CLIENTS | PEOPLE | PERFORMANCE

Pacific National

Greta Provisioning Facility

Biodiversity Offset Package

January 2013

INFRASTRUCTURE | MINING & INDUSTRY | DEFENCE | PROPERTY & BUILDINGS | ENVIRONMENT

Contents

Table Index

Figure Index

Appendices

1. Executive Summary

GHD was commissioned by Pacific National (the Proponent) to oversee the provision of biodiversity offsets for the proposed development of a Train Support Facility at Greta, in the Hunter Valley, New South Wales (the Project). This Biodiversity Offset Package (referred to as 'the offsets package') has been prepared by GHD to provide biodiversity offsets to compensate for impacts arising from the Project.

The Project comprises the construction of a series of rail sidings, maintenance facilities and staff car parking within a 49 ha site. The Project has been assessed under Part 3A of the NSW Environmental Planning and Assessment Act 1979 (EPA Act) and will result in impacts on native biota. An ecological impact assessment of the Project has been performed and has identified and quantified the impacts on native biodiversity along with proposed measures to avoid and mitigate these impacts (SKM, 2010a, 2010b). The outcome of this and subsequent assessments is that the Project would result in residual impacts equating to the removal of approximately 19.8 ha of vegetation, including the removal of EECs and habitat for threatened species (DoP, 2011a). Subsequent consultation with the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) established that DSEWPaC would require biodiversity offsets for removal of vegetation within a 20.47 hectare development area that also includes areas that may be developed at some point in the future.

Biodiversity offsets are required to compensate for residual impacts on EECs, threatened species and their habitats and clearing of native vegetation. A biodiversity offset comprises one or more appropriate actions that are put in place to counterbalance specific impacts on native biota and their habitats. Appropriate actions are considered to be long-term management activities that aim to improve biodiversity conservation. This can include legal protection of land (i.e. an offset site) to ensure security of management actions and remove threats (DECC, 2008).

An offsets package for the Project has been presented that includes the purchase and retirement of biodiversity credits using the BioBanking methodology and the OEH (2011) offsets policy. This offsets package includes the conservation of two biobank sites:

- A portion of the subject site outside of the development footprint, which is referred to as the 'Greta biobank site'.
- A privately owned site at The Branch, which is referred to as the 'Branch Lane biobank site'.

The BioBanking methodology has been used to develop the offsets package as follows:

- Desktop application of the BioBanking methodology to determine impacts of the development and the Project offsetting requirements in terms of biodiversity credits.
- Site survey of the Greta biobank site and the Branch Lane biobank site using the BioBanking plot/transect methodology and additional targeted surveys appropriate to biodiversity values at the sites.
- Assessment of the biobanks using the BioBanking methodology to determine the biodiversity credits that will be generated when biobanking agreements are obtained for the sites and they are formally set aside and managed for conservation.

- Comparison of the biodiversity credit profiles of the development site and biobank sites to demonstrate that the biobanks are appropriate to offset biodiversity impacts of the Project.
- Finalisation of the offsets package using the OEH (2011) policy and associated variation criteria.

The offset rules state that ecosystem credits that are retired from a biobank site are determined to be compatible with those required by impacts at the development site if conditions presented in the DECC (2009) methodology are met. Of these, the most critical is that 'the number of ecosystem credits obtained and retired from the biobank site is equal to or greater than the number of credits required at the development site'. A suite of biodiversity credits has been identified and included in this offsets package that are appropriate to compensate for impacts of the Project. That is, sufficient biodiversity credits could be generated to offset the Project development impacts when the Greta biobank and Branch Lane biobank are entered into biobanking agreements.

The Greta biobank site is approximately 20.33 hectares in area and makes a suitable 'like for like' contribution to the offsets package since it will achieve conservation outcomes within an area approximately equal in size to the development area and within the same overall patch of native vegetation and habitat. Local populations of native species, including threatened biota, that will be affected by the Project will directly benefit from the regeneration of degraded or cleared land into Forest Red Gum – Spotted Gum Forest within the Greta biobank site.

The Branch Lane biobank site will contribute the majority of the offset for the Project by conserving approximately 116 hectares of habitat. The site has attributes that make it highly suitable as an offset site, including continuity with a patch of native vegetation and habitat resources for threatened biota. The Branch Lane biobank site is the preferred site for this project and consultation has now commenced with the land owner regarding progression of a biobanking agreement and sale of biodiversity credits. Pacific National and the landowner have executed a binding agreement for the transfer of an agreed number and type of biodiversity credits.

The BioBanking methodology has been varied with reference to the *Interim policy for assessment of biodiversity offsets for Part 3A Projects* (OEH 2011). This framework specifies the assessment process and decision-making criteria for using BioBanking so that a Part 3A Project may achieve an '*improve or maintain'*, '*no net loss'* or '*mitigated net loss'* outcome.

The Project has resulted in direct impacts to Red Flag areas and this offset package would require a variation to the offset type (i.e. not all vegetation types would be directly offset) and so would achieve a 'mitigated net loss' as defined in the interim policy (OEH, 2011). Variation criterion f) would be applied to convert ecosystem credits to a regional conservation priority in a regional conservation plan. Additional ecosystem credits would be presented to compensate for the removal of EECs within the development area. All threatened fauna species predicted to occur in ecosystem credits associated with the development area are also predicted to occur at the Branch Lane biobank site.

Given the overall surplus of biodiversity credits, the conservation of like for like habitats within the Greta biobank site and the high conservation significance of the Branch Lane biobank site, the offsets package for the Project would achieve conservation outcomes that more than compensate for the impacts of the Project.

2. Introduction

2.1 Overview

GHD was commissioned by Pacific National (the Proponent) to oversee the provision of biodiversity offsets for the proposed development of a Train Support Facility at Greta, in the Hunter Valley, New South Wales (the Project). This Biodiversity Offset Package (referred to as 'the offset package') has been prepared by GHD to provide biodiversity offsets to compensate for impacts arising from the Project.

The Project comprises the construction of a series of rail sidings, maintenance facilities and staff car parking on a 49 ha site, referred to in this document as the 'subject site' and shown on Figure 1. The subject site is a former rural property containing a mix of near-intact and regenerating bushland and cleared land.

The Project has been assessed under Part 3A of the EP&A Act and will result in impacts on native biota. An ecological impact assessment of the Project has been performed and has identified and quantified the impacts on native biodiversity along with proposed measures to avoid and mitigate these impacts (SKM, 2010a, 2010b). The outcome of this assessment is that the Project would result in residual impacts equating to the removal of approximately 19.8 ha of vegetation, including the removal of endangered ecological communities (EECs) and habitat for threatened species (DoP, 2011a).

Biodiversity offsets are required to compensate for residual impacts on EECs, threatened species and their habitats and clearing of native vegetation. A biodiversity offset comprises one or more appropriate actions that are put in place to counterbalance specific impacts on native biota and their habitats. Appropriate actions are considered to be long-term management activities that aim to improve biodiversity conservation. This can include legal protection of land (i.e. an offset site) to ensure security of management actions and remove threats (DECC, 2008).

This offset package has been prepared to address Condition 12. of the NSW Planning Minister's Conditions of Approval for the Project which states: "Prior to commencement of construction, or unless otherwise agreed to by the Director-General, the Proponent shall develop and submit a Biodiversity Offset Package for the approval of the Director-General. The package shall detail how the ecological values lost as a result of the Project will be offset, and the final offset measures that will be used to meet the offset requirements".

The Project is a controlled action under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and so the Project environmental assessment and biodiversity offset must also satisfy the requirements of the Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC). Specifically the Project must comply with the Commonwealth Conditions of Approval dated 13 May 2011, which includes the following conditions:

- 12. The person taking the action must submit a Biodiversity Offset Package for the Minister's approval.

- 13. The Biodiversity Offset Package outlined in Condition 12 must also provide for the conservation and management in perpetuity of an area of habitat for listed threatened species and ecological communities equal or greater in size to that determined by the NSW Biodiversity Banking and Offsets Scheme methodology.

The NSW Biodiversity Banking and Offsets Scheme (BioBanking) has been used to determine the number of biodiversity credits required to offset impacts of the Project and the biodiversity credits that would be generated by the conservation of two biobank sites, comprising:

- A portion of the subject site outside of the development footprint, which is referred to as the 'Greta biobank', as shown on Figure 1.
- A privately owned site at The Branch, which is referred to as the 'Branch Lane' biobank site, as shown on Figure 2.

These biobank sites contain an appropriate suite of vegetation types, threatened biota and habitat resources to offset biodiversity impacts arising from the Project.

BioBanking operates on an '*improve or maintain'* principle and includes a methodology for calculating offset ratios, trading biodiversity values and protecting areas with higher conservation values. The BioBanking methodology does not strictly apply to Part 3A Projects. The *Interim policy for assessment of biodiversity offsets for Part 3A Projects* (OEH 2011) [the 'Interim Policy'} provides a framework for determining biodiversity offsets for Part 3A Projects using a modified form of the BioBanking methodology. This framework specifies the assessment process and decision-making criteria for using BioBanking so that a Part 3A Project may achieve an '*improve or maintain'*, '*no net loss'* or '*mitigated net loss'* outcome. This offsets package has been prepared using the Interim Policy and includes detailed justification of the outcome and associated decision-making criteria.

The BioBanking calculations presented in this report would also be used to support a biobanking agreement for the biobank sites. Pacific National would purchase and retire biodiversity credits generated at the biobank sites. The BioBanking Trust Fund would fund the management of the biobank site in perpetuity and ensure that the site is conserved and actively managed to achieve long term gains in biodiversity values.

2.2 Objectives

2.2.1 Overall Biodiversity Offsets Package

The overall objectives of this biodiversity offsets package are to:

- Satisfy relevant NSW and Federal Conditions of Approval.
- Describe the process by which the impact of the Project, specifically the clearing of native vegetation, will achieve a 'maintain or improve' outcome through the conservation of high-value habitat in the region of the Project.
- Provide relevant information on offsetting/BioBanking and the Project.
- Describe the ecological impacts of the Project.
- Describe the proposed offset site/s, their ecological values, to compensate for the impact of the Project.

- Describe the security and implementation of the offsets for the Project using the BioBanking.
- Describe the monitoring and reporting obligations for the offset site/s using BioBanking.

2.2.2 Development site

The aim of the assessment works for the development site was;

- To describe the natural environment of the development area as a guide to the scale and type of biodiversity offsets that will be required;
- To conduct a rapid desktop assessment to allow for initial offsets planning (using a modified methodology agreed with DECCW BioBanking Unit); and
- To recalculate the biodiversity credits required to offset impacts of the Project (a Development assessment) in accordance with the BioBanking methodology, after additional site surveys.

2.2.3 Greta biobank site

The aim of the biodiversity offset package for the Greta biobank site was:

- To select an appropriate biobank site as close as possible to the site of impact that is targeted to the matter/s being impacted under the EPBC Act;
- To assess the site's suitability for use as a BioBanking site against relevant ecological principles, such as '*like for like'* and regulatory instruments;
- To undertake additional site surveys according to the BioBanking methodology to supplement the Project ecological assessment;
- To undertake targeted surveys for Slaty Red Gum (*Eucalyptus glaucina*);
- To determine the BioBanking credit value as a guide to the number and type of biodiversity credits to calculate the number of credits that will be generated when a biobanking agreement is obtained for each site; and
- To describe 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.

2.2.4 Branch Lane biobank site

The aim of the assessment works for the Branch Lane biobank site was:

- To select an appropriate biobank site that will deliver real conservation outcomes that is targeted to the matter/s being impacted under the EPBC Act;
- To assess the site's suitability for use as a biobanking site against relevant ecological principles, such as '*like for like'* and regulatory instruments;
- To undertake site surveys in accordance with the BioBanking methodology;
- To determine the biodiversity credit value as a guide to the number and type of biodiversity credits that will be generated when a biobanking agreement is obtained for the site; and

- To describe 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.

2.3 Relationship with Existing Reports

This offsets package has been prepared giving consideration to information contained in the following:

- Sinclair Knight Mertz (SKM) (2010a) *Train Support Facility, Greta, NSW Ecological Impact Assessment.*
- Monteath and Powers Pty Ltd (2010a) *Environmental Assessment for Pacific National Train Support Facility at Greta in the Cessnock City Council Local Government Area*
- Monteath and Powers Pty Ltd (2010b) *Submissions and Preferred project report for or Pacific National Train Support Facility at Greta in the Cessnock City Council Local Government Area.*
- SKM (2010b) *Addendum Report Train Support Facility Greta, NSW Ecological Impact Assessment.*
- DoP (2011b) Director General's Environmental Assessment Section 75I of the *Environmental Planning and Assessment Act 1979*.

Ecological values and impacts referred to in this report are referenced from the ecological assessments (as above) for the Project's study areas. These reports contain information relevant to the Offsets Package, including vegetation type and condition, conservation significance, impact assessment and suggested mitigation measures.

Additional consideration of the specific requirements of the EPBC Act is included in the GHD (2012) *Greta Provisioning Facility EPBC Act Biodiversity Offset Assessment*.

2.4 Site Context

The subject site, including the location of the proposed facility is Lot 1 DP 1129191 and has frontage onto Mansfield Street, Greta, NSW. It is geographically located in the Hunter Valley in the Local Government Area of Cessnock near the Township of Greta. The Township of Greta is located approximately 50 kilometres northwest of Newcastle and 20 kilometres north of Cessnock.

The subject site contains the development footprint for the Project as well as the Greta biobank site, which will be set aside as a biodiversity offset for the Project.

Consultation with DSEWPaC revealed that the Department would require biodiversity offsets for areas of the subject site that may be developed at some point in the future in addition to areas within the development footprint for the Project. Therefore the development area for this BioBanking assessment is a greater area than the 19.8 hectare development footprint for the Project presented in the environmental assessment (DOP, 2010).

The development footprint has also changed since the determination of the environmental assessment (DOP, 2010) due to the purchase of a small portion of the site by the Australian Rail Track Corporation (ARTC) to accommodate rail infrastructure. This approximately 0.3 hectare area in the south east of the study area was divided from Lot 1 DP 1129191, set aside for use by the ARTC and the site layout for the Project modified accordingly.

The development area for this BioBanking assessment and offsets package is shown on Figure 1 and comprises:

- The development footprint, which is 24.22 hectares in area and contains 19.8 hectares of native vegetation.
- The potential future use area, which is 2.38 hectares in area and contains 0.67 hectares of native vegetation.

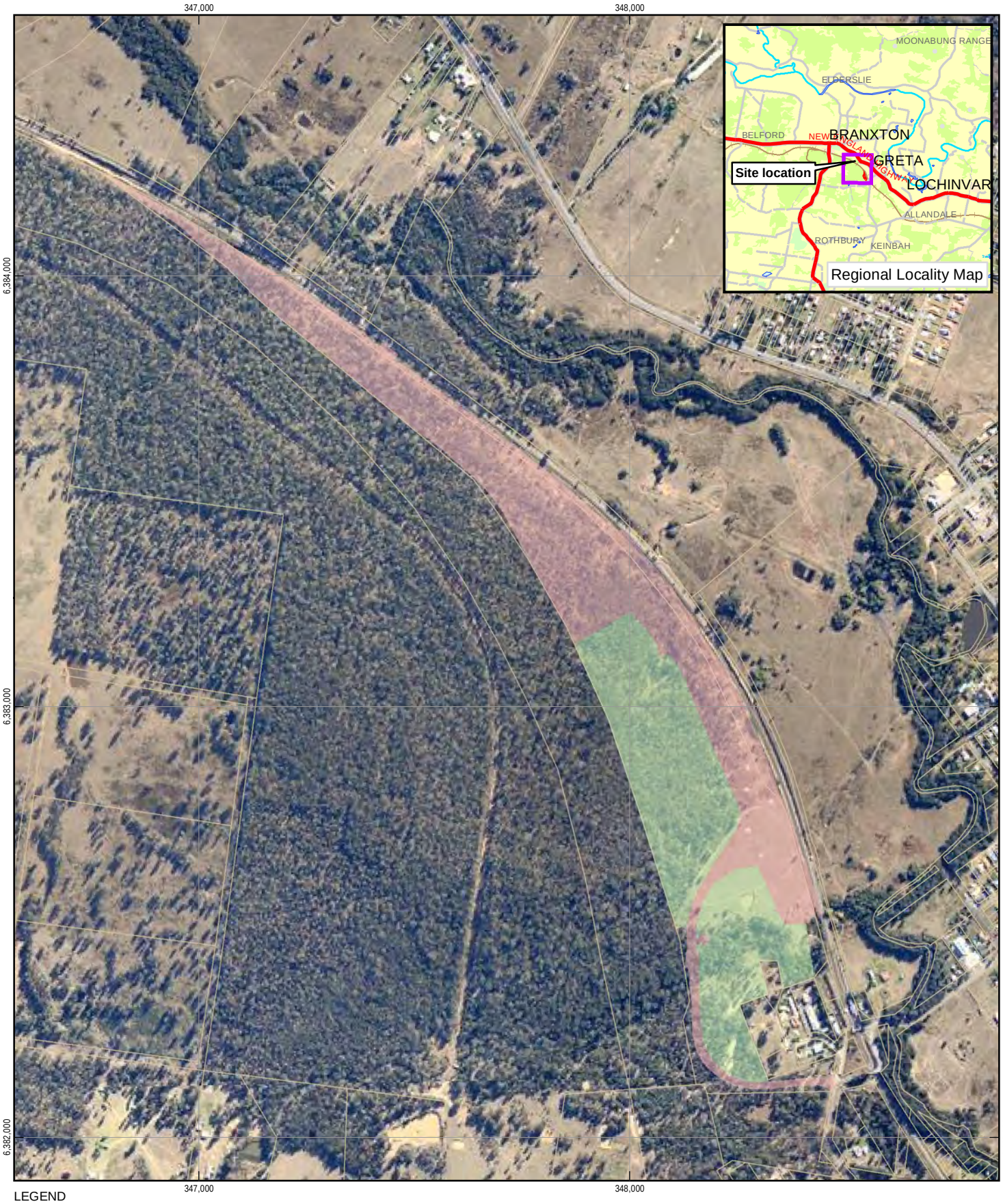
Only removal of native vegetation requires biodiversity offsets in this offsets package and so the development area included in BioBanking credit calculations is 20.47 hectares.

The subject site is located on the south western side of, and adjacent to the Great Northern Railway at Greta and adjacent to the route for the proposed Hunter Expressway. The proposed development extends northwest from near Greta Railway Station for a distance of about 2.4 kilometres and extends southwest to the proposed corridor for the new freeway. Construction of the Hunter Expressway has begun and so the development footprint for the expressway has been added to aerial photographs with Geographical Information Science (GIS) and considered in all calculations and assessments included in this offsets package.

The regional location of the subject site is shown in Figure 1 along with location of the development area, the Hunter Expressway and the Greta biobank within the subject site.

A second biodiversity offset site for the Project was identified at The Branch and is referred to as the 'Branch Lane biobank site'. It is located in the lower portion of the Hunter CMA in the Local Government Area of Great Lakes City Council near the Township of Karuah. The Branch Lane biobank site is located approximately 60 kilometres east-northeast of the study area at Greta.

The regional location of the Branch Lane biobank site is shown in Figure 2 along with the location of the development area.



LEGEND

- Development Area
- Biobank Site
- Cadastre

1:12,000 (at A4)

0 40 80 160 240 320 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 56

N

GHD

CLIENTS | PEOPLE | PERFORMANCE

Pacific National
Greta Provisioning Facility
Biodiversity Offsets Package

Job Number	22-15242
Revision	A
Date	18 Sep 2012

Subject Site Location & Layout

Figure 1

G:\22\15502\GIS\Maps\MXD\22_15502_Z020_Greta_Sitelocation_Options.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 LPI, Cadastre, 2012.; Navigate StreetMap. Copyright Navigate NAVTEQ & PSMA Australia, Street Map, Jan 2011. Created by: nahansen, BHambly

406,000 407,000 408,000 409,000 410,000 411,000 412,000

6,394,000
6,393,000
6,392,000
6,391,000

The Branch Lane

Image © 2012 GeoEye

©2010 Google

Pacific Highway

406,000 407,000 408,000 409,000 410,000 411,000 412,000

Paper Size A3

0 100 200 400 600 800

Metres

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

N

LEGEND

Branch Lane biobank site boundary

GHD

CLIENTS | PEOPLE | PERFORMANCE

Pacific National
Greta Provisioning Facility
Biodiversity Offsets Package

Branch Lane Biobank Site Location

Job Number	22-15502
Revision	A
Date	06 Aug 2012

Figure 2

G:\22\15502\GIS\Maps\MXD\22_15502_Z021_BranchLaneBiobankSiteLocation.mxd

Data source: Data Custodian, Data Set Name/Title, Version/Date. Google Earth Pro, Aerial Imagery, 2012. Copyright Navigate NAVTEQ & PSMA Australia, Street Map, Jan 2011. Created by:apmiller, BHambly

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

2.5 BioBanking

The NSW Biodiversity Banking and Offsets Scheme (BioBanking) has been established by the then New South Wales Department of Environment Climate Change and Water (DECCW) to help 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.

