was no fauna residing in this tube.

Tubes 76, 82 were not in places having been brought in in May.

28 July 2015; No vertebrate fauna was detected in any of the tubes. Tubes 4, 39 & 72 were brought in for repairs. The base had fallen out of tube 72 with the other tubes distorted such that the lids had popped off and couldn't be replaced.

18 August 2015; No vertebrate fauna was detected in any of the tubes and the tubes were collected and brought in from the site.

References

Triggs, B. (1996). *Tracks, Scats and Other Traces. A Field Guide to Australian Mammals*. Oxford University Press, Melbourne.