To establish credits for 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.

Developers can also apply for a BioBanking statement that specifies the number and class of credits that must be acquired to counterbalance or offset the impacts on biodiversity values that are likely to occur as a result of development. The scheme provides an alternative path to the threatened species assessment of significance process required under the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act).

The BioBanking Assessment Methodology (the methodology) 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 DECCW and ensures accountability and compliance through legislation, regular reporting requirements and financial measures.

Overall, it is hoped the scheme will conserve areas with high biodiversity values by providing incentives for conservation and disincentives for loss.

The DECC (2009) BioBanking methodology aims to encourage and secure investment in conservation and to provide financial incentives for the protection of biodiversity values by:

- Providing a measurable, consistent, transparent, and robust framework for the assessment and management of biodiversity offsets.
- Creating new opportunities for conservation on private land.
- Providing permanent security and management for biodiversity offsets.
- Providing a secure mechanism for investment in biodiversity conservation.

2.6 Glossary of Terms

2.6.1 Project Definitions

Subject Site	The site for the Project; the parcel of land containing the various component areas of the Project.
Development footprint	The area of direct disturbance for construction of the Project.
Potential future use area	Areas of land within the subject site that may be required for construction of infrastructure at some point in the future.
Development area	The area of impact included in the BioBanking calculations presented in this offsets package. Comprises the mapped area of native vegetation within the Project development footprint and potential future use area.
Greta biobank site	A portion of the subject site that has been set aside for conservation to offset biodiversity impacts arising from the Project. This area of land will be included in a biobanking agreement.
Branch Lane biobank site	A parcel of land at The Branch, NSW that has been set aside for conservation to offset biodiversity impacts arising from the Project. This area of land will be included in a biobanking agreement.

2.6.2 BioBanking Definitions

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)	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 Credit Calculator (the calculator)	The software component of the BioBanking Assessment Methodology that calculates the credits created or credits required.
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	Means the BioBanking 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 offsets	Actions 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.
Compulsory development	Development that in the opinion of the Minister of Planning is "of State or regional environmental planning significance". Section 127ZM (7) of the *TSC Amendment (Biodiversity BioBanking Act 2006, No 125*) specifies that these projects have priorities and the Minister of Planning is not required to concur to the issue of the BioBanking statement if the project is of importance to the State. When the project has a state or regional environmental planning significance it satisfies the condition to be declared as a part 3A project.
BioBanking Credit Calculator (the credit calculator)	The credit calculator is the software component of the methodology. It is a database that contains threatened species, habitat and vegetation data. The credit calculator determines the number of ecosystem credits and species credits required at a development site and the number of ecosystem credits and species credits created at a biobank site. It does this on the basis of the existing biodiversity data, equations, information collected at the site and GIS calculations according to the assessment process outlined in the methodology.
Development site	Land that is designated by a BioBanking statement to be a development site.
The calculator	See BioBanking Credit Calculator.
The development footprint	The portion of the subject site that is proposed for development.
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).
Management action	An action or proposed action in respect of which a biodiversity credit may be created.

Red flag areas	A red flag area is an area of land that is identified by the methodology as having high biodiversity conservation values. A development cannot be determined as improving or maintaining biodiversity values, and a BioBanking statement cannot be issued, if the development directly impacts on a red flag area; unless, the Director General makes a determination that it is possible for the development be regarded as improving or maintaining biodiversity values.
Species credit	A credit that relates to an individual threatened species that cannot be reliably predicted based on habitat surrogates. Threatened species that require species credits are identified in the Threatened Species Profile Database.

3. Methodology

3.1 Desktop Assessment

3.1.1 Literature and Database Review

The following resources were reviewed to describe the existing environment of the site and to, as far as possible, obtain the necessary site data to perform BioBanking credit calculations:

- The Project environmental assessment (SKM, 2010a, 2010b; Monteath and Powys, 2010)
- DECC (2008a) *NSW (Mitchell) Landscapes Version 3 (2008)*
- DECC (2008b) *Descriptions for NSW (Mitchell) Landscapes*
- OEH (2011) Vegetation Types Database
- DECCW (2010b) Threatened Species Profile Database
- DECCW (2010c) NSW Interim Vegetation Extent remote sensing imagery
- Aerial photographs and satellite imagery of the study area
- Hunter Councils (2002) *Lower Hunter Central Coast Regional Environmental Mapping Survey* 'LHCCREMS' Vegetation Mapping

3.1.2 Geographical Information System (GIS) Analysis

Geographical Information System (GIS) was used in the current assessment as follows:

- Plotting of the site, development site and biobank site boundaries on a high resolution aerial photo base.
- Preliminary mapping of vegetation types across the site, based on available information.
- Assessment of native vegetation cover, extent and connectivity at the landscape scale.
- Stratification and mapping of the site and calculation of the extent of vegetation patches.

3.2 BioBanking Assessment and Credit Calculation

Biodiversity credits were estimated at the development site according to the methodology presented in the DECC (2009) BioBanking Assessment Methodology and Credit Calculator Operational Manual. 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.

The BioBanking assessment methodology was used to develop the Offsets Strategy for the Project as follows (GHD, 2010a, 2010b):

- Desktop application of the BioBanking methodology to determine impacts of the development and the Project offsetting requirements in terms of biodiversity credits using Version 1.2 of the credit calculator.

- Application of the BioBanking methodology to portions of the subject site that would be set aside as a biobank and managed for conservation.
- Comparison of the credit profiles of the development site and biobank site to determine the residual impacts of the development and the requirement for an additional biobank site to offset impacts of the Project.
- Identification of potentially suitable additional biobank sites containing appropriate biodiversity credits to offset residual impacts of the Project.

The BioBanking assessment for the Project has been finalised in this offsets package as follows:

- Site survey of the Greta biobank site and the Branch Lane biobank site using the BioBanking plot/transect methodology and additional targeted surveys appropriate to biodiversity values at the sites.
- Supplementary site survey of the Greta study area to determine if any Slaty Red Gum (*Eucalyptus glaucina)* or its hybrids are present and would be removed by the development. Slaty Red Gum is listed as a vulnerable species under the TSC Act and the species and associated hybrids are listed as vulnerable under the EPBC Act.
- Assessment of the biobanks using the BioBanking methodology and Version 2.0 of the credit calculator to determine the biodiversity credits that will be generated when biobanking agreements are obtained for the sites and they are formally set aside and managed for conservation.
- Comparison of the biodiversity credit profiles of the development site and biobank sites to demonstrate that the biobanks are appropriate to offset biodiversity impacts of the Project.
- Finalisation of the offsets package using the OEH (2011) policy and associated variation criteria.

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), except the threatened species or populations that require species credits; and
- 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 in the Threatened Species Profile Database (DECCW, 2010b).

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. These BioBanking assessment reports are appended to this offsets package.

3.3 Potential Offset Property Comparison

GHD performed a desktop assessment of potential offset properties. The review involved the following tasks:

1. Locate chosen property/s on Google Earth/Six Viewer.

2. Overlay with Hunter Councils (2002) LHCCREMS mapping and estimate whether relevant vegetation types to offset the impacts arising from the project may be present on the site.
3. Estimate the vegetation percentage cover based on air photo interpretation, 'local' knowledge and topographic features.
4. Revise the Hunter Councils (2002) LHCCREMS vegetation mapping (if required) and estimate the approximate area of each vegetation type on the site if more than one vegetation type potentially present based on air photo interpretation, 'local' knowledge and topographical features.
5. Estimate whether vegetation appears to be regrowth from air photo interpretation, 'local' knowledge and topographical features.
6. Estimate the condition of vegetation at the site as either 'low' or 'moderate to high' according to the BioBanking methodology (DECC, 2009).

A summary of the potential offset sites considered in this assessment is provided in the Offset Strategy (GHD, 2010a, 2010b).

3.4 Site Survey

Site surveys of the Greta biobank portion of the subject site were conducted according to the BioBanking methodology to supplement the Project ecological assessment. GHD ecologists have also conducted site surveys of the Branch Lane biobank site and other potentially suitable biobank sites at other locations in the Hunter Valley. Survey effort that has directly contributed to this offset package is summarised in Table 1 and described below.

Table 1 GHD Survey Effort

Date	Study Area	Survey Effort	Survey Methods
1 and 2 February 2011	The subject site	2 ecologists for 2 days 8 plot / transects	20 m x 50 m BioBanking plot / transect surveys within the Greta biobank site. Targeted search for *Eucalyptus glaucina*, opportunistic fauna and threatened plant observations within the entire subject site.
29 April 2011	The subject site	2 ecologists for 1 day	Supplementary targeted search for *Eucalyptus glaucina*, including plotting of intergrades with *E. tereticornis,* opportunistic fauna and threatened plant observations within the entire subject site.

Date	Study Area	Survey Effort	Survey Methods
14 to 17 February 2012	The Branch Lane biobank site	2 ecologists for 4 days 14 plot /transects	Broad-scale vegetation survey, vegetation mapping, opportunistic fauna and threatened plant observations within the entire subject site. 20 m x 50 m BioBanking plot / transect surveys
26 April 2012	The Branch Lane biobank site	2 ecologists for 1 day 2 plot /transects	Supplementary 20 m x 50 m BioBanking plot / transect surveys. Opportunistic fauna and threatened plant observations within the entire subject site.

Plot and transect surveys were conducted on site in accordance with the methodology provided in DECC (2009). The site value was determined by assessing ten 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. A total of eight plots were sampled within the Greta biobank site within the subject site as shown on Figure 3. A total of 16 plots were sampled within the Branch Lane biobank site as shown on Figure 4.

An agglomerative hierarchical cluster analysis (PATN) was completed on the species richness and cover abundance data collected within plots sampled at the Branch Lane biobank site. User defined groups were created to match the vegetation zones identified in the preliminary survey of the site. The resultant dendrogram and ordination plot was used to test the preliminary vegetation mapping and the assigned DECCW (2010a) vegetation types and condition classes.

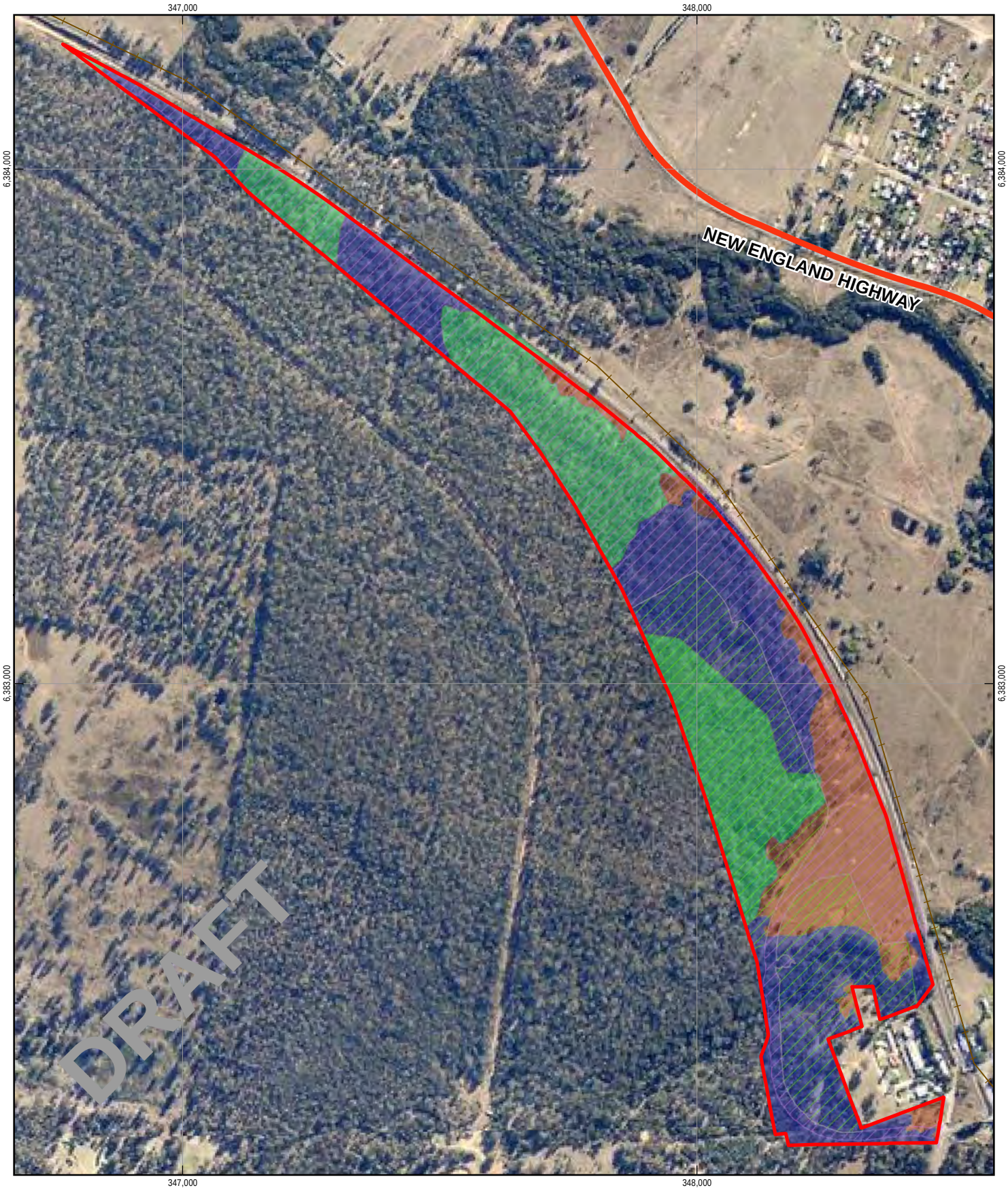
A targeted search for Slaty Red Gum (*Eucalyptus glaucina*) was conducted through all areas of suitable habitat within the subject site by checking all red gum species for diagnostic features. A voucher specimen of the species was collected from a mature, fruiting Slaty Red Gum outside the subject site to allow for field checking of diagnostic features. No Slaty Red Gum were recorded on the subject site. A supplementary survey for *E. glaucina* hybrids / intergrades with *E. tereticornis* was also conducted. No Slaty Red Gum hybrids were recorded within the development area. No systematic targeted surveys for other threatened species were conducted. Opportunistic observations of fauna and threatened plants were recorded and the locations of threatened species were captured with a handheld GPS.

3.5 Staff Qualifications

This report, including all BioBanking credit calculations, was prepared by Ben Harrington. The assessment was peer reviewed by Daniel Williams. Staff qualifications are presented in Table 2.

Table 2 GHD Ecology Personnel and Qualifications

Name	Position / Project Role	Qualifications	Relevant Experience
Ben Harrington	Senior Ecologist / desktop assessment, site surveys, credit calculations and reporting	BSc, MSc (Physical Geography) BioBanking Assessor Accreditation*	7+ years
Anders Bofeldt	Botanist / site surveys	Dip. Hort.	18+ years
Mark Aitkens	Senior Ecologist / desktop assessment, and reporting	BSc (Env Biology)	14+ years
Matt Flower	Botanist / site surveys	BEnvSc, MSc (Ethnobiology)	6+ years
Daniel Williams	Principal Ecologist / Peer review, final credit calculation, consultation and planning	B. App. Sc. BioBanking Assessor Accreditation*	13+ years
* Refer to DECCW (2010c) list of accredited assessors.			



Legend

- Subject Site
- Development Area
- Biobank Site
- Forest Red Gum - Grey Gum dry open forest (Low condition)
- Forest Red Gum - Grey Gum dry open forest (Moderate/good condition)
- Grey Ironbark - Spotted Gum - Grey Box Open forest (Moderate/good condition)

0 50 100 200 300 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 56

N

CLIENTS | PEOPLE | PERFORMANCE

Pacific National
Greta Provisioning Facility
Biodiversity Offsets Package

Job Number	22-15502
Revision	A
Date	18 Sep 2012

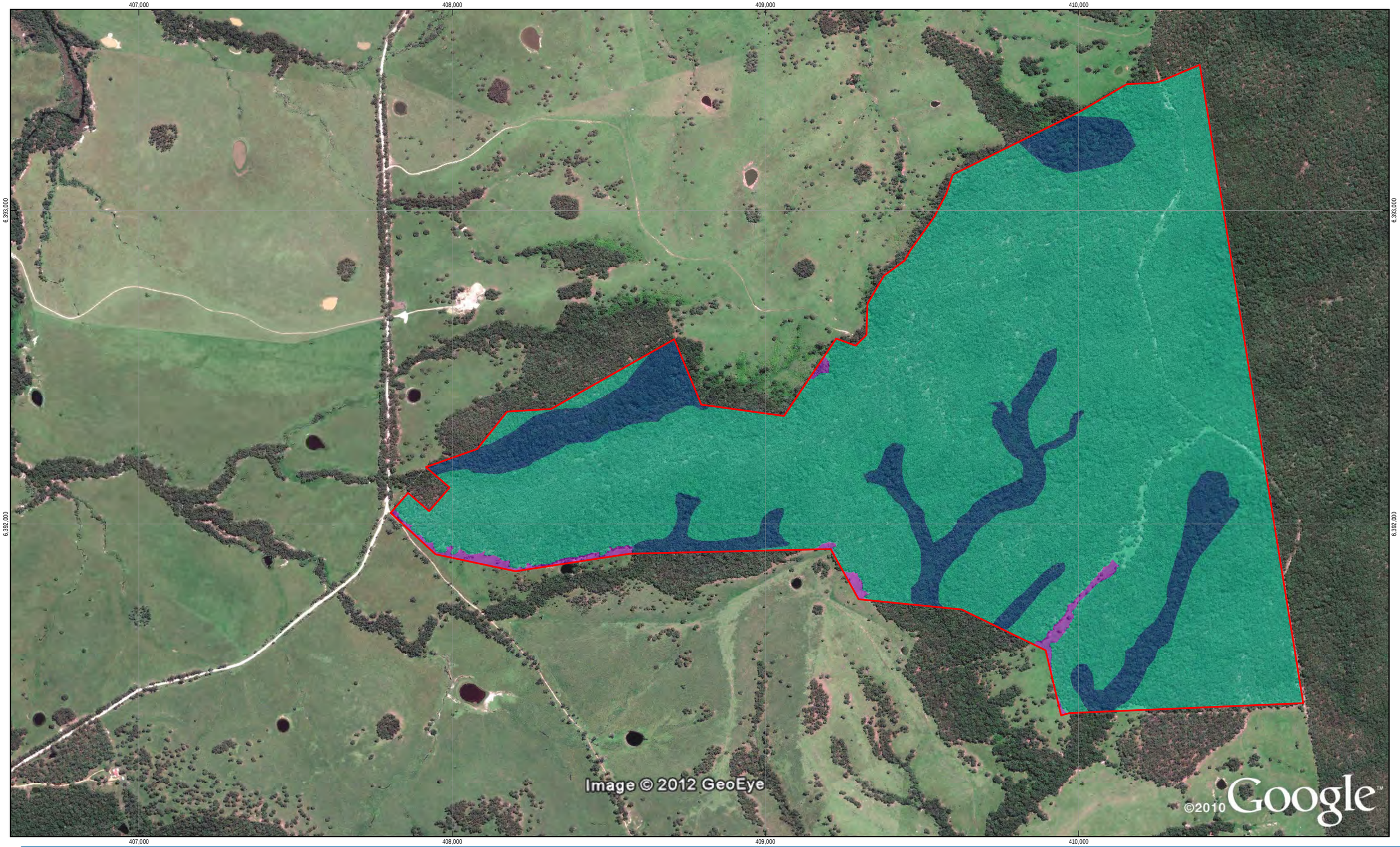
Subject Site Vegetation Zones

Figure 3

G:\22\15502\GIS\Maps\MXD\22_15502_Z005_Greta_Biobank_Vegetation.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 2010; Navigate StreetMap: StreetMap - Jan 2010. Created by: nahansen



Paper Size A3

0 75 150 300 450 600

Metres

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

N

LEGEND

Vegetation zone

- HU630_Low (Cleared Spotted Gum - Grey Gum Ironbark Forest)
- HU630_Moderate/Good (Spotted Gum - Grey Gum Ironbark Forest)
- HU642_Moderate/Good (Tallowwood - Brush Box - Sydney Blue Gum moist shrubby forest)

Branch Lane biobank site boundary

CLIENTS|PEOPLE|PERFORMANCE

Pacific National
Greta Provisioning Facility
Biodiversity Offset Package

Job Number	22-15502
Revision	A
Date	14 Aug 2012

Branch Lane Biobank Vegetation Zones

Figure 4

N:\AU\Sydney\Projects\22\15502\GIS\Maps\MXD\22_15502_Z019_Karuah Vegetation_20120314.mxd

Data source: Data Custodian, Data Set Name/Title, Version/Date. Google Earth Pro, Aerial Imagery, 2012. Created by:nahansen

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

4. Existing Environment

4.1 Development Area

4.1.1 Approach

The following section describes the natural environment of the development area as a guide to the scale and type of biodiversity offsets that will be required to address residual impacts of the Project. This description is based on information presented in the Project environmental assessment included in SKM (2010a, 2010b), Monteath and Powys (2010) and DOP (2010), and supplementary site surveys conducted by GHD ecologists.

4.1.2 Site Context

The subject site is dominated by intact native vegetation in good condition. It occurs within an approximately 100 hectare parcel of open space administered by Pacific National. Historical land uses appear to include timber getting, grazing, stock keeping, and construction of railway infrastructure adjoining the site. Disturbed areas include stock fences, a horse racing/exercising track, dirt tracks, farm dams, borrow pits and construction lay down areas. The southern portion of the site is affected by mine subsidence.

The main Hunter east-west railway lies to the north and east of the subject site and beyond that rural-residential land and the township of Greta. The train line to the east of the site would comprise a hostile gap for many fauna species known or likely to occur at the site. The subject site adjoins over 500 hectares of vegetated open space to the west and south-west. The Hunter Expressway is currently being constructed through this vegetated corridor as shown on Figure 1. The footprint for the Hunter Expressway will significantly reduce the extent of this vegetated corridor and interrupt east-west terrestrial fauna movement opportunities. The Hunter Expressway would probably include fauna crossings as part of the design, however the precise location and intended function of these crossings relative to the subject site is not known. Therefore for the purpose of this assessment the Hunter Expressway is assumed to comprise a 'hostile gap', that is a complete barrier to fauna movement. In this context, there is a narrow (approximately 50 metres to 300 metres wide) north-south fauna movement corridor running through the subject site. This corridor is interrupted by Hunter Expressway infrastructure to the north but is connected to fauna movement corridors to the south and from there to additional contiguous vegetation to the south, west and north-west as shown on Figure 6. The primary link referred to in Figure 6, is the location where the project impacts or proposed biobank site rehabilitation activities will have the most significant change to the connectivity with surrounding vegetation.

4.1.3 Vegetation and Habitat Resources

SKM (2010a, 2010b) vegetation mapping was ground-truthed during the GHD site survey and matched to DECCW (2010b) NSW Vegetation Types and BioBanking condition classes. Three distinct vegetation types and broad condition classes were identified in the subject site, including vegetation consistent with two EECs listed under the TSC Act. Vegetation types within the subject site are presented in Table 3 and mapped on Figure 3.

The most extensive vegetation type is Grey Ironbark - Spotted Gum - Grey Box open forest in good condition. This vegetation appears to be approximately 50 year old regrowth though there are occasional pre-European age trees. There are some areas of moderate condition vegetation comprising younger regrowth associated with disturbed areas such as easements, quarries and laydown areas. Forest Red Gum - Grey Gum dry open forest at the site includes a variety of condition classes influenced by a variety of past and present land uses, including clearing for grazing and rail infrastructure. There is an area of low condition Forest Red Gum - Grey Gum dry open forest that is dominated by native grasses and environmental weeds with very occasional native shrubs and trees. There are localised patches of wind and bird-borne environmental weeds along the edges of tracks and cleared land and adjacent to existing railway infrastructure.

The site contains a number of farm dams dominated by Common Reed (*Phragmites australis*), and Cumbungi (*Typha orientalis*).

There is a small, channel confined, intermittent drainage line in the south of the subject site that did not contain surface water at the time of the survey. This drainage line is in moderate condition with mostly intact geomorphology, moderate in-stream and fringing vegetation, moderate riparian vegetation and good in-stream leaf litter and woody debris. The drainage line features severe infestation with noxious and environmental weeds, including Lantana (*Lantana camara).* The access road within the proposed development footprint would remove riparian habitat and alter the structure and flow-regime of this drainage line.

Areas of moderate and good condition vegetation within the development footprint are equivalent to undisturbed vegetation for the majority of BioBanking site attribute variables (over-, mid- and understorey vegetation cover, weed cover, quantities of woody debris and over storey regeneration). The site contains moderate numbers of hollow-bearing trees.

The Project ecological assessment identified areas of lower ecological value, comprising cleared land and land currently used for access which featured minimal native vegetation (SKM, 2010a, 2010b). These areas were not mapped as native vegetation and were not included in vegetation clearing estimates for the Project (DoP, 2010). Offsetting of Low condition vegetation is not required in BioBanking assessments of development sites. Low condition vegetation may be included in BioBanking assessments of biobank sites since these areas may be actively managed and allowed to regenerate into native vegetation. Therefore for the purposes of this assessment cleared areas within the subject site have been identified as Low condition forms of the native vegetation type that was likely to be present before clearing, as shown on Figure 3.

Table 3 Vegetation Types within the Greta Development Area

Vegetation Type (DECCW, 2010b)	Condition	SKM (2010) Map Unit	Area within Development Area (hectares)	Conservation Significance	Description (SKM, 2010a)
Grey Ironbark - Spotted Gum - Grey Box open forest on hills of the Hunter Valley, Sydney Basin	Moderate/good	1: Spotted Gum – Ironbark Forest	9.79	EEC listed on the TSC Act (Central Hunter Spotted Gum – Ironbark – Grey Gum Forest)	This community is associated with higher elevated slopes of the study area. It supports an open canopy ranging between 15-20 m dominated by Spotted Gum (*Corymbia maculata*) and Narrow-leaved Ironbark (*Eucalyptus crebra*) along with occasional Grey Box (*Eucalyptus moluccana*). The mid-storey contains Bulloak (*Allocasuarina luehmannii*) and the understorey features a mix of shrub and groundcover species, including Black Thorn (*Bursaria spinosa*), Gorse Bitter - pea (*Daviesia ulicifolia*), Needlebush (*Hakea sericea*), Narrow - leaved Geebung (*Persoonia linearis*), Rice Flower (*Pimelea linifolia* subsp. *linifolia*), Purple Wiregrass (*Aristida ramosa*), Three - awn Spear - grass (*A. vagans*), Weeping Grass (*Microlaena stipoides*) Many-flowered Mat-rush (*Lomandra multiflora)* and Poverty Raspwort (*Gonocarpus tetragynus*). No BioBanking habitat attribute data was collected in the development area and so all data was entered as benchmark values.
Forest Red Gum - Grey Gum dry open forest on hills of the lower Hunter Valley, Sydney Basin	Moderate/good	2: Forest Red Gum – Ironbark Forest	10.68	EEC listed on the TSC Act (Hunter Lowland Red Gum Forest)	This community is associated with lower elevated areas of the study area, including open depressions and slopes surrounding drainage lines. It supports an open canopy ranging between 15-20 m dominated by Forest Red Gum (*Eucalyptus tereticornis*) and Narrow-leaved Ironbark along with Rough-barked Apple (*Angophora floribunda*), Grey Gum (*E. punctata*) and Spotted Gum. Some areas support a high abundance of regenerating trees with larger trees interspersed. A moderate abundance of small-medium sized trees (4-8 m high) are present, including *Melaleuca decora*, Prickly-leaved Paperbark (*Melaleuca nodosa*) and Bulloak.

Vegetation Type (DECCW, 2010b)	Condition	SKM (2010) Map Unit	Area within Development Area (hectares)	Conservation Significance	Description (SKM, 2010a)
					Dominant shrub species include Gorse Bitter - pea, Needlebush, Narrow - leaved Geebung, Coffee Bush, Rice Flower, *Acacia falcata*, Silver - stemmed Wattle (*Acacia parvipinnula*) and *Leptopsermum parvifolium*. Groundcover species include Weeping Grass and Barbed - wire Grass, with other grasses occurring in lower abundance forbs such as Rough Raspwort (*Haloragis heterophylla*), White Root, Mat - rush (*Lomandra longifolia*) and Blue Bottle - daisy (*Lagenophora stipitata*). No BioBanking habitat attribute data was collected in the development area and so all data was entered as benchmark values.
Forest Red Gum - Grey Gum dry open forest on hills of the lower Hunter Valley, Sydney Basin	Low	3: Regenerating Shrubland and unmapped areas of cleared land	-*	EEC listed on the TSC Act (Hunter Lowland Red Gum Forest)	Regenerating Shrubland adjoins cleared land and features a moderate density of the shrub Needlebush with regenerating Eucalypt species. These areas are considered to be regenerating examples of the surrounding forest types. Cleared land, features a derived grassland of Cooch (*Cynodon dactylon*) and speargrasses (*Aristida* spp.) with very occasional seedlings of native trees and shrubs and occasional native herbs. Low condition vegetation that was not included in BioBanking calculations.
Total			**20.47***		

* only the 20.47 hectares of intact native vegetation within the development area requires biodiversity offsets in this assessment.

4.1.4 Conservation Significance

Threatened Flora Species

On the basis of regional records, reports and the presence of suitable habitat, a total of six threatened flora species potentially occur in the vicinity of the subject site: North Rothbury Persoonia (*Persoonia pauciflora)*, Bynoe's Wattle (*Acacia bynoeana*), Leafless Tongue Orchid (*Cryptostylis hunteriana*), Slaty Red Gum (*Eucalyptus glaucina*), *Eucalyptus parramattensis* subsp. *decadens* and Small-flower Grevillea (*Grevillea parviflora* subsp. *parviflora*). SKM (2010) undertook targeted searches for these threatened flora species that they considered to have a high - moderate potential to occur in the study area. The outcome of this assessment was that none of these species was found in the study area, that the study area does not provide optimal habitat for these species and that they are unlikely to occur (SKM, 2010a).

GHD ecologists undertook a supplementary search of the subject site in January 2011 targeting Slaty Red Gym (*Eucalyptus glaucina*). Slaty Red Gum is listed as a vulnerable species under the TSC Act and the species and associated hybrids and intergrades are listed as vulnerable under the EPBC Act. A flowering Slaty Red Gum was observed approximately 10 kilometres from the subject site and a voucher specimen was collected to assist with field identification of the species. No Slaty Red Gum were observed in the subject site. A large number of Forest Red Gum (*Eucalyptus tereticornis*) were observed, including some with physical characteristics that suggested genetic influence of Slaty Red Gum. A second site survey was conducted in April 2011 targeting intergrades between *E. glaucina* and *E. tereticornis.* Based on the results of SKM (2010a; 2010b) and subsequent GHD site surveys the project would not remove any Slaty Red Gum individuals. The NSW TSC Act definition of Slaty Red Gum does not include hybrids and OEH do not require assessment of hybrids as a threatened species (Lewer, S., OEH, pers. comm.). Therefore it is not necessary to specifically address Slaty Red Gum in the BioBanking credit calculations.

Preliminary consultation with DSEWPaC revealed that they considered hybrid or intergrades as equivalent to Slaty Red Gum individuals and that removal of Slaty Red Gum intergrades would also require offsets. The DSEWPaC conditions of approval for the Project require offsets for removal of Slaty Red Gum intergrades through conservation of at least four intergrades for every one intergrade to be removed. Detailed design has ensured that the final development area for the Project does not contain any intergrades. Therefore no specific offsets for intergrades have been included in this offsets package. Nonetheless it should be noted that there are 11 likely Slaty Red Gum intergrades within the Greta biobank site.

Threatened Ecological Communities

SKM (2010a) identified two listed EECs (Schedule 1 part 3; TSC Act) within the subject site:

- Lower Hunter Spotted Gum – Ironbark Forest in the Sydney Basin Bioregion
- Hunter Lowland Redgum Forest in the Sydney Basin and North coast Bioregions.

SKM subsequently revised their description of areas mapped as Lower Hunter Spotted Gum – Ironbark Forest and reclassified them as Central Hunter Spotted Gum – Ironbark – Grey Box Forest (SKM, 2010b). GHD site surveys support the identification of Central Hunter Spotted Gum – Ironbark – Grey Box Forest on the subject site.

The majority of the area of these EECs across the site is intact forest in good condition and would provide habitat for a diverse range of native flora and fauna species, including rare and threatened species (SKM, 2010a). Some areas of regenerating forest are present which represent early stages of recovery of these EEC types and were assumed to comprise a low-condition form of Hunter Lowland Redgum Forest that meets the DECC (2009) definition of 'low' condition vegetation.

No EECs listed under the EPBC Act were identified in the subject site or are otherwise of relevance to this assessment.

Threatened and Migratory Fauna Species

Three threatened fauna species were recorded in SKM (2010a, 2010b) field surveys:

- Squirrel Glider (*Petaurus norfolcensis*) - Vulnerable species (TSC Act);
- Grey - crowned Babbler (eastern subsp) (*Pomatostomus t. temporalis*) - Vulnerable species (TSC Act); and
- Speckled Warbler (*Pyrrholaemus saggitatus)* - Vulnerable species (TSC Act).

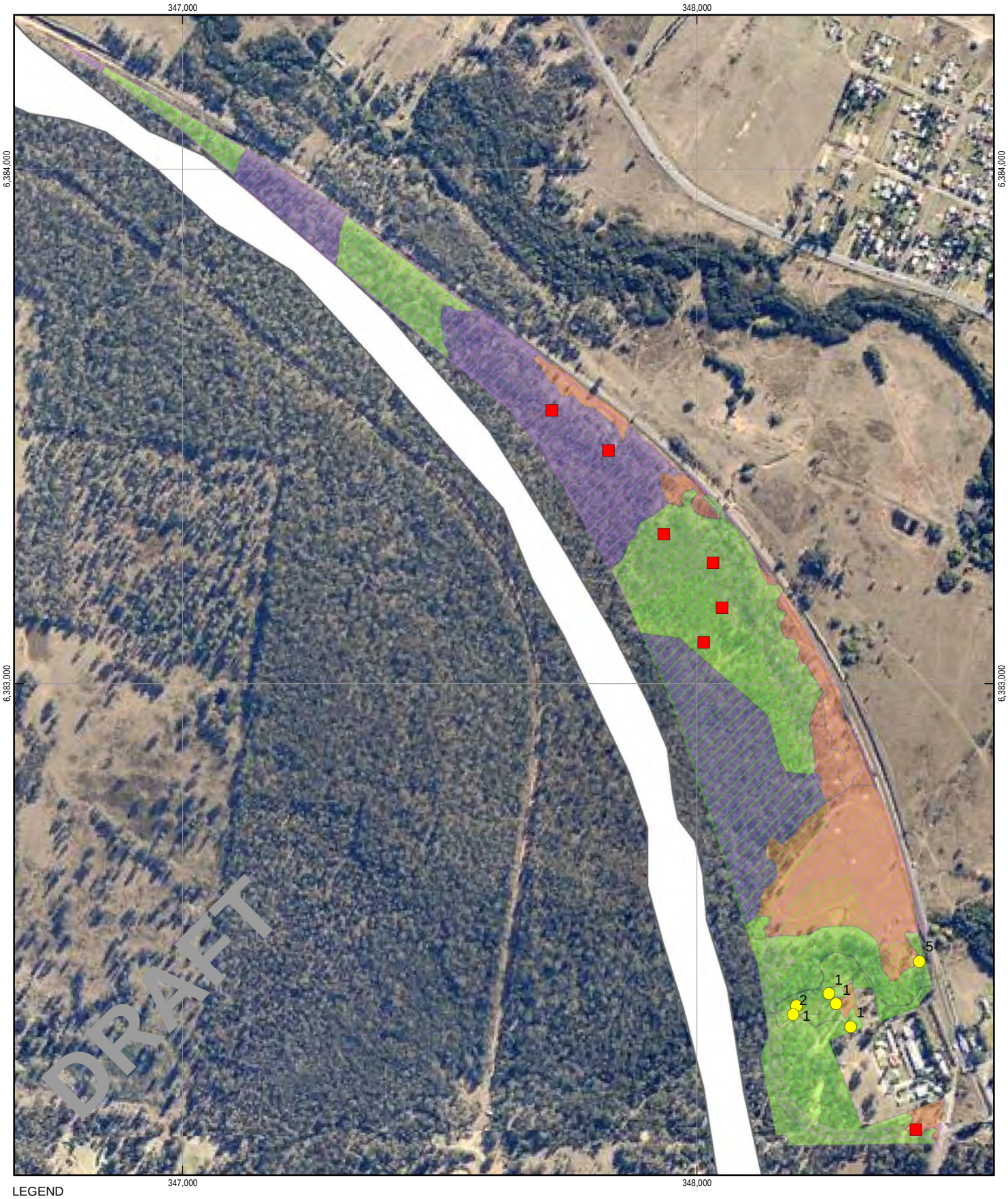
The authors also identified critical foraging habitat for the Grey-headed Flying-Fox (Vulnerable species listed under the EPBC Act and TSC Act) as defined in the Draft Recovery Plan (DECCW, 2009b) for the species and habitat for a number of other threatened fauna species (SKM, 2010a).

GHD ecologists also recorded Grey-crowned Babblers at the subject site.

Potential habitat for a number of additional threatened and/or migratory species listed under the EPBC Act was identified within the subject site. This suite of listed fauna was considered 'subject species' for the impact assessment. Assessments of significance under the EP&A Act and EPBC Act found that the Project would be unlikely to have a significant negative impact on any of these listed fauna species (SKM, 2010a, 2010b), however the action was determined a controlled action by the Minister's delegate as it was considered that the action is likely to have a significant impact on threatened species listed under the EPBC Act.

To address impacts on MNES the offsets package will consider the removal of habitat for the following listed biota:

- Swift Parrot (*Lathamus discolor*)
- Spotted-tail Quoll (*Dasyurus maculatus*)
- Regent Honeyeater (*Xanthomyza phrygia*)
- Grey-headed Flying-fox (*Pteropus poliocephalus*)
- Migratory birds of woodland, forest and grasslands.



LEGEND

- Grey-crowned Babbler
- Likely Slaty Red Gum hybrid (No of individuals)
- Development Area
- Biobank Site
- Hunter Expressway

Endangered Ecological Communities (TSC Act)

- Central Hunter Ironbark – Spotted Gum – Grey Box Forest (Moderate/good condition)
- Hunter Lowlands Red Gum Forest (Low condition)
- Hunter Lowlands Red Gum Forest (Moderate/good condition)

1:10,000 (at A4)

0 50 100 200 300 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 56

N

GHD

CLIENTS | PEOPLE | PERFORMANCE

Pacific National
Greta Provisioning Facility
Biodiversity Offsets Package

Job Number	22-15502
Revision	B
Date	18 Sep 2012

Subject Site Threatened Biota

Figure 5

G:\22\15502\GIS\Maps\MXD\22_15502_Z023_Greta_Biobank_Threatened_Biota_RevB.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 2010; Navigate StreetMap: StreetMap - Jan 2010. Created by: nahansen

4.2 Greta Biobank

4.2.1 Approach

The site for the Greta biobank contains intact native vegetation that would not be cleared for construction of the proposed rail facility or potential future uses. An area of approximately 20.33 hectares will be set aside as the Greta biobank and will directly contribute to the offsets package for the Project. The vegetation types, threatened biota and habitat resources within the Greta biobank site are equivalent to those within the Project development area.

GHD conducted surveys of the Greta biobank site, including collection of plot data using the BioBanking methodology. Vegetation condition and habitat resources within the Greta biobank have been quantified using these plot data. These data are included in the BioBanking credit calculations (refer Section 5.3.1).

4.2.2 Site Context

The proposed biobank immediately adjoins the development footprint and contains vegetation and habitats which are covered by the overall description of the subject site provided in Section 4.1.2 above.

4.2.3 Vegetation and Habitat Resources

Vegetation types within the Greta biobank site are described in Table 4.

The most extensive vegetation type in the Greta biobank site is Forest Red Gum - Grey Gum dry open forest in moderate-good condition. This vegetation appears to comprise approximately 50 year old regrowth though there are occasional pre-European age trees. There are some areas of moderate condition vegetation comprising younger regrowth and low condition vegetation where the forest has been converted to shrubland or grassland.

The full list of species recorded within the Greta biobank is given in Appendix C.

Areas of moderate and good condition vegetation within the biobank site are equivalent to undisturbed vegetation for the majority of BioBanking site attribute variables (over-, mid- and understorey vegetation cover, weed cover, length of fallen logs and over storey regeneration). The site contains relatively few hollow-bearing trees. Low condition vegetation is highly disturbed vegetation with respect to over- and mid-storey vegetation cover, quantities of fallen timber and numbers of hollow bearing trees. However site attributes for weed cover, native understorey vegetation cover and over storey regeneration were relatively good. Overall the Greta biobank contains a mixture of near-intact, regenerating and highly-disturbed native vegetation that would benefit from conservation and active management. The biobank site is likely to develop increased native vegetation cover and diversity and quantities of habitat resources with management.

The Greta biobank has two farm dams containing freshwater wetlands dominated by Common Reed. These are artificial features and have not been mapped as separate vegetation types. These freshwater wetlands would provide habitat resources for native fauna and so would not be removed or otherwise altered as part of the management of the biobank site.

There is a small, channel confined, intermittent drainage through the biobank site that is in moderate condition aside from a 'patch' infested with noxious and environmental weeds. The biobank would provide for active management of weeds and potentially also restoration of aquatic and riparian habitat resources.

The site also contains a number of small, bedrock confined, intermittent drainage lines that contained occasional pools of surface water at the time of the survey. These are in very good condition and feature intact geomorphology, very good riparian vegetation and good in-stream leaf litter, rock fragments and woody debris.

There are no cliff lines, large boulders and extensive areas of caves, overhangs and fissures within the site. There are no rock outcrops with platey rock fragments and fissures.

The BioBanking summary of habitat resources at the site was completed with reference to the above observations.

4.2.4 Conservation Significance

The Greta biobank site is contiguous with the development area and contains the same suite of threatened biota and associated habitat resources as described in Section 4.1.4 above.

Preliminary consultation with DSEWPaC revealed that they considered hybrid or intergrades as equivalent to *Eucalyptus glaucina* individuals. There are 11 likely *E. glaucina* intergrades within the Greta biobank site as shown on Figure 5.

Table 4 Greta Biobank Site Vegetation

Vegetation Type (DECCW, 2010b)	Condition	Area within Biobank Site (ha)	Conservation Significance	Description
Grey Ironbark - Spotted Gum - Grey Box open forest on hills of the Hunter Valley, Sydney Basin	Moderate/good	7.45	EEC listed on TSC Act (Spotted Gum – Ironbark – Grey Gum Forest)	This vegetation type is equivalent to the community identified by (SKM, 2010a) and presented in Table 3. It is an open forest of Spotted Gum and Narrow-leaved Ironbark with occasional Grey Box, mid-storey of and moderately diverse understorey of native shrubs, grasses and herbs. BioBanking habitat attribute data was collected in plots and confirms that this vegetation is near-intact and in good condition. Canopy, shrub and understorey vegetation cover was equivalent to undisturbed remnants. There are good quantities of woody debris and leaf litter, but relatively few hollow-bearing trees. This vegetation type has good 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 and management of pest fauna.
Forest Red Gum - Grey Gum dry open forest on hills of the lower Hunter Valley, Sydney Basin	Moderate/good	9.85	EEC listed on TSC Act (Hunter Lowland Red Gum Forest)	This vegetation type is basically equivalent to the community described by (SKM, 2010a) and presented in Table 3. Some areas of Forest Red Gum - Grey Gum dry open forest within the biobank site are in poorer condition, featuring patches of sub-mature regrowth of Forest Red Gum. Mature stands comprise a structurally-developed open forest of Forest Red Gum and Narrow-leaved Ironbark along with Rough-barked Apple and Spotted Gum. Some areas support dense patches of regenerating Forest Red Gum forming a low closed forest with larger trees interspersed. There are localised, dense stands of smaller trees in the mid storey including *Melaleuca* spp. and Bulloak. There is a moderately diverse understorey of native shrubs, grasses and herbs. BioBanking habitat attribute data was collected in plots and confirms that this vegetation is near-intact and in moderate to good condition. Canopy, shrub and understorey vegetation cover is highly variable and includes vegetation equivalent to undisturbed remnants as well as sub-mature regrowth. There are good quantities of woody debris and leaf litter, but relatively few hollow-bearing trees.

Vegetation Type (DECCW, 2010b)	Condition	Area within Biobank Site (ha)	Conservation Significance	Description
				This vegetation type has very good potential for achieving gains in biodiversity values through management within a biobank site. Improvement in biodiversity value could be obtained through development of vegetation structure and habitat resources (particularly in stands of immature regrowth), removal of exotic plants, remediation of a drainage line, including removal of a severe weed infestation and through management of pest fauna.
Forest Red Gum - Grey Gum dry open forest on hills of the lower Hunter Valley, Sydney Basin	Low	3.00	EEC (Hunter Lowland Red Gum Forest)	This vegetation type includes the Regenerating Shrubland described by SKM (2010a) as well as some areas of un-mapped cleared land. It includes localised dense patches of the shrub Needlebush with regenerating Eucalypt species. It also includes a derived grassland of Cooch (*Cynodon dactylon*) and speargrasses (*Aristida* spp.) with very occasional seedlings of native trees and shrubs and occasional native herbs. This vegetation type has very good potential for achieving gains in biodiversity values through management within a biobank site. Improvement in biodiversity value could be obtained through development of vegetation structure and habitat resources, removal of exotic plants and through management of pest fauna. There are Eucalyptus seedlings spread throughout this vegetation type and it is likely that in the absence of grazing pressure or other disturbance it would regenerate into native forest.
Total		**20.30**		

4.3 Branch Lane Biobank

4.3.1 Approach

Staged field investigations of the Branch Lane biobank site (Figure 2) were undertaken in accordance with the BioBanking methodology as follows:

- Vegetation type and condition mapping and stratification of the site into vegetation zones.
- Plot / transect surveys within vegetation zones to calculate site value scores and allow the determination of ecosystem credits.

No targeted surveys for species credit-type threatened species were conducted at the Branch Lane biobank site since only ecosystem credits are required in this offset package. The landowner may decide to perform targeted surveys and obtain species credits as a modification to the biobanking agreement for the Branch Lane biobank site.

4.3.2 Site Location

The Branch Lane biobank site is covered by intact native vegetation in good condition. The site is situated within an approximately 300 hectare parcel of open space. Historical land uses appear to include timber getting and grazing. Disturbed areas include cleared land converted to exotic pasture, dirt tracks, borrow pits, log dumps and construction laydown areas. Current disturbances include grazing.

The Branch contains rural residential land on large lots. The site is bordered to the north, west and south by partially cleared grazing country. Upper slopes, ridges and drainage lines are generally covered by intact native vegetation while lower slopes and flats at the edge of the property boundary have been cleared and converted to exotic pasture. There is native vegetation within open space to the east. There is a gravel road to the west of the site that would not comprise a hostile gap for the majority of fauna species known or likely to occur. Vegetated corridors connect the site with other patches of native vegetation in all directions. Fauna movement would be most restricted to the west, where connected native vegetation is restricted to a narrow riparian corridor. The site is connected by this narrow vegetated corridor to Karuah National Park to the south-west.

4.3.3 Vegetation and Habitat Resources

Based on vegetation types and broad condition classes, three vegetation zones were identified in the Branch Lane biobank site. PATN analysis completed on the species richness and cover abundance data collected within plots confirmed these three vegetation zones. Vegetation zones within the Branch Lane biobank site are presented in Table 3 and mapped on Figure 4. Plant species within plots and vegetation zones are listed in Appendix C.

The most extensive vegetation zone is Spotted Gum - Grey Ironbark forest dry open forest in good condition. This vegetation appears to be approximately 70 year old regrowth though there are occasional pre-European age trees. There are some areas of moderate condition vegetation comprising younger regrowth associated with disturbed areas such as easements and laydown areas but these were not extensive or distinct enough to warrant treatment asa separate vegetation zone.

The structure and species composition of this vegetation type varies considerably with slope position and aspect: exposed north and west facing slopes and ridges support a 'dry' forest with an open shrub layer and grassy understorey; while sheltered east and south facing slopes support a 'wet' forest with a mid storey of small trees, denser shrub layer and understorey of grasses, herbs, ferns and scramblers. Sufficient plot / transects were sampled to treat this vegetation zone as two separate vegetation types. Subsequent PATN analysis of variation in plant species and cover abundance within and between plots revealed that wet and dry forms were a single vegetation type.

Tallowwood - Brush Box - Sydney Blue Gum moist shrubby forest in good condition occurs in sheltered gullies and drainage lines throughout the site. This is a highly variable and diverse vegetation type with elements of Hunter Valley dry rainforest vegetation types (such as Grey Myrtle *Backhousia myrtifolia*) as well as species of the mid coast of NSW (such as Brushbox *Lophostemon confertus*). PATN analysis did not support splitting this vegetation zone into more than one vegetation type and so a single vegetation type that was the best fit was selected.

The margins of the site at the edge of the property boundaries, where it adjoins surrounding grazing country, contain a derived exotic grassland. These areas have been mapped as Spotted Gum - Grey Ironbark forest dry open forest in low condition based on surrounding intact vegetation, remnant canopy trees and native understorey species.

Intact vegetation within the Branch Lane biobank site is relatively weed-free. There are localised patches of wind-borne environmental weeds in fire breaks, along the edges of tracks and cleared land. These patches of partially disturbed land are dominated by opportunistic native plants such as Indian Weed (*Sigisbeckia orientalis*) and regenerating canopy species and so for the purposes of the BioBanking assessment have not been separated from surrounding moderate/good condition vegetation. There are occasional localised infestations of the bird-borne noxious weed Lantana (*Lantana camara**).

The Branch Lane biobank site contains a number of small, channel confined, intermittent drainage lines that contained occasional pools of surface water at the time of the survey. These are in good to very good condition and feature mostly intact geomorphology, good in-stream and fringing vegetation, very good riparian vegetation and good in-stream leaf litter and woody debris. These drainage lines contain habitat for frogs that prefer to breed in creeks, including species associated with rainforest creeks.

There are a number of farm dams in grazing country close to the Branch Lane biobank. There are a number of intermittent flooded depressions within the site associated with drainage works as well as natural features. Dams and flooded depressions contain surface water and wetland plants that would have habitat value for such species as native frogs, bats, birds and reptiles.

All vegetation at the site are in good condition in accordance with the BioBanking Methodology and are equivalent to undisturbed vegetation for the majority of BioBanking site attribute variables (over-, mid- and understorey vegetation cover, weed cover, length of fallen logs and over storey regeneration). The site contains moderate numbers of hollow-bearing trees. There appears to have been timber harvesting at the site however hollow-bearing trees have been retained in the form of less desirable species and/or trees with defects.

There are no cliff lines or deep rock overhangs at the site. There are some rock outcrops and areas of exposed sandstone and conglomerate substrate, however these rocks have a rounded

weathered profile and do not feature caves or fissures with any notable habitat value. There are platey rock fragments and rock fragments that would have shelter value for native fauna. The BioBanking summary of habitat resources at the site is presented in Appendix B.

4.3.4 Native Species

Flora species

A total of 238 plant species were recorded during field surveys, of which 215 are native. No threatened flora species were recorded as described in Section 4.3.5. The ROTAP species *Macrozamia flexuosa* is present in moderate numbers across the Branch Lane biobank site. The full list of species recorded is given in Appendix C. It should be noted, however, that flora composition changes over time and that some species are not easily detectable when not flowering. These surveys may not have detected the full range of species likely to occur at this site.

The majority of plots had scores for plant species richness that were at or above benchmark values for appropriate vegetation types. Overall the site contains a diverse assemblage of native flora and is likely to support viable patches of all vegetation types and ecological communities present.

Table 5 Vegetation Types within the Branch Lane biobank

Vegetation Type (DECCW, 2010b)	Condition	Area within Biobank Site (ha)	Conservation Significance	Description
Spotted Gum - Grey Ironbark forest dry open forest of the lower foothills of the Barrington Tops, North Coast	Moderate/good	238.60	Native	This vegetation type is associated with mid and upper slopes of the biobank site. The overstorey is 20-30 m tall and dominated by Spotted Gum (*Corymbia maculata*), Grey Gum (*Eucalyptus punctata*) and Grey Ironbark (*Eucalyptus siderophloia*) with a mixture of other ironbark and stringybark *Eucalyptus* species sub-dominant. The lower vegetation strata are diverse and structurally complex and vary between dry and wet aspects. The dry form comprises: sparse mid-storey of Black She-oak (*Allocasuarina littoralis*), *Melaleuca nodosa* and juvenile *Eucalyptus* species; an open shrub layer of Black Thorn (*Bursaria spinosa*), Narrow - leaved Geebung (*Persoonia linearis*), Silver-stemmed Wattle (*Acacia parvipinnula*) and Peach Heath (*Lissanthe strigosa*); a groundcover dominated by grasses such as Three - awn Spear - grass (*Aristida vagans*), Weeping Grass (*Microlaena stipoides*) and Kangaroo Grass (*Themeda australis*); graminoids and sedges such as Many-flowered Mat-rush (*Lomandra multiflora)* and Variable Sword-sedge (*Lepdiosperma laterale*); and occasional herbs such as Poverty Raspwort (*Gonocarpus tetragynus*) scramblers such as *Glycine* species. There is negligible exotic plant cover in this vegetation type. The wet form comprises: mid-storey of Forest Oak (*Allocasuarina torulosa*) and juvenile Turpentine (*Syncarpia glomulifera*) and *Eucalyptus* species. A locally dense shrub layer of Narrow - leaved Geebung (*Persoonia linearis*), Swamp Wattle (*Acacia elongata*) and Coffe Bush (*Breynia oblongifolia*); shade-tolerant grasses such as Weeping Grass (*Microlaena stipoides*) *Entolasia* spp. And *Oplismenus* spp.; graminoids and sedges such as Spike-headed Mat-rush (*Lomandra longifolia)* and Rough Sword-sedge (*Gahnia clarkii*); and a range of groundcover species such as Maidenhair fern (*Adiantum aethiopicum*), White Root (*Pratia purpurascens*), Indian Pennywort (*Centella asiatica*) and *Glycine* species. There is very little exotic plant cover in this vegetation type aside from

Vegetation Type (DECCW, 2010b)	Condition	Area within Biobank Site (ha)	Conservation Significance	Description
				occasional localised patches of Lantana (*Lantana camara**). BioBanking site value data was collected in plot / transects and confirms that this vegetation is near-intact and in good condition. Species richness and canopy, mid storey and understorey vegetation cover was equivalent to undisturbed remnants. There are good quantities of woody debris and leaf litter and moderate numbers of hollow-bearing trees. This vegetation type has 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 and management of weeds and pest fauna.
Tallowwood - Brush Box - Sydney Blue Gum moist shrubby forest on coastal foothills of the southern North Coast	Moderate/good	38.38	Native	This vegetation type is associated with drainage lines and gullies. The overstorey is 20-30 m tall and is dominated by Brushbox (*Lophostemon conferta*) with a highly variable mix of *Eucalyptus,* including Sydney Blue Gum (*E. saligna*), Small-fruited Grey Gum (*E. propinqua*), White Mahogany (*E.acmenoides*) and Spotted Gum (*Corymbia maculata*). There is a dense mid storey of rainforest species, including Grey Myrtle (*Backhousia myrtifolia*), Brush Cherry (*Szygium australe*), Sandpaper Fig (*Ficus coronata*) and Cabbage Tree palm (*Livistona australis*). The ground cover is dense and highly variable and includes: rainforest shrubs such as Black Plum (*Diospyros australis*), Rough-fruit Pittosporum (*Pittosporum revolutum*); shade-tolerant grasses such as *Entolasia* spp. and *Oplismenus* spp.; graminoids and sedges such as Spike-headed Mat-rush (*Lomandra longifolia)* and Settlers Flax (*Gymnostachys anceps*); ferns such as Maidenhair fern (*Adiantum aethiopicum*), Black Maidenhair Fern (*Adiantum formosum*) and Gristle Fern (*Blechnum cartilagineum*); and herbs such as Pastel Flower (*Pseuderanthemum variabile*) and White Root (*Pratia purpurascens*). Woody vines and climbers are abundant and include Water Vine (*Cissus hypoglauca*), Pearl Vine (*Sarcopetalum harveyanum*), Sweet Morinda (*Morinda jasminoides*) and Wonga Wonga Vine (*Pandorea pandoreana*). There is also a considerable diversity of epiphytes such as Stag Horn Fern (*Platycerium bifurcatum*) and Tangle Orchids (*Plectorrhiza tridentata*) and

Vegetation Type (DECCW, 2010b)	Condition	Area within Biobank Site (ha)	Conservation Significance	Description
				lithophytes such as *Plectranthus parviflorus*. BioBanking site value data was collected in plot / transects and confirms that this vegetation is near-intact and in good condition. Species richness and canopy, mid storey and understorey vegetation cover was equivalent to undisturbed remnants. There are good quantities of woody debris and leaf litter and moderate numbers of hollow-bearing trees. This vegetation type has 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 and management of weeds and pest fauna.
Spotted Gum - Grey Ironbark forest dry open forest of the lower foothills of the Barrington Tops, North Coast	Low	3.23	Native – low condition	This low condition vegetation type features a canopy reduced to occasional paddock trees and very sparse shrub layer resulting in a derived grassland structure. The vegetation cover is dominated by the exotic grasses Giant Parramatta Grass (*Sporobolus fertilis*), Pale Pigeon Grass (*Setaria gracilis*), Carpet Grass (*Axonopus fissifolius*) and Paspalum (*Paspalum dilatatum*). There is a diverse range of herbaceous environmental weeds. There is also a moderate diversity but low overall cover abundance of native grasses, herbs and scramblers and very occasional native shrubs and juvenile *Eucalyptus.* BioBanking site value data confirms that this vegetation is in low condition. Canopy, shrub and understorey vegetation cover, woody debris, leaf litter and hollow-bearing trees are all below benchmark values. Species richness and regeneration are at or near benchmark in the majority of plots suggesting the potential for assisted natural regeneration to restore this vegetation zone to moderate/good condition.
Total		**280.21**		

Fauna species

A total of 65 native fauna species were recorded, including 54 birds, two mammals, four reptiles and eight frogs. The full list of species recorded is given in Appendix C.

Birds from a number of different guilds (i.e. species with different lifestyles and habitat requirements) were recorded on the site, including:

- A diverse range of small forest or woodland species, including Thornbills (*Acanthiza* spp.), the Spotted Pardalote (*Pardalotus punctatus*), White-browed Scrubwren (*Sericornis frontalis*), Rufous Whistler (*Pachycephala rufiventris*) and Eastern Yellow Robin (*Eopsaltria australis*).
- Larger forest or woodland species, including the Cicadabird (*Coracina tenuirostris*), Black-faced Cuckoo-shrike (*Coracina novaehollandiae*) and Grey Shrike-thrush (*Colluricincla harmonica*).
- Parrots, including the Australian King-Parrot (*Alisterus scapularis*), Musk Lorikeet (*Glossopsitta concinna*), Eastern Rosella (*Platycercus eximius*) and Rainbow Lorikeet (*Trichoglossus haematodus*).

Two native macropod species, the Eastern Grey Kangaroo (*Macropus giganteus*) and the Red-necked Wallaby (*Macropus rufogriseus*) were seen during surveys.

At least four native reptile species were recorded: the Eastern Water Dragon (*Physignathus lesueurii*), Land Mullet (*Bellatorias major*), Lace Monitor (*Varanus varius*) and unidentified grass skinks (*Lampropholis* sp.).

Eight species of frogs were recorded calling from wetland habitats within the site, including common, generalist species of flooded depressions such as the Common Eastern Froglet (*Crinia signifera*), Eastern Dwarf Tree Frog (*Litoria fallax*) and Brown-striped Frog (*Limnodynastes peronii*). The Red-backed Toadlet (*Pseudophryne coriacea*) was heard calling from leaf litter in moist forest close to drainage lines.

The fauna survey effort conducted to date would not be expected to describe the full suite of species that would occur. The abundance and diversity of native fauna species recorded in these diurnal, opportunistic surveys suggests that the site provides valuable habitat resources. It is likely that additional targeted surveys, including nocturnal surveys, would reveal a considerably greater diversity of species, potentially including threatened frogs, micro bats, arboreal mammals and forest owls.

4.3.5 Conservation Significance

Threatened Flora Species

No threatened flora species were recorded during surveys of the Branch Lane biobank site.

Threatened Ecological Communities

No threatened ecological communities are present at the Branch Lane biobank site.

Spotted Gum - Grey Ironbark forest at the site is structurally and floristically equivalent to Lower Hunter Spotted Gum – Ironbark Forest which is listed as an EEC under the TSC Act. Spotted Gum - Grey Ironbark forest does not comprise a local occurrence of the EEC because it is not within the geographic range defined in the Scientific Committee determination for Lower Hunter Spotted Gum – Ironbark Forest. Notheless Spotted Gum - Grey Ironbark forest at the site contains many of the species within the EEC and is contiguous with vegetated corridors and reserves to the west of the site that are within the distribution of the EEC. OEH staff have inspected the site and confirmed the functional similarity of vegetation at the site to Lower Hunter Spotted Gum – Ironbark Forest and that the Branch Lane biobank would help contribute to the regional conservation of the species that collectively comprise the EEC (Lewer, S., OEH, pers. comm.).

Threatened Fauna Species

Two threatened fauna species were identified during field surveys of the Branch Lane biobank site:

- Grey-crowned Babbler (eastern subspecies) (*Pomatostomus t. temporalis*)
- Varied Sittella (*Daphoenositta chrysoptera*).

Both of these species are listed as vulnerable under the TSC Act and are not listed as threatened under the EPBC Act.

Neither of these threatened fauna species are of the type that require species credits within the BioBanking assessment methodology (DECCW, 2010c; DECC, 2009).

The Branch Lane biobank site contains critical habitat for the Grey-headed Flying Fox as defined in the Recovery Plan for the species (DECCW 2009b). Specifically, the site: would provide habitat resources for the Branch breeding camp (DSEWPAC, 2012) and associated population of >30,000 individuals; and contains large numbers of Spotted Gum (*Eucalyptus maculata*) that flower during winter and spring (during food bottlenecks); and large numbers of Grey Gum (*Eucalyptus punctata*) that flower during summer and autumn (during the breeding season) (DECCW, 2009b).

5. BioBanking Credit Calculations

5.1 Approach

The BioBanking methodology was applied in a two-stage approach at the development site: a rapid assessment to allow for initial offsets planning (using a modified methodology agreed with the OEH BioBanking Unit); and then a complete biobanking assessment of the development area in accordance with the methodology.

For the rapid assessment of the development area, available and extrapolated data was entered into Version 1.1 of the credit calculator to estimate the number of credits that would need to be purchased and retired if the entire development area was included in an application for a biobanking statement. The detailed assessment then included the collection of data according to the Biobanking methodology and entered into Version 1.2 of the credit calculator to calculate the credit impact for the development site. The complete BioBanking Credit Report for the development area is included as Appendix A.

For the two biobank sites, data was collected according to the BioBanking methodology and entered into Version 2.0 of the calculator to calculate the number of credits that will be generated when a biobanking agreement is obtained for each site. The complete BioBanking credit report for the Greta biobank site is included as Appendix B. The BioBanking credit report for the Branch Lane biobank site is included as **Error! Reference source not found.**.

This BioBanking assessment was completed by Ben Harrington (Assessor Accreditation no. 0073) and peer reviewed by Daniel Williams (Assessor Accreditation no. 0082).

5.2 Development Area

5.2.1 Development Area Location

The development site is located in the 'Hunter / Central Rivers' CMA region; the 'Hunter' CMA sub-region; and falls within the Central Hunter Foothills Mitchell Landscape (DECC, 2008).

5.2.2 Development Area Landscape Value

The BioBanking methodology uses 100 hectare and 1,000 hectare assessment circles centred on the site to estimate the extent and connectivity of native vegetation and habitat surrounding the site. These assessment circles are shown in Figure 6. Vegetation cover and connectivity was estimated based on the current situation and after the development of the site. The data in Table 6 below was obtained from GIS measurement of foliage projective cover within the assessment circles. The percentage change in native vegetation cover was estimated by subtracting the area of woody vegetation within the development area from the total area within the assessment circles. Patch size and connectivity were assessed using GIS and air photo interpretation of native vegetation cover within the assessment circles and adjoining areas of native vegetation.

Impacts on connectivity are calculated by entering the 'primary link' for the development, which is the vegetated link that will experience the greatest change in connectivity as a result of the development.

There are no east-west vegetated corridors in the vicinity of the subject site because the existing railway is a hostile gap and lies immediately to the east of the subject site. There is a north-south vegetated corridor that runs through the subject site. The development footprint for the Hunter Expressway lies immediately to the west of the subject site and limits the width of this corridor. The precise location and intended function of possible fauna crossings associated with the Hunter Expressway is not known and so for the purpose of this assessment the Hunter Expressway is assumed to comprise a hostile gap.

The north-south fauna movement corridor running through the subject site is approximately 50 metres to 300 metres wide. This corridor connects to a soon to be isolated patch of vegetation of approximately 1.2 hectares. The completion of both the Hunter Expressway and Greta Train facility will leave this patch isolated between the two hostile barriers, leaving its long term viability questionable. As such, for the purpose of this assessment, GHD applied the 'Use of Judgement Principle' (DECC 2009a) and assumed the primary link to be to vegetation to the south of the site.

The primary link for the development is in the south of the subject site, where the primary link will remain unchanged. In fact, successful rehabilitation of the Greta biobank site will see this connection increased to over 100 m, as shown on Figure 6.

Table 6 Development Area Landscape Assessment Values

% Native vegetation cover in 1000 ha assessment circle – before development	% Native vegetation cover in 1000 ha assessment circle – after development	% Native vegetation cover in 100 ha assessment circle– before development	% Native vegetation cover in 100 ha assessment circle– after development	Connectivity value width – before development	Connectivity value width– after development
43 (41-50)	41 (41-50)	72 (71-80)	58 (51-60)	80 m (>30 – 100 m)	80 m (30 – 100 m)

5.2.3 Development Area Site Value

One vegetation zone was created for each native vegetation type and broad condition state at the site. The area of each subzone was calculated using GIS. Vegetation zones within the development area are summarised below in Table 7. The area of the development site is greater than the 19.8 hectares of vegetation to be removed within the project development footprint (DoP, 2011; SKM, 2010a) because DSEWPaC has requested that areas of potential future development be included in this offsets package. Only intact native vegetation (i.e. vegetation in moderate/good condition) requires biodiversity offsets as part of the project approval. Intact native vegetation within the development footprint and the potential future use areas has yielded a 'development area' with a total area of 20.47 hectares for the purposes of this BioBanking assessment and offsets package.

The two vegetation zones within the development area contain native vegetation in moderate/good condition and are connected. One threatened species sub zone was created for each vegetation zone. These vegetated areas are connected to an area of fragmented native vegetation and grazing country to the south of the subject site.

The area of contiguous treed vegetation connected to the subject site was calculated with GIS and is 285 hectares, so for both threatened species sub zones the adjacent remnant area is 285 hectares. There is well over 500 hectares of contiguous derived grassland with occasional shrubs and paddock trees connected to the subject site and so the patch size, including low condition vegetation is equal to the maximum area within the BioBanking methodology of 501 hectares.

The EEC status of each vegetation zone within the development was determined through GHD field survey of the site.

The initial rapid assessment used information from the vegetation quadrats that were sampled during preparation of the (SKM (2010a, 2010b) ecological assessment and used in vegetation community description and mapping but were not included in the initial BioBanking calculations since data was not collected using the BioBanking plot/transect methodology. Site value data for each vegetation type was entered for each transect/plot field in each threatened species sub zone. Site values were estimated with reference to benchmark condition values for each vegetation type based on the descriptions of vegetation condition and habitat resources contained in the Project ecological assessment. The Project ecological assessment noted that the majority of the investigation area is in good condition and so for all site attributes the mid value of the benchmark range was entered (e.g. if the benchmark for 'native overstorey cover' was 15 to 70 a value of 43 was entered).

The final credit calculations (as shown in Appendix A) used the detailed plot data collected during surveys on the 18th May 2011 and was completed using credit calculator Version 1.2.

Table 7 Development Area vegetation zones

Vegetation Zone	Threatened Species Sub Zone	Red Flag / EEC Status	Area (ha)	Adjacent Remnant Area (ha)	Patch Size including Low Condition Vegetation (ha)
HU556_Moderate/Good_Dev (Spotted Gum – Ironbark – Grey Box Forest)	TSSZ 1	EEC (Central Hunter Spotted-gum –Ironbark – Grey Box Forest)	9.79	285	501
HU544_Moderate/Good_Dev (Forest Red Gum – Ironbark Forest)	TSSZ 2	EEC (Hunter Lowland Red Gum Forest)	10.68	285	501

Changes in site biodiversity values through the development of a site is the basis for calculation of species and ecosystem credits required to offset impacts. Complete clearing of vegetation for a development reduces the site values to zero. There are certain circumstances where portions of a development are managed such that some site value is retained. These circumstances include asset protection zones where only partial vegetation removal may be required. It is assumed that the entire development site area will be cleared and so the default decrease in site value was entered into the credit calculator as shown in Table 8. This assumes that vegetation and habitat would be completely removed within the development area.

Table 8 Development Management Zones

Management Zone	Threatened Species Sub Zone(s)	Area (ha)	Management / Attribute Scores
1 (Cleared Spotted Gum - Ironbark - Grey Box Open Forest)	TSSZ 1	9.79	Clearing / Default decrease in site value.
2 (Cleared Forest Red Gum – Ironbark Open Forest)	TSSZ 2	10.68	Clearing / Default decrease in site value.

5.2.4 Development Area Ecosystem Credits

A total of 1,036 ecosystem credits were calculated for the development impact. The ecosystem credit profile for the development area is included as **Error! Reference source not found.** and summarised in Table 9.

Table 9 Development Area Ecosystem Credit Profile

Vegetation Type	Area (ha)	Ecosystem Credits Required	Minimum Patch Size	Minimum Vegetation % Cover Class
Grey Ironbark - Spotted Gum - Grey Box open forest on hills of the Hunter Valley, Sydney Basin [HU556]	9.8	623	100 ha	30%
Forest Red Gum - Grey Gum dry open forest on hills of the lower Hunter Valley, Sydney Basin [HU544]	10.7	413	0 ha	0%

5.2.5 Development Area Species within Ecosystem Credits

The credit calculator reports the suite of threatened fauna species that are predicted to be associated with ecosystem credits generated for the development. That is, the threatened fauna species that are predicted to use habitat within the vegetation types at the site. Each of these species has a 'Tg score' that feeds into the ecosystem credit calculations. The fauna species with the lowest Tg score determines the overall credit requirement for the site. The lower the Tg score the greater the number of credits that are required to offset impacts on that species and all other species associated with the ecosystem credits. In certain cases, the fauna species with the lowest Tg score can be reliably excluded from occurring at the site and the credit calculations adjusted accordingly.

For the development, the species with the lowest Tg scores are the TSC Act listed forest owls: the Powerful Owl (*N. strenua*), Barking Owl (*N. connivens*) and Masked Owl (*Tyto novaehollandiae)*. The EPBC Act listed threatened species with the lowest Tg score is the Spotted-tailed Quoll (*Dasyurus maculatus*). The surveys of the development site indicate only foraging and/or shelter resources for these species. In addition, the development site will be located between two 'hostile gaps' (the Hunter Expressway and the train track). As such, the Tg scores for these species were

adjusted, in consultation with OEH, as per the following:

- The version of the Credit Calculator used for the calculations contains a modified Tg value for the forest owls, altered from 0.33 to 0.75. An 'Expert Report' has been completed for these species in accordance with the BioBanking methodology and submitted to OEH.
- The version of the Credit Calculator used for the calculations contains a modified Tg value for the Spotted-tailed Quoll, altered from 0.35 to 0.38, An 'Expert Report' completed for this species in accordance with the BioBanking methodology and submitted to OEH.

5.2.6 Development Area Species Credits

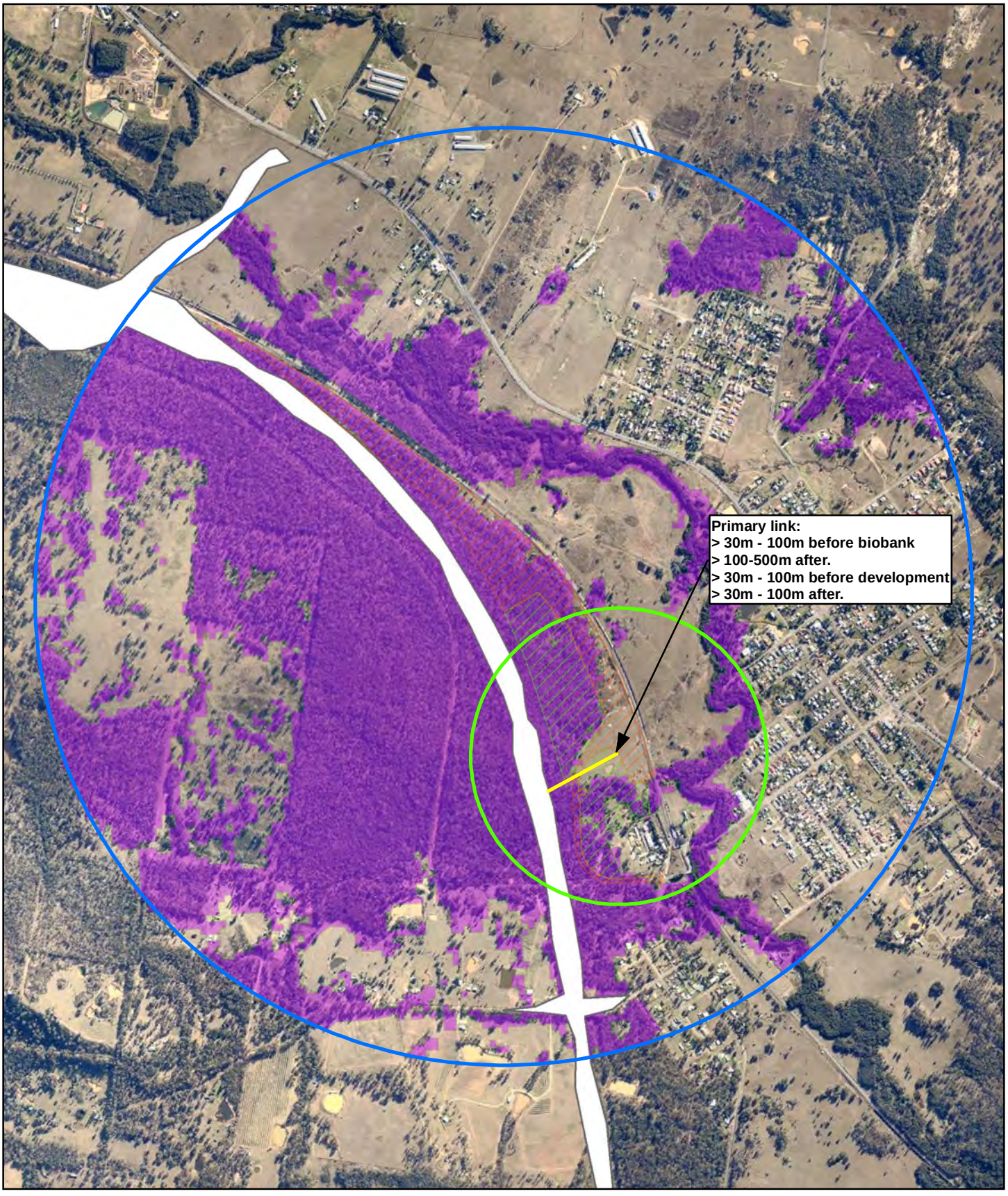
The geographic and habitat questions in Step 2 of the credit calculator were answered based on information obtained in the desktop assessment. The credit calculator combines this information with the vegetation and landscape data to generate lists of the threatened species predicted to occur at the site and those requiring targeted survey. Since an ecological impact assessment to accompany a Part 3A Project Application has already been performed it is assumed that no additional targeted threatened species surveys would be required for this assessment.

The results from targeted surveys for threatened species are entered into the credit calculator in Step 5e 'Enter Threatened Species Survey Results'. For each species, the credit calculator requires a 'Yes' or 'No' answer for the question, 'Is the species impacted by the development?' Answers must be justified by recording the Identification Method as either 'Survey', 'Assumed Presence' or 'Expert Report'.

The Project ecological assessments were considered to provide reliable evidence that the species would not be affected by the development. Therefore in all cases the data was entered as 'No' and 'Survey'.

5.2.7 Development Area Red Flags

The development area contains a number of red flag areas including over-cleared vegetation types and EECs (refer Appendix A). Since the proposed activity is subject to a Part 3A Project Application and a biobanking statement is not being obtained, then no further assessment of red flag areas is required.



LEGEND

- 100ha Biobank Assesment Circle
- 1000ha Assesment Circle
- Development Area
- Biobank Site
- Vegetation cover
- Primary Link
- Railways
- Hunter Expressway

1:20,000 (at A4)

0 75 150 300 450 600

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 56

N

GHD

CLIENTS | PEOPLE | PERFORMANCE

Pacific National
Greta Provisioning Facility
Biodiversity Offsets Package

Greta Subject Site
Landscape Assessment

Job Number	22-15502
Revision	A
Date	18 Sep 2012

Figure 6

G:\22\15502\GIS\Maps\MXD\22_15502_Z012_Greta_Landscape_AssessmentaCircles_F3Updare.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 2010; Navigate StreetMap: StreetMap - Jan 2010. Created by: qjchung

5.3 Greta Biobank Site

5.3.1 Greta Biobank Location

The Greta biobank site is located in the 'Hunter / Central Rivers' CMA region; the 'Hunter' CMA sub-region; and falls within the Central Hunter Foothills Mitchell Landscape (DECC, 2008).

5.3.2 Greta Biobank Landscape Value

The 100 hectare and 1,000 hectare assessment circles for the Greta biobank site are shown in Figure 6. Vegetation cover and connectivity was estimated based on the current situation and after the regeneration of low condition vegetation within the biobank. The data in Table 6 below was obtained from GIS measurement of foliage projective cover within the assessment circles. The percentage change in native vegetation cover was estimated by adding the area of non-woody vegetation within the Greta biobank site (i.e. the area that will be regenerated within the biobank) to the total area within the assessment circles. Patch size and connectivity were assessed using GIS and air photo interpretation of native vegetation cover within the assessment circles and adjoining areas of native vegetation. Management of the Greta biobank site would increase native vegetation cover by regenerating approximately 4 hectares of treeless vegetation within the assessment circles.

Impacts on connectivity are calculated by entering the 'primary link' for the biobank, which is the vegetated link that will experience the greatest change in connectivity as a result of regeneration of vegetation within the biobank. There are no east-west vegetated corridors in the vicinity of the subject site because the existing railway is a hostile gap and lies immediately to the east of the subject site. As described above, the development footprint for the Hunter Expressway lies immediately to the west of the subject site and for the purpose of this assessment is assumed to comprise a hostile gap. There is a north-south vegetated corridor that runs through the subject site.

The north-south fauna movement corridor running through the subject site is approximately 50 metres to 300 metres wide. The primary link for the biobank is in the south of the subject site, where the Greta biobank site will increase the link from approximately 92 metres wide to 292 metres wide as shown on Figure 6. Therefore the impact of the biobank on this vegetated corridor would result in a gain in linkage width classes from >30-100 metres to 100-300 metres.

Table 10 Greta Biobank Landscape Assessment Values

% Native vegetation cover in 1000 ha assessment circle – before biobank	% Native vegetation cover in 1000 ha assessment circle – after biobank	% Native vegetation cover in 100 ha assessment circle– before biobank	% Native vegetation cover in 100 ha assessment circle– after biobank	Connectivity value width – before biobank	Connectivity value width– after biobank
43.1 (41-50)	43.4 (41-50)	48 (41-50)	52 (51-60)	92 (>30-100 m)	292 (>100 m-300 m)

5.3.3 Greta Biobank Site Value

One vegetation zone was created for each native vegetation type and broad condition state at the site. The area of each vegetation zone was calculated using GIS. Vegetation zones within the Greta biobank site are summarised in Table 11.

One threatened species sub zone was created for each vegetation zone.These vegetated areas are connected to an area of fragmented native vegetation and grazing country to the south of the subject site. The area of contiguous treed vegetation connected to the subject site was calculated with GIS and is 285 hectares, so for both threatened species sub zones in moderate/good condition the adjacent remnant area is 285 hectares.

Threatened species sub zone 3 contains Forest Red Gum – Ironbark Forest in low condition and so the adjacent remnant area is zero.

There is well over 500 hectares of contiguous derived grassland with occasional shrubs and paddock trees connected to the subject site and so the patch size, including low condition vegetation for all vegetation zones within the Greta biobank is equal to the maximum area within the BioBanking methodology of 501 hectares.

The EEC status of each vegetation zone within the development was determined through GHD field survey of the site. Data was collected using the BioBanking plot/transect methodology and so site value data for each vegetation type was entered for each transect/plot field in each threatened species sub zone.

Table 11 Greta Biobank vegetation zones

Threatened Species Sub Zone	Vegetation Zone	Red Flag / EEC Status	Area (ha)	Adjacent Remnant Area (ha)	Patch Size including Low Condition Vegetation (ha)
TSSZ 1	HU556_Moderate/Good (Spotted Gum – Ironbark – Grey Box Forest)	EEC (Central Hunter Spotted-gum – Ironbark – Grey Box Forest)	7.45	285	501
TSSZ 2	HU544_Moderate/Good (Forest Red Gum – Ironbark Forest)	EEC (Hunter Lowland Red Gum Forest)	9.85	285	501
TSSZ 3	HU544_Low (Forest Red Gum – Ironbark Forest)	EEC (Hunter Lowland Red Gum Forest)	3.00	0	501

Changes in site biodiversity values through the development of a site is the basis for calculation of species and ecosystem credits required to offset impacts. Complete clearing of vegetation for a development reduces the site values to zero. There are certain circumstances where portions of a biobank are managed more intensively to increase the gain in site value that could be achieved. It is assumed that the entire biobank area will be managed according to standard site management measures and so the default increase in site value was entered into the credit calculator as shown in Table 12.

Table 12 Greta Biobank Management Zones

Management Zone	Threatened Species Sub Zone(s)	Area (ha)	Management / Attribute Scores
1 (Spotted Gum -Ironbark - Grey Box Open Forest)	TSSZ 1	7.45	Standard management / Default increase in site value.
2 (Forest Red Gum – Ironbark Open Forest)	TSSZ 2	9.85	Standard management / Default increase in site value.
3 (Low-condition Forest Red Gum – Ironbark Open Forest)	TSSZ 3	3.00	Standard management / Default increase in site value.

5.3.4 Greta Biobank Ecosystem Credits

The ecosystem credit profile for the Greta biobank site is included as Appendix A and summarised in Table 13.

Table 13 Greta Biobank Ecosystem Credit Profile

Vegetation Type	Area (ha)	Ecosystem Credits Generated	Surrounding Vegetation % Cover Class	Patch Size Including Low Condition
Grey Ironbark - Spotted Gum - Grey Box open forest on hills of the Hunter Valley, Sydney Basin [HU556]	7.45	67	31-70%	>100 ha
Forest Red Gum - Grey Gum dry open forest on hills of the lower Hunter Valley, Sydney Basin [HU544]	9.85	82	31-70%	>100 ha
Forest Red Gum - Grey Gum dry open forest on hills of the lower Hunter Valley, Sydney Basin [HU544]	3.00	31	31-70%	0-5 m

5.3.5 Species within Ecosystem Credits

The credit calculator reports the suite of threatened fauna species that are predicted to be associated with ecosystem credits generated for the biobank. That is, the threatened fauna species that are predicted to use habitat within the vegetation types at the site. Each of these species has a 'Tg score' that feeds into the ecosystem credit calculations the lowest Tg score determines the overall credit requirement for the site.

The species predicted to occur in ecosystem credits associated with the biobank site are presented in Appendix A. For the development, the species with the lowest Tg scores are the TSC Act listed forest owls: the Powerful Owl (*N. strenua*) and Masked Owl (*Tyto novaehollandiae)*. The EPBC Act listed threatened species with the lowest Tg score is the Spotted-tailed Quoll (*Dasyurus*

maculatus). As described above for the development area, the Tg scores for these species were adjusted, in consultation with OEH, as per the following:

- A modified Tg value for the forest owls, altered from 0.33 to 0.75
- A modified Tg value for the Spotted-tailed Quoll, altered from 0.35 to 0.38.

Expert Report have been completed for these species in accordance with the BioBanking methodology and submitted to OEH.

5.3.6 Greta Biobank Species Credits

Targeted surveys for the Slaty Red Gum (*Eucalyptus glaucina*) were conducted across the entire Greta subject site and did not record any individuals. No other targeted surveys for threatened species have been conducted at the Greta biobank site though the existing survey effort would reliably exclude the majority of threatened plant species potentially present at the site.

A number of threatened fauna species were recorded by SKM (2010a) or opportunistically during GHD ecosystem surveys as described in Section 4.3.5. All of these threatened species are ecosystem credit-type species.

The results from targeted surveys for threatened species are entered into the credit calculator in Step 5e 'Enter Threatened Species Survey Results'. For each species, the credit calculator requires a 'Yes' or 'No' answer for the question, 'Is the species present and to be managed at the biobank site?' Answers must be justified by recording the Identification Method as either 'Survey', or 'Expert Report'. None of these threatened species have been recorded at the site and so for all of these threatened species the data was entered as 'No' and 'Survey'.

Pacific National may decide to conduct additional targeted surveys for species credit-type threatened species, such as nocturnal fauna surveys or trapping, and generate additional species credits as part of their application for a biobanking agreement. These credits would be available for sale to other parties.

5.3.7 Suitability of the Site

The Greta biobank site would conserve vegetation types and habitat resources that are precisely equivalent to those within the development area and that are located within the same overall patch of habitat. The delivery of biodiversity offsets within the Greta biobank site would directly benefit local populations of native vegetation types and threatened biota to be impacted by the development.

The Greta biobank site meets the 'like for like' criterion and other OEH and DSEWPaC requirements for biodiversity offsets, except with regards to the scale of offset to be delivered. The Branch Lane biobank would make up the shortfall in biodiversity offsets for the Project as described below.

5.3.8 Security of Offset Delivery

The Greta biobank site would be formally secured for biodiversity conservation under a biobankingagreement.

5.4 Branch Lane Biobank Site

5.4.1 Branch Lane Biobank Location

The Branch Lane biobank site is located in the 'Hunter / Central Rivers' CMA region; the 'Karuah-Manning CMA sub-region; and falls within the 'Newcastle Coastal Ramp' Mitchell Landscape (DECC, 2008).

5.4.2 Branch Lane Biobank Landscape Value

The landscape value was assessed using GIS and air photo interpretation of native vegetation cover within the assessment circles and adjoining areas of native vegetation. The Branch Lane biobank site is part of a very large patch of native vegetation that is connected to native vegetation on private land to the east and in Werakata National Park to the west and southwest and to Karuah National Park and State forest to the west and south west. This link narrows towards the western edge of the Branch Lane biobank site and is reduced to a riparian corridor to the west of the site.

A 1,000 ha and a 100 ha assessment circle were created over the Branch Lane biobank site as per the BioBanking methodology. The site fits within a single 1,000 ha assessment circle. The 100 ha assessment circle and primary link were placed over low condition vegetation at the site so as to capture the greatest possible change in vegetation cover with the establishment of the biobank. The landscape assessment is shown in Figure 7. Vegetation cover and connectivity were estimated with GIS based on the current situation and after establishment and management of a biobank at the site. The data in Table 14 below was obtained from GIS measurement of foliage projective cover within the assessment circles and the width of the primary link.

Management of the biobank site would increase foliage projective cover within the assessment circles through regeneration of low condition vegetation. This increase was not sufficient to increase the score to a higher cover class.

Management of the biobank site would increase the width of the primary link by approximately 41 metres through regeneration of low condition vegetation. This would increase the connectivity score by one class.

Table 14 Branch Lane Biobank Landscape Assessment

% Native vegetation cover in 1000 ha assessment circle – before biobank	% Native vegetation cover in 1000 ha assessment circle – after biobank	% Native vegetation cover in 100 ha assessment circle– before biobank	% Native vegetation cover in 100 ha assessment circle– after biobank	Connectivity value width – before biobank	Connectivity value width– after biobank
54.3 (51-60%)	54.63 ha (51-60%)	72 (71-80%)	75.3 (71-80%)	494 m (>100-500 m)	535 m (>500 m)

406,000 407,000 408,000 409,000 410,000 411,000 412,000

6,394,000
6,393,000
6,392,000
6,391,000

Primary link:
> 100-500m before biobank,
> 500m after.

Image © 2012 GeoEye

©2010 Google

406,000 407,000 408,000 409,000 410,000 411,000 412,000

Paper Size A3

0 100 200 400 600 800

Metres

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

N

LEGEND

- Branch Lane biobank site boundary
- Primary Link
- Branch Lane 100 ha Landscape Assessment Circle
- Branch Lane 1000 ha Landscape Assessment Circle
- Native Vegetation Cover

GHD

CLIENTS | PEOPLE | PERFORMANCE

Pacific National
Greta Provisioning Facility
Biodiversity Offsets Package

Branch Lane Biobank Landscape Assessment

Job Number	22-15502
Revision	A
Date	06 Aug 2012

Figure 7

G:\22\15502\GIS\Maps\MXD\22_15502_Z018_KaruahBiobankLandscapeAssessment_site_layout.mxd

Data source: Data Custodian, Data Set Name/Title, Version/Date. Google Earth Pro, Aerial Imagery, 2012. Created by:apmiller

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

5.4.3 Branch Lane Biobank Site Value

One vegetation zone was created for each native vegetation type and broad condition class identified in the site surveys. Vegetation zones within the Branch Lane biobank site are summarised below in Table 15. The Branch Lane biobank site is part of a continuous patch of native vegetation that is over 1000 hectares in area. Therefore for all vegetation zones which contain native vegetation in 'moderate / good' condition 'Adjacent remnant area' and 'Patch size, including low condition vegetation' is equal to the maximum patch size within the BioBanking methodology (501 ha). One vegetation zone is in 'low' condition and and so 'Adjacent remnant area' equals zero. This low condition vegetation is continuous with over 500 hectares of intact vegetation and so 'Patch size, including low condition vegetation' is equal to the maximum patch size within the BioBanking methodology (501 ha).

The conservation status of vegetation types within the biobank site was determined based on plot data, habitat assessments, DECCW profiles and the experience and judgement of GHD field ecologists. There are no TECs at the site though Spotted Gum- Grey Gum Ironbark Forest at the site is functionally similar to Lower Hunter Spotted Gum – Ironbark Forest as described in Section 4.3.5 above.

Table 15 Branch Lane Biobank vegetation zones

Vegetation Zone	Area (ha)	Adjacent Remnant Area	Patch Size Including Low Condition Vegetation	Plot/transects Completed
1 -HU630_Moderate/Good (Spotted Gum- Grey Gum Ironbark Forest)	238.60	501	501	2, 3, 7,9,10,12,13,14,20,21
2 - HU642_Moderate/Good (Tallowwood - Brush Box - Sydney Blue Gum moist shrubby forest)	38.38	501	501	4,5,11,15
3 - HU630_Low (Cleared Spotted Gum- Grey Gum Ironbark Forest)	3.23	0	501	23,24

Increases in site biodiversity values through establishment and management of the biobank site is the basis for calculation of species and ecosystem credits that are generated. Specific management actions and areas within the biobank site are not proposed for moderate and good condition vegetation zones and so the default increase in site value was entered into the credit calculator as shown in Table 16. This assumes that vegetation and habitat would be managed according to the standard minimum actions required by the methodology.

Table 16 Branch Lane Biobank Management Zones

Management Zone	Vegetation Zone	Area (ha)	Management / Attribute Scores
1 - (Spotted Gum- Grey Gum Ironbark Forest)	1 - HU630_Moderate/Good (Spotted Gum- Grey Gum Ironbark Forest)	238.60	Standard management / Default increase in site value.
2 - (Tallowwood - Brush Box - Sydney Blue Gum moist shrubby forest)	2 - HU642_Moderate/Good (Tallowwood - Brush Box - Sydney Blue Gum moist shrubby forest)	38.38	Standard management / Default increase in site value
3 - (Cleared Spotted Gum- Grey Gum Ironbark Forest)	3 - HU630_Low (Cleared Spotted Gum- Grey Gum Ironbark Forest)	3.23	Standard management / Default increase in site value

5.4.4 Branch Lane Biobank Ecosystem Credits

The ecosystem credit profile for the Branch Lane biobank site is included as **Error! Reference source not found.** and summarised in Table 17. Not all of these ecosystem credits would be required to offset impacts of the development. The credits that would be presented as the offset package for the development are present in Section 6.

Table 17 Branch Lane Biobank Ecosystem Credit Profile

Vegetation Type	Area (ha)	Ecosystem Credits Generated	Surrounding Vegetation % Cover Class	Patch Size
Spotted Gum - Grey Ironbark forest dry open forest of the lower foothills of the Barrington Tops, North Coast	238.6	1870	31-70%	>100 ha
Tallowwood - Brush Box - Sydney Blue Gum moist shrubby forest on coastal foothills of the southern North Coast	38.38	316	31-70%	>100 ha
Spotted Gum - Grey Ironbark forest dry open forest of the lower foothills of the Barrington Tops, North Coast	3.23	32	31-70%	

5.4.5 Species within Ecosystem Credits

The credit calculator reports the suite of threatened fauna species that are predicted to be associated with ecosystem credits generated for the Branch Lane biobank site and the fauna species with the lowest Tg score determines the overall credit requirement for the site. The species predicted to occur in ecosystem credits associated with the Branch Lane biobank site are presented in **Error! Reference source not found.**. For the development, the species with the lowest Tg score is Stephens' Banded Snake (*Hoplocephalus stephensii*). There is appropriate wet forest with hollow-bearing trees in the vicinity of drainage lines at the biobank site and so the biobank site contains breeding, foraging and shelter resources for this species. Therefore the Tg score and ecosystem credit calculations presented in this report do not require adjustment.

5.4.6 Branch Lane Biobank Species Credits

The results from targeted surveys for threatened species are entered into the credit calculator in Step 5e 'Enter Threatened Species Survey Results'. For each species, the credit calculator requires a 'Yes' or 'No' answer for the question, 'Is the species present and to be managed at the biobank site?' Answers must be justified by recording the Identification Method as either 'Survey', 'Assumed Presence' or 'Expert Report'. No species credit-type threatened fauna species were recorded and so for all species credit-type threatened species the data was entered as 'No' and 'Survey'.

No targeted surveys for threatened species have been conducted at the Branch Lane biobank site. Two ecostem-credit type threatened fauna species were recorded opportunistically as described in Section 4.3.5

The land owner may decide to conduct additional targeted surveys for species credit-type threatened species and generate additional species credits as part of their application for a biobanking agreement for the site.

5.4.7 Suitability of the Site

There is not a perfect match between vegetation types within the development area and the Branch Lane biobank site, which reflects the inherent difficulty of identifying a viable offset site or sites with the desired attributes. Despite this, the Branch Lane biobank site is considered to be a suitable offset site for the development due to:

- The presence of native vegetation forest in good condition and associated habitat resources.
- The functional similarity of vegetation at the site with vegetation to be removed in the development area.
- The presence of two threatened fauna species and the presence of habitat resources for a range of other threatened biota.
- The location of the proposed biobank site within a large contiguous patch of vegetation.

5.4.8 Security of Offset Delivery

The Branch Lane biobank site is the preferred site for this project and consultation has now commenced with the land owner regarding progression of a biobanking agreement and sale of biodiversity credits. Pacific National and the landowner have executed a binding agreement for the transfer of an agreed number and type of biodiversity credits.

6. BioBanking Credit Comparison

6.1 Variation Criteria for Mitigated Net Loss

The Interim Policy (OEH 2011) states that if a Project offset package includes a variation applied to offset type and/or Red Flag areas are only partially protected, then the Project will achieve a 'Tier 3 - mitigated net loss standard'. Red Flag areas will not be protected within the development area and not all vegetation types within the development area would be fully offset with matching vegetation types and so this offset package would achieve a Tier 3 - mitigated net loss standard.

There are matching ecosystem credits for all vegetation types within the development area within the Greta biobank site. However, the Greta biobank site would not generate enough ecosystem credits to fully offset impacts within the development area and so additional credits from the Branch Lane biobank site are being presented. Not all vegetation types within the development area would be fully offset with matching ecosystem credits generated at the Branch Lane biobank site.

The Interim Policy (OEH 2011) includes specific variation criteria which may be applied to the offsetting requirements of the BioBanking methodology for Tier 3 Projects. The application of these criteria to the Project is summarised below.

Variation criterion f) would be applied to convert ecosystem credits to a regional conservation priority in a regional conservation plan because no matching credits are available and variation a) is not possible. Variation criterion a) states that it is possible to convert ecosystem credits for one vegetation type to any vegetation type within the same vegetation formation in the same IBRA bioregion. The development site is in the Sydney Basin Bioregion however, despite being in the same CMA region, the Branch Lane biobank site is in the NSW North Coast Bioregion. Therefore variation criterion a) cannot be applied to the Project.

This offsets package would conserve the Branch Lane biobank which is in an area classified as a regional conservation priority in the *Lower Hunter Regional Conservation Plan* (DECCW 2009c) as a substitute for matching ecosystem credits. DECCW (2009c) identifies specific areas as regional conservation priorities that should be conserved and managed through mechanisms such as BioBanking. The Branch Lane biobank falls within an area identified as a regional investment priority for the Lower Hunter Region through "consolidation of Karuah wetlands and lowland coastal forest habitat" (map 3, p35 DECCW 2009c). The site is continuous with a patch of native vegetation and habitat of many thousands of hectares that is connected to Karuah National Park. Conservation and management of the site as a biobank would directly contribute to this regional conservation priority.

The scale and type of biodiversity offset within this regional conservation priority is expressed in terms of biodiversity credits as follows:

- Ecosystem credits for Grey Ironbark - Spotted Gum - Grey Box open forest on hills of the Hunter Valley, Sydney Basin in the development area would be traded with credits for Spotted Gum - Grey Ironbark forest dry open forest of the lower foothills of the Barrington Tops, North Coast at the Branch Lane biobank site.
- Ecosystem credits for Forest Red Gum - Grey Gum dry open forest on hills of the lower Hunter Valley, Sydney Basin in the development area would be traded with credits for Spotted Gum - Grey Ironbark forest dry open forest of the lower foothills of the Barrington Tops, North Coast at the Branch Lane biobank.

Ecosystem credits within the development area are all vegetation types that would be Red Flag areas (i.e. EECs and/or extensively cleared vegetation types). The DECC (2009) methodology would normally require a 'Section 2.3 assessment' to determine that the impact of a development on EECs or other Red Flag areas can be regarded as improving or maintaining biodiversity values however Red Flags do not apply to Major Projects. Matters that are considered as part of a 'Section 2.3 assessment' include whether extra credits are proposed to be retired in addition to the number of credits that must be retired in accordance with the methodology. Whilst not required for major projects extra ecosystem credits have been included in this offset package to further compensate for impacts on EECs (see below).

6.2 Offset Package Credit Contribution

The biodiversity credits that are included in this offset package are presented in Table 18. The number and type of biodiversity credits have been determined with reference to:

- The biodiversity credit profile of the development area, which comprises the biodiversity credits that would be required to offset impacts arising from the Project
- The biodiversity credit profile of the Greta biobank site and the Branch Lane biobank site, which comprises the biodiversity credits that would be generated if the biobank sites were set aside and managed for conservation in perpetuity
- The biodiversity credit trading rules for BioBanking assessments presented in DECC (2009)
- The variation criteria for the biodiversity credit trading rules that may be applied to Part 3A Projects presented in OEH (2011)
- The experience and assessor's judgement of GHD ecologists
- Consultation with OEH on this Project and on other similar projects in the region.

The biodiversity credits that are included in this offset package exceed the minimum that would be required to achieve a 'Tier 3 - mitigated net loss standard' (DECCW, 2010a). Tier 3 Projects include those where 'impacts are partially offset' (DECCW, 2010a) i.e. less than the required number of biodiversity credits are retired. As shown in Table 18, greater than the required number of biodiversity credits would be retired as part of this offset package. This additional contribution of credits is considered appropriate because all of the vegetation types within the development footprint are EECs. This approach is comparable to a 'Section 2.3 assessment' that would be undertaken for BioBanking assessments that are not linked to Part 3A Projects (DECC, 2009).

6.2.1 Ecosystem Credits

The BioBanking methodology states that impacts of a development on biodiversity values must be offset by the retirement of biodiversity credits at the biobank site determined in accordance with the offset rules. The offset rules state that ecosystem credits that are retired from a biobank site are determined to be compatible with those required by impacts at the development site if a number of conditions are met, including that "the number of ecosystem credits obtained and retired from the biobank site is equal to or greater than the number of credits required at the development site" (DECC, 2009). The BioBanking ecosystem credit comparison between the development area and the Greta and Branch Lane biobank sites is presented in Table 18. These rules may be altered or may not apply when the Project is being assessed under Part 3A of the EP&A Act using the variation criteria stated in Attachment B of the OEH (2011) Interim Policy as described above.

The DECC (2009) ecosystem credit trading rules are presented below along with a comparison of

the biodiversity credit profiles of the development site and the biobank sites.

1. *The number of ecosystem credits obtained and retired from the biobank site is equal to or greater than the number of credits required at the development site*: a total of 1,085 ecosystem credits will be retired from the biobank sites, which is greater than the 1,036 ecosystem credits required for the development area. Variation criteria f) of the OEH (2011) Interim Policy was applied to identify ecosystem credits in a regional conservation priority area for each type within the development area credit profile. There is a surplus of credits for each ecosystem credit type as shown in Table 18. Therefore condition 1 is met.
2. *The CMA subregion of the biobank site is the same as the subregion of the development site*: The development site and biobank site are both in the Hunter CMA sub-region and therefore condition 2 is met.
3. *The vegetation types identified in the credit profile at the biobank site are the same as the vegetation types identified in the in the credit profile of the credits required at the development site*: The vegetation types associated with 'Grey Ironbark - Spotted Gum - Grey Box open forest on hills of the Hunter Valley' and 'Forest Red Gum - Grey Gum dry open forest on hills of the lower Hunter Valley, Sydney Basin' ecosystem credits in the credit profile of the development area are present in the Greta biobank site, but not the Branch Lane biobank site. Therefore condition 3 is partially met.
4. *The vegetation formation identified in the credit profile at the biobank site is the same as the vegetation formation identified in the credit profile of the credits required at the development site*: All ecosystem credits that would be traded between the development area and the biobank sites in this offset package are within the Dry Sclerophyll Forests Vegetation Formation. Therefore condition 4 is met.
5. *The surrounding vegetation cover class identified in the credit profile at the biobank site is equal to, or greater than, the surrounding vegetation cover class in the credit profile of the credits required at the development site*: the surrounding vegetation cover class percentages of ecosystem credits required at the development site (> 30%) are matched by credits with equivalent or greater percentages at the Greta biobank site (>31-70 %) and the Branch Lane biobank site (>70%). Therefore condition 5 is met.
6. *The patch size, including low condition class identified in the credit profile at the biobank site is equal to, or greater than, the patch size, including low condition class identified in the credit profile of the credits required at the development site*: the patch size, including low condition vegetation of ecosystem credits required at the development site (minimum 100 hectares) are matched by credits with equivalent or greater patch sizes at the biobank sites (> 100 hectares). Therefore condition 6 is met.

The partial inconsistency with condition 3 reflects the inherent difficulty of identifying a viable biobank site or sites with the desired credit profile. The BioBanking scheme is intended to address this issue by providing for the trading of a wide range of biodiversity credits across multiple biobank sites via a register. However because the scheme is relatively new only a limited range of biodiversity credits are available. Nonetheless, this offset package has partially offset all ecosystem credit types within the development area according to the strict application of the biodiversity credit trading rules and has fully offset all credits using the DECCW (2010) variation criteria.

Table 18 Offset Package - Comparison between the Development Area Credits Required and Biobank Credits Contribution

Vegetation Type	Development Ecosystem Credits Required	Greta Biobank Site Credits Generated	Branch Lane Biobank Site Credits Generated to retire	Offset Package Credit Comparison
Grey Ironbark - Spotted Gum - Grey Box open forest on hills of the Hunter Valley, Sydney Basin [HU556]	623	67	580*	24 credit surplus, of credits within the same vegetation formation and within a regional conservation priority area according to variation criteria f) of OEH (2011)*
Forest Red Gum - Grey Gum dry open forest on hills of the lower Hunter Valley, Sydney Basin [HU544]	413	113	333**	33 credit surplus, of credits within the same vegetation formation and within a regional conservation priority area according to variation criteria f) of OEH (2011)**
Total	**1,036**	**1,093**		**57 credit surplus**

***** Spotted Gum - Grey Ironbark forest dry open forest of the lower foothills of the Barrington Tops [HU630], which is within the Dry Sclerophyll Forest vegetation formation along with Grey Ironbark - Spotted Gum - Grey Box open forest on hills of the Hunter Valley, Sydney Basin [HU556] and is within an area identified as a regional investment priority for the Lower Hunter Region (map 3, p35 DECCW 2009c).

****** Spotted Gum - Grey Ironbark forest dry open forest of the lower foothills of the Barrington Tops [HU630] ecosystem credits, which is within the Dry Sclerophyll Forest vegetation formation along with Forest Red Gum - Grey Gum dry open forest on hills of the lower Hunter Valley, Sydney Basin [HU 630] and is within an area identified as a regional investment priority for the Lower Hunter Region (map 3, p35 DECCW 2009c).

6.2.2 Species within Ecosystem Credits

As described though Section 4 and summarised in Table 18, the vegetation types and ecosystems within the biobank sites are very similar to those within the development site. This comparison is supported by the threatened species that were recorded in site surveys or are predicted to occur within development and biobank sites as presented in Table 19.

A total of five threatened fauna species, all of which are listed as vulnerable under the TSC Act were identified in the development area during SKM (2010a, 2010b) and GHD field surveys. Critical foraging habitat for the Grey-headed Flying-Fox as defined in the Draft Recovery Plan for the species was also identified. The local populations of these species would also occur within the Greta biobank and use habitat resources in this area. Of these species two were also recorded directly during surveys of the Branch Lane biobank site: the Grey-crowned Babbler and the Varied Sitella. Critical foraging habitat for the Grey-headed Flying-Fox is also present in the the Branch Lane biobank site. The Squirrel Glider is nocturnal and arboreal and so would not be expected to be detected in the surveys of the Branch Lane biobank site, which did not include nocturnal survey. The Branch Lane biobank site does contain suitable foraging and shelter habitat resources for the Squirrel Glider.

None of the threatened fauna species recorded within the development area are of the type that require species credits within the BioBanking assessment methodology (DECCW, 2010c; DECC, 2009). All of these species are also predicted to occur with ecosystem credits at the development site and are also predicted to occur in ecosystem credits generated at the biobank site as shown in Table 19.

Table 19 Comparison between Development and Biobank Threatened Fauna Species

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Greta Subject Site (Development and Biobank)		Branch Lane Biobank Site	
				Recorded	Predicted	Recorded	Predicted
Birds							
Ninox connivens	Barking Owl	V	-		Yes		Yes
Melithretus gularis gularis	Black-chinned Honeyeater	V	-		Yes		Yes
Climacteris picumnus victoriae	Brown Treecreeper	V	-		Yes		Yes
Burhinus grallarius	Bush Stone-curlew	E	-		Yes		Yes
Stagonopleura guttata	Diamond Firetail	V	-		Yes		Yes
Callocephalon fimbriatum	Gang-gang Cockatoo	V	-		Species Credit-species		Species Credit-species
Calyptorhynchus lathami	Glossy Black-cockatoo	V	-		Yes		Yes
Pomatostomus temporalis temporalis	Grey-crowned Babbler	V	-	Yes	Yes	Yes	Yes

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Greta Subject Site (Development and Biobank)		Branch Lane Biobank Site	
				Recorded	Predicted	Recorded	Predicted
Petroica boodang	Scarlet Robin	V	-		Yes		Yes
Petroica phoenicea	Flame Robin	V	-		Yes		Yes
Melanodryas cucullata cucullata	Hooded Robin	V	-		Yes		Yes
Glossopsitta pusilla	Little Lorikeet	V	-	Yes*	*		Yes
Anseranas semipalmata	Magpie Goose	V	-		Yes		Yes
Tyto novaehollandiae	Masked Owl	V	-		Yes		Yes
Grantiella picta	Painted Honeyeater	V	-		Yes		Yes
Ninox strenua	Powerful Owl	V	-		Yes		Yes
Xanthomyza phrygia	Regent Honeyeater	CE	E		Yes		Yes
Pyrrholaemus sagittatus	Speckled Warbler	V		Yes	Yes		Yes
Lathamus discolor	Swift Parrot	E	E, M		Yes		Yes
Neophema pulchella	Turquoise Parrot	V	-		Yes		Yes
Daphoenositta chrysoptera	Varied Sitella	V	-	Yes*	*	Yes	Yes
Mammals							
Phascogale tapoatafa	Brush-tailed Phascogale	V	-		Yes		Yes
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V	-		Yes		Yes
Vespadelus troughtoni	Eastern Cave Bat	V	-		Yes		Yes
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-		Yes		Yes
Mormopterus norfolkensis	Eastern Freetail-bat	V			Yes		Yes
Cercartetus nanus	Eastern Pygmy-possum	V	-		Yes		Yes
Scoteanax rueppellii	Greater Broad-nosed Bat	V	-		Yes		Yes
Nyctophilus timoriensis	Greater Long-eared Bat	V	V				Yes
Pteropus	Grey-headed	V	V		Yes		Yes

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Greta Subject Site (Development and Biobank)		Branch Lane Biobank Site	
				Recorded	Predicted	Recorded	Predicted
poliocephalus	Flying-fox						
Phascolarctos cinereus	Koala	V	V		Yes		Yes
Myotis macropus	Large-footed Myotis	V	-		Yes		Yes
Miniopterus australis	Little Bentwing-bat	V	-		Yes		Yes
Dasyurus maculatus	Spotted-tailed Quoll	V	E		Yes		Yes
Petaurus norfolcensis	Squirrel Glider	V	-	Yes	Yes		Yes
Petaurus australis	Yellow-bellied Glider	V	-		Yes		Yes
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	-		Yes		Yes

Key: V – Vulnerable; E – Endangered; EP – Endangered Population; CE – Critically Endangered; M – Migratory

***** species was not listed as threatened or included in the credit calculator at the time of the assessment.

6.2.3 Species Credits

No species credits are required as no species of the type which require calculation of species credits have been recorded in the development area during SKM (2010a, 201b) nor GHD targeted surveys.

6.3 Offsets for Matters of National Environmental Significance

The offset package for the Project will conserve offset sites containing native vegetation and habitats equivalent to those within the development area using the framework of BioBanking. The following section describes how this approach will ensure that any impacts on MNES arising from the development are addressed by the offset package.

6.3.1 Threatened Flora

No threatened flora listed under the EPBC Act were identified in the subject site or are otherwise of relevance to this assessment. There is potential habitat for Slaty Red Gum (*Eucalyptus glaucina*), a vulnerable species listed under the EPBC Act, within the subject site however surveys by SKM (2010a, 2010b) and supplementary targeted surveys for *E. glaucina* and potential *E. glaucina* hybrids by GHD did not detect any individuals of the species within the development area. BioBanking only requires specific offsets for threatened plants (i.e. purchase of species credits) where individual threatened plants are to be removed. Therefore the Offset Package will not include any specific offset contributions for *E. glaucina*. Nonetheless, the offsets package will conserve 11 likely *E. glaucina* hybrids within the Greta biobank site.

6.3.2 Threatened Ecological Communities

No threatened ecological communities listed under the EPBC Act were identified in the development area or are otherwise of relevance to this assessment.

6.3.3 Threatened Fauna

The SKM (2009a, 2009b) ecological assessments included targeted field surveys for threatened fauna in conjunction with relevant database searches and assessments of fauna habitats and fauna species richness, distribution and abundance.

No EPBC Act-listed threatened fauna were directly recorded.

There is potential habitat for a number of threatened fauna listed under the EPBC Act within the development area: the Swift Parrot (*Lathamus discolor*), Regent Honeyeater (*Xanthomyza phrygia*), Spotted-tailed Quoll (*Dasyurus maculatus*) and Grey-headed Flying-fox (*Pteropus poliocephalus)*. *Eucalyptus* forest within the development area comprises critical foraging habitat for the Grey-headed Flying Fox as defined in the Draft Recovery Plan for the species (DECCW, 2009b). Potential habitat for a number of migratory species listed under the EPBC Act was identified within the development area. This suite of listed fauna was considered ‘subject species’ for the impact assessment.

Assessments of significance under the EP&A Act and EPBC Act found that the Project will be unlikely to have a significant negative impact on any of these listed fauna species (SKM, 2009a, 2009b).

Habitat assessments for threatened fauna were conducted within the development area and the biobank sites using the BioBanking assessment methodology (DECC, 2009). The BioBanking credit calculator queries a database of threatened biota records against the location of the site, landscape attributes and a series of habitat parameters in order to predict the suite of threatened fauna that are likely to be supported by habitats at the site. The results of this assessment process are presented as Table 19. The development area and Greta biobank site share a common suite of native biota populations and associated habitat resources. Further, all of the species predicted to

occur in association with habitats at the development area are also predicted to occur in association with habitats at the Branch Lane biobank site.

Each of the threatened fauna species that are predicted to use habitat within the vegetation types at the site has a 'Tg score' within the BioBanking credit calculator that feeds into the ecosystem credit calculations. The Tg score varies between threatened species depending on the ability of that species and its habitat resources to respond to management actions at a biobank site. Species which rely on habitat resources that take a long time to develop (e.g. hollow-bearing trees) have lower Tg scores. The lower the Tg score the greater the area of offsets that are required to address impacts on that species and all other species associated with the area of habitat. The fauna species with the lowest Tg score determines the overall offset requirement for the site. For the development, the species with the lowest Tg scores are the TSC Act listed forest owls the Barking Owl, Powerful Owl and Masked Owl. The EPBC Act listed threatened species with the lowest Tg score is the Spotted-tailed Quoll.

According to the ecological impact assessment conducted for the Project the development area contains potential foraging resources for all four of these species (SKM, 2009a). This has been confirmed by additional surveys conducted by GHD as part of this BioBanking assessment. For the two biobank sites, the species with the lowest Tg scores are the same three TSC Act listed forest owls. The EPBC Act listed threatened species with the lowest Tg score is also the Spotted-tailed Quoll. Based on habitat assessments conducted during the site surveys, the biobank sites contain potential foraging and shelter habitat for all four of these species. The site does not contain breeding resources for these species as stated in the expert reports included as Appendix D. The Tg score and offset calculations presented in this offsets package are based on a robust methodology (DECCW, 2010b; DECC, 2009) and are likely to be more conservative than would be required to address impacts on EPBC act listed fauna alone.

There is approximately 20 hectares of critical foraging habitat for the Grey-headed Flying-Fox in the development area and the DSEWPaC Ministers Conditions of Approval (letter of 13 May 2011) specifically refer to offsetting requirements for this species. Critical foraging habitat for the Grey-headed Flying-Fox is also present in the Greta biobank site in both Spotted Gum-Ironbark Forest and Red Gum Forest and in the Branch Lane biobank site in Spotted Gum-Grey Ironbark Forest.

The DSEWPaC Conditions of Approval require that for each hectare of suitable habitat for the Grey Headed Flying Fox, the Regent Honeyeater, the Swift Parrot and other listed threatened species to be impacted (sic) by the action, the proposed offset site or sites must protect a minimum of 5 hectares of suitable habitat (5:1 ratio). Offsetting requirements for these threatened species are expressed in ecosystem credits calculated using the BioBanking methodology in Table 19. In terms of hectares of habitat, this equates to the conservation of 135.9 hectares to offset the removal of 20.47 hectares or an offsets ratio of 6.66: 1. This is greater than the required offsetting ratio of 5:1 presented in the Minister's Conditions of Approval.

7. Biodiversity Offset Site Management Framework

7.1 Summary

The offsets package for the Project will identify biodiversity offset (biobank) sites that will be formally titled and conserved under biobanking agreements. To deliver the biodiversity outcomes required by a biobanking agreement, the following biodiversity management framework would be implemented at the biobank sites:

- ***Conservation*** – A 'conservation covenant' would be placed over the biobank sites in perpetuity. This covenant extinguishes all potential future land uses other than exploration/mining rights.
- ***Vegetation Rehabilitation*** – Existing vegetation would have a 'targeted' weed control program applied to improve 'condition' throughout the biobank sites. Revegetation activities would increase the extent of native vegetation, through time, of the biobank sites. It is recommended these works be completed within the first five to ten years of management of the biobank sites.
- ***Maintenance and monitoring*** – An annual maintenance and monitoring regime would be applied to the biobank sites in perpetuity to ensure improvements in ecological values are maintained.

7.2 Conservation Covenant (biobanking agreement)

Entering into a biobanking agreement places a conservation covenant over the land, regardless of zoning. The covenant is the strongest available on private lands and extinguishes all land uses other than conservation. The estimated timeline for completing the biobanking agreements for both the Greta and Branch Lane biobank sites is shown in Table 20, below.

Table 20 Program for completing biobanking agreements

Task description	Timing – Branch Lane	Timing – Greta BioBank Site
Complete draft Management Actions Plan and costing template	6 months from approval of the Offsets Package	6 months from approval of the Offsets Package
biobanking agreement signed	12 months from approval of the Offset Package	18 months of the Offset Package
Review Management Actions Plan (DSEWPaC) and approval by OEH	1 month prior to signing of biobanking agreement	1 month prior to signing of biobanking agreement
Implementation of Management Actions Plan	Commence immediately after approval of the Management Action Plan	Commence immediately after approval (1) of the Management Action Plan

Note: (1) These works will commence after construction is completed.

There are circumstances where additional approval from the NSW Minister for the Environment may overturn the covenant for mining rights and, potentially, significant infrastructure but the BioBanking methodology includes mechanisms to ensure any impacts from these activities are, again, suitably offset as an addition to any offsetting activities required by a given project in its own right. Details of this policy can be provided by the BioBanking Unit.

Pacific National have secured clear commitment from the land owner of the Branch Lane biobank site that they will enter into a biobanking agreement. Pacific National and the landowner have executed a binding agreement for the transfer of an agreed number and type of biodiversity credits

biobanking agreements include detailed contractual and financial obligations on the landowner and the purchaser and, in the absence of draft biobanking agreements (including the draft detailed management actions plan and contractual obligations on both parties), it is unreasonable to expect a land owner to commit at this stage as these are the documents to be prepared/negotiated and agreed in the next 12 months. The offset package can commit to entering the next stage of negotiations and, as contingency, can commit to retiring the minimum number of credits required to offset its impact. This is the most important point when using BioBanking as this achieves the 'improve or maintain' outcome for ecology required for approval.

7.3 Management Actions

7.3.1 Approach

The following describes the actions that would likely be required for ongoing management of the biobank sites. A Management Actions Plan (prepared in accordance with the BioBanking Methodology), detailing rehabilitation activities and an associated management program, would be prepared and included in the final biobanking agreements. The Management Actions Plan forms the basis of the funds required to be placed in the BioBanking Trust when purchasing the credits. The BioBanking Trust then funds the biobank site owner to implement the management actions plan.

Biobank sites may have two types of management actions applied:

- Standard Management Actions.
- Site Specific Management Actions.

The management actions applicable to the biobank sites are described below.

7.3.2 Standard Management Actions

Standard management actions are those actions required on biobank sites to improve vegetation condition when entering into a biobanking agreement. The standard management actions for all biobank sites are:

- Management of grazing for conservation
- Weed control
- Management of fire for conservation
- Management of human disturbance
- Retention of regrowth and remnant native vegetation
- Replanting or supplementary planting where natural regeneration would not be sufficient
- Retention of dead timber
- Erosion control
- Retention of rocks

7.3.3 Greta Site Specific Management Actions

Based on the habitat resources within the site and the suite of threatened species which are predicted to occur, the credit calculator nominates management actions that would be required to alleviate site-specific threats. Undertaking these actions is over and above the minimal requirements for a biobank site. Additional management actions required at the Greta biobank site are presented in Appendix A and summarised below:

- Cat and/or Fox control
- Exclude miscellaneous feral species
- Control of feral and/or overabundant native herbivores (e.g. rabbit, goats, deer etc)
- Maintain or reintroduce flow regimes (aquatic flora)

The Management Actions Plan will identify site specific vegetation rehabilitation and management actions appropriate for the Greta biobank site which would be completed during the preparation of the biobanking agreement.

Based on the results of the GHD site surveys these management actions would be applied at the Greta biobank site as follows:

- Rehabilitation of the drainage line in the south of the site, including treatment of locally severe infestation with Lantana (*Lantana camara*) and Camphor Laurel (*Cinnamonum camphora*)
- Revegetation of Forest Red Gum - Grey Gum dry open forest in Low condition including:
  - De-commissioning of the current dirt access road in the south of the site and associated informal tracks. Assisted natural regeneration of these areas with brush matting, placement of woody debris etc.
  - Revegetation of the horse track in the central portion of the site, including removal of fences, treatment of exotic pasture, supplementary planting and assisted natural regeneration through brush matting, placement of woody debris etc.
- Bush regeneration of Grey Ironbark - Spotted Gum - Grey Box open forest and Forest Red Gum - Grey Gum dry open forest in moderate/good condition, including treatment of localised Lantana and Prickly Pear (*Opuntia* sp.) infestations.
- Restoration of natural flow regimes in the drainage line in the south of the site through removal of barriers such as temporary access culvert and decommissioning the acess track in the south of the site.

Regeneration activities would be coordinated with environmental management measures through the construction phase of the Project as described in the Abigroup (2011) *Greta Train Support Facility Flora and Fauna Management Plan* (the FFMP). The FFMP is a sub plan to the Construction Environment Management Plan for the Project. The FFMP has been developed to provide a guide to minimising adverse impacts on flora and fauna and to meet the requirements of the Ministers Conditions of Approval and the Statement of Commitments (Abigroup, 2011). Rehabilitation of the access road and horse track would follow directly from rehabilitation of construction laydown areas and would utilise habitat resources salvaged from the development footprint under the FFMP. It is assumed that the construction laydown areas would contain an appropriate planting medium, including topsoil that would be conducive to regeneration of native vegetation within the biobank site.

These items would be described in greater detail in the Management Actions Plan.

Table 21 Summary of Rehabilitation and Management for Greta biobank site

Management Measure	Activities required	Timing
Management of grazing	◗ Install stock fencing in accordance with the MAP	◗ Within the first year of establishing the biobank site
	◗ Maintenance and repair	◗ Annually
Weed control	◗ Control of noxious and large woody weeds (min 80% control)	Within first 3 years of establishing biobank site
	◗ Completion of primary and secondary bush regeneration programs targeting other weeds	Within first 10 years of establishing biobank site
Management of human disturbance	Install controlled access point/s and fencing in accordance with the MAP	Within the first 6 months of establishing the biobank site
Retention of vegetation and retention of dead timber	Installation of protective fencing in accordance with MAP	Within first 6 months of establishing biobank site
Revegetation	Installation of native species, as described in the MAP, in areas currently devoid of existing vegetation	All plants to be installed within first 3 years of establishing biobank site. Minimum 85% survival rate or additional plantings required.
Erosion control	Installation of erosion control measures in accordance with the MAP	Within first 3 months of establishing biobank site.
Slaty Red Gum Protection	Individuals of Slaty Red Gum 'hybrids' protected through appropriate temporary fencing throughout the construction phase and via a perimeter fence for the life of the biobank	Within first 3 months of establishing biobank sie
Feral animal control	Trapping and targeted removal of pest species	Immediately upon establishment of biobank site and monitored regularly
Maintain or reintroduce flow regimes (aquatic flora)	Removal of any 'barriers' to flow regimes	Within first year of establishing biobank site.
Monitoring and Reporting	Reports will be prepared and issued in accordance with MAP by OEH. Provision will be made in the MAP copies of each report to be issued to the Minister of DSEWPaC.	Annually in perpetuity

7.3.4 Branch Lane Site Specific Management Actions

Additional management actions required at the Branch Lane biobank site are presented in Table 22 and summarised below:

- Cat and/or Fox control
- Exclude miscellaneous feral species
- Control of feral and/or overabundant native herbivores (e.g. rabbit, goats, deer etc)
- Maintain or reintroduce flow regimes (aquatic flora).

The Management Actions Plan will identify site specific vegetation rehabilitation and management actions appropriate for the Branch Lane biobank site which would be completed during the preparation of the biobanking agreement.

Based on the results of the GHD site surveys these management actions would be applied at the Branch Lane biobank site as follows:

- Monitoring of the condition of the drainage lines through Tallowwood - Brush Box - Sydney Blue Gum moist shrubby forest at the site, including treatment of environmental weeds as required
- Monitoring of local populations of threatened plants and communication with contractors to avoid accidental herbicide spraying or other impacts. The Management Actions Plan would include specific reference to these species and appropriate identification guidelines
- Bush regeneration of Spotted Gum - Grey Gum Ironbark Forest and Tallowwood - Brush Box - Sydney Blue Gum moist shrubby forest in moderate/good condition, including treatment of localised Lantana and herbaceous environmental weed infestations.

These items would be described in greater detail in the Management Actions Plan.

Table 22 Summary of Rehabilitation and Management for Branch Lane biobank site

Management Measure	Activities required	Timing
Management of grazing	NA	NA
Weed control	◗ Control of noxious and large woody weeds	Within first 3 years of establishing biobank site
	◗ Completion of primary and secondary bush regeneration programs	Within first 10 years of establishing biobank site
Management of human disturbance	Install controlled access point/s and fencing in accordance with the MAP	Within the first 6 months of establishing the biobank site
Retention of vegetation and retention of dead timber	Monitor human disturbance for things such as fire wood gathering	Within first 6 months of establishing biobank site
Erosion control	NA (not required at Branch Lane)	NA
Feral animal control	Trapping and targeted removal of pest species	Immediately upon establishment of biobank site and monitored regularly
Maintain or reintroduce flow regimes (aquatic flora)	Removal of any 'barriers' to flow regimes	Within first year of establishing biobank site.
Monitoring and Reporting	Reports will be prepared and issued in accordance with MAP by OEH. Provision will be made in the MAP copies of each report to be issued to the Minister of DSEWPaC.	Annually in perpetuity

7.4 Summary of Rehabilitation and Management Activities

The following general summary of management activities that would be adopted at the biobank sites outlines the minimum standards and measures that would be required. These activities will be described in greater detail in the Management Actions Plan (to be completed during the preparation of the biobanking agreement as described in Section 8.3.2).

7.4.1 Targeted Weed Control

The biobank sites would be subjected to a targeted weed control program to treat noxious and large woody weeds. These works may require the use of mechanical tools such as chainsaws and 'high cutters' as well as the use of a variety of herbicides. As such, suitably qualified and experienced contractors only will complete these works. Follow-up weed control would be included in the bush regeneration program.

7.4.2 Bush Regeneration

A comprehensive bush regeneration program is to be implemented to improve the condition of existing remnant vegetation throughout the site. Bush regeneration activities will occur during the initial stages of the biobanking agreement (i.e. the first 10 years) and will be completed by appropriately qualified and experienced contractors. Primary bush regeneration activities will focus on noxious weeds, woody weeds and ground covers. Follow-up bush regeneration activities will focus on small perennials, annuals and introduced grasses. It is anticipated that after the first 10 years bush regeneration activities will be limited to the monitoring of weed infestation and treatment as required.

7.4.3 Weed Waste

It is recommended that weed material from bush regeneration works is piled and left *in situ* to break down. All weeds propagules will be collected and 'bagged' on site and disposed of at a suitable waste facility.

7.4.4 Seed Collection

Seed collection will require a 123c licence under the *National Parks and Wildlife Act 1974* (NPW Act) subject to approval from DECCW. Only experienced and qualified staff will perform seed collection activities. All seed collection, management, cleaning and storage will be in accordance with *Florabank Seed Collection Guidelines* (prepared by Greening Australia and now accepted as industry best practice).

All plant material to be used throughout the project will be of local provenance, collected from within a five kilometre radius of the site.

7.4.5 Plant Propagation

Plant propagation refers to the germinating of collected seed and the 'growing on' of plants in enviro cells, hiko cells or forestry tubes. All plants will be produced from local provenance seed. This activity should be managed by a suitably qualified and experienced native plant production nursery.

7.4.6 Revegetation Works

To supplement rehabilitation activities, it is recommended an experienced native plant nursery provide native tube stock to be planted in low condition portions of the Greta biobank site. All plants would be of local provenance. Revegetation activities would include the targeted planting of Slaty Red Gum.

There will be no revegetation activities at Branch Lane as the site is already covered in existing native vegetation, generally in good condition.

7.4.7 Broadcasting of Native Seed

To supplement rehabilitation activities, it is recommended that pre-treated acacias, peas and native grass seed, comprising a suite of species representative of these Families within adjoining native vegetation, be broadcast throughout rehabilitation zones. This will add further diversity to the site, particularly in ground cover strata, and help improve native plant colonisation.

7.4.8 Maintenance Activities

Maintenance activities would include but not be limited to:

- General maintenance activities such as repairing damaged tree guards, installing replacement plants where required, weeding inside the tree guards and continued follow-up spot weed spraying.
- Watering - plants should be watered in on installation. All plantings should then receive follow-up watering during the first eight weeks to assist plant establishment. Should weather conditions remain dry for an extended period of time, additional watering may be required.

Newly installed plants will require spot spraying of Round-up® and Biactive herbicides using back packs. Suitably qualified contractors would carry out all spraying.

7.5 Monitoring of Biobank sites

The purchase of credits includes two components: Part A being the cost of rehabilitation and management and, Part B being the 'profit' to the relevant landowner. The Part A funds are the equivalent of all costs associated with the rehabilitation, management and monitoring of the biobank site/s in perpetuity.

The BioBanking methodology includes preparation of a Management Actions Plan for each biobank site. The methodology also includes a credit pricing tool which places a commercial value for completing each of the actions listed in the Management Actions Plan. These funds are held by the BioBanking Trust and managed by OEH. The funds are provided to the land owner on an annual basis for the amount equivalent to works required in that year. The biobank owner is then required to submit standards reports, outlining the works completed, their success and monitoring results. OEH then review the reports and, if works have been completely satisfactorily, provide the next payment for the following years work. The OEH also include site visits as part of their auditing process.

A total of seven plot/transects were sampled within the Greta biobank site and 15 within the Branch Lane biobank site using the BioBanking methodology. Each plot/transect was also systematically photographed according to the methodology prescribed by the DECCW BioBanking unit. These site attribute data and photographs would form the baseline for monitoring of the condition of the biobank site. The biobanking agreement for this site would include detailed monitoring requirements which would use these plots as their focus. Further, once the biobanking agreement has been signed by the landholder it becomes their responsibility to undertake all monitoring and the results of such would be assessed when the DECCW BioBanking Trust provides management funds at the beginning of each year.

The DECCW will also provide copies of each annual report to DSEWPaC for their records, as required by conditions of consent.

7.6 Compliance Assurance

BioBanking includes a range of provisions to ensure delivery of the conservation outcomes. The OEH have the ability to:

- Enforce the provisions of the conservation covenant placed over the land.
- Adjust rehabilitation and management actions program depending on how the site responds.

- Includes contingency for things such as ‘natural disasters which may impact on the success or otherwise of the program.
- Have the authority to take legal actions against biobank site owners for non-compliance including, as a last resort, acquisition of the land.

8. Conclusions

8.1 BioBanking Credit Calculations

An offset package has been presented that includes the purchase and retirement of biodiversity credits from the Greta biobank and the Branch Lane biobank to compensate for impacts arising from the Project. Impacts of a development on biodiversity values must be offset by the retirement of biodiversity credits at the biobank site(s) determined in accordance with the DECC (2009) offset rules and the DECCW (2011) Interim offsets policy.

The offset rules state that ecosystem credits that are retired from a biobank site are determined to be compatible with those required by impacts at the development site if conditions presented in the DECC (2009) methodology are met. Of these, the most critical is that 'the number of ecosystem credits obtained and retired from the biobank site is equal to or greater than the number of credits required at the development site'. A suite of biodiversity credits has been identified and included in this offset package that are appropriate to compensate for impacts of the Project. That is, sufficient biodiversity credits could be generated to offset the Project development impacts when the Greta biobank site and Branch Lane biobank site are entered into biobanking agreements. The suite of biodiversity credits that comprise the offset package for the Project are presented in Table 18.

The Greta biobank site is approximately 20.33 hectares and makes a suitable 'like for like' contribution to the offset package since it will achieve conservation outcomes within an area approximately equal in size to the development area and within the same overall patch of native vegetation and habitat. Local populations of native species, including threatened biota that will be affected by the Project will directly benefit from the regeneration of degraded or cleared land into Forest Red Gum – Spotted Gum Forest within the Greta biobank site.

The Branch Lane biobank site will contribute the majority of the offset for the Project. It has attributes that make it highly suitable as an offset site including:

- Landscape context – the site is continuous with a patch of native vegetation and habitat of many thousands of hectares that is connected to Karuah National Park
- Potential for improvement – the site contains localised weed infestations that will be treated and habitat for threatened fauna that would benefit from the management of exotic predators
- Conservation significance – the site:
  - Is dominated by intact native vegetation in good condition
  - Contains at least two threatened fauna species and important habitat associated with drainage lines, foraging resources and hollow-bearing trees that are likely to also support a number of other threatened species.

The specific offset contributions within this offset package are the biodiversity credits that are presented in Table 18 which would be purchased and retired by Pacific National.

There is not a perfect match between vegetation types within the development area and the Branch Lane biobank site, which reflects the inherent difficulty of identifying a viable offset site or sites with the desired attributes. BioBanking is intended to address this issue by providing for the trading of a wide range of biodiversity credits across multiple biobank sites via a register. However the scheme is relatively new and only a limited range of biodiversity credits are available. The BioBanking methodology has been varied with reference to the OEH (2011) Interim Policy for assessment of biodiversity offsets for Part 3A Projects. This framework specifies the assessment process and decision-making criteria for using BioBanking so that a Part 3A Project may achieve an '*improve or maintain*', '*no net loss'* or '*mitigated net loss'* outcome.

The Project has resulted in direct impacts to Red Flag areas and this offset package would require a variation to the offset type (i.e. not all vegetation types would be directly offset) and so would achieve a 'mitigated net loss' as defined in the OEH (2011) Interim Policy. The Interim Policy variation criteria f) has been applied to the offsets package to trade ecosystem credits with a regional conservation priority. The offset package would conserve a large, continuous parcel of native vegetation with known populations of at least two threatened species. Additional ecosystem credits would be presented to compensate for the removal of EECs within the development area.

All threatened fauna species predicted to occur in ecosystem credits associated with the development area are also predicted to occur at the Branch Lane biobank site.

The offset contribution included in this offset package was calculated using the BioBanking Assessment methodology and includes greater than the required number of biodiversity impacts to offset impacts of the Project. The biodiversity values to be conserved are an appropriate match for the impacts of the Project within the framework of the DECCW (2010) policy, including representative habitat resources for all threatened biota that will be subject to impacts. Given the overall surplus of biodiversity credits, the conservation of like for like habitats within the Greta biobank site and the high conservation significance of the Branch Lane biobank site, the offset package for the Project would achieve conservation outcomes that more than compensate for the impacts of the Project.

8.2 Alignment with Offsetting Principles

Table 23 summarises the alignment of the offset package with the DECC (2008) offsetting principles.

Table 23 Comparison of the Offsets Package with the DECC (2008) Offsetting Principals

DECC (2008) Principles for the use of biodiversity offsets in NSW	Attributes of offset package
1. Impacts must be avoided first by using prevention and mitigation measures.	The approach to avoidance and mitigation of impacts is presented in SKM (2009a, 2009b). There are unavoidable impacts on up to 20.47 ha of native vegetation because the Project development area is constrained by the location of the existing rail corridor and other infrastructure.
2. All regulatory requirements must be met.	An Environmental Assessment (Monteath and Powys, 2009) incorporating an ecological impact assessment (SKM, 2009a, 2009b) was prepared for the Project in accordance with all regulatory requirements and

DECC (2008) Principles for the use of biodiversity offsets in NSW	Attributes of offset package
	appropriate guidelines.
3. Offsets must never reward ongoing poor performance.	The Project involves the construction of important infrastructure and has a sound social and economic justification based on an environmental impact assessment (Monteath and Powys, 2009) incorporating an ecological impact assessment (SKM, 2009a, 2009b).
4. Offsets will complement other government programs.	The offsets package has been prepared using the BioBanking methodology and accordingly complements OEH and the NSW Governments approach to biodiversity conservation. It complements other government programs and biodiversity conservation initiatives, in general, by contributing to regional habitat connectivity, managing weed and pest species and conservation of EECs and threatened species habitat.
5. Offsets must be underpinned by sound ecological principles.	The preparation of the Offset Package was underpinned by the DECC (2009) BioBanking methodology and OEH (2011) Interim Offsets Policy.
6. Offsets should aim to result in a net improvement in biodiversity over time.	The proposed Offset Package would result in a net improvement in biodiversity values over time because it has been developed with the BioBanking methodology and associated management actions for biobank sites. Specifically, improvements would result through assisted natural regeneration, revegetation and management of weed and pest species.

DECC (2008) Principles for the use of biodiversity offsets in NSW	Attributes of offset package
7. Offsets must be enduring - they must offset the impact of the development for the period that the impact occurs.	The offset package includes conservation of two offset sites under biobanking agreements, which will ensure conservation in perpetuity.
8. Offsets should be agreed prior to the impact occurring.	The Offset Package has been prepared and will be agreed with OEH, DoP and DSEWPaC prior to vegetation clearing for construction of the Project.
9. Offsets must be quantifiable - the impacts and benefits must be reliably estimated.	Impacts and benefits were quantified using the BioBanking methodology.
10. Offsets must be targeted.	The biobank sites were targeted to achieve, as far as practicable: like for like conservation of vegetation types to be removed; conservation of EECs; conservation of threatened species habitat; conservation of remnant vegetation in the regional locality of the development site; and viable patches of habitat with good connectivity to other habitat in the locality.
11. Offsets must be located appropriately.	The biobank sites are in the same IBRA bioregion and CMA sub region as the development area. The biobank sites have very similar suites of vegetation types as the development site, including matching vegetation types within approximately 15% of the overall offset area. The biobank sites would support a very similar suite of native flora and fauna, including threatened biota. The Branch Lane biobank site is also a relatively large, viable patch of habitat with good connectivity to other habitat in the locality.
12. Offsets must be supplementary.	Conservation of the biobank sites is not currently achieved by land use zoning, a Covenant or by any other restriction on title. Management of the biobank sites is not funded by any other scheme.
13. Offsets and their actions must be enforceable through development consent conditions, licence conditions, conservation agreements or a contract.	This offset package is enforced by the Ministers Conditions of Approval included in the Project Approval. Conservation and management of the offset sites would be enforced through biobanking agreements.

Table 24 summarises the alignment of the offsets package with the DSEWPaC (2007) offsetting principles.

Table 24 Comparison of the offset package with the DSEWPaC (2007) Offsetting Principles

Principles for the use of environmental offsets	Attributes of offset package
1. Offsets should be targeted to the matter/s being impacted under the EPBC Act.	The Greta biobank site contains suitable habitat for Slaty Red Gum and includes Slaty Red Gum 'hybrids'. The Branch Lane biobank contains habitat for the Grey-headed Flying Fox, Regent Honeyeater and Swift Parrot to offset the removal of 20.47 hectares of habitat within the development area. Additional habitat for these species will be conserved in the Greta biobank site. The Branch Lane biobank site also contains potential habitat for other EPBC listed species.
2. A flexible approach has been taken to the design of the offsets	The final development footprint for Greta included the conservation of vegetation through BioBanking, thereby ensuring they will not be subjected to potential future impacts from development. The access roads and other infrastructure were also adjusted to ensure the biobank site included Slaty Red Gum hybrids. Further flexibility was applied to ensure the Greta biobank site maintained and improved connectivity within the locality. The Branch Lane biobank was chosen as it includes similar vegetation types and habitat to that being impacted by the project, in better condition. The biobank also includes known populations and habitat for threatened species. Both biobank sites will be conserved and managed in perpetuity achieving long term conservation outcomes.
3. Offsets to deliver real conservation outcomes	The proposed offset package places lands of high ecological value under conservation, through the use of a conservation covenant on title, in perpetuity. In addition, the offset includes investment into the BioBanking Trust Fund to commence active rehabilitation and management of this land immediately upon retirement of credits. These works will be completed in accordance with the Management Actions Plans attached to the biobanking agreement. The Branch Lane biobank will have rehabilitation and management activities commence immediately after the sale of the credits. The Greta biobank will have rehabilitation and management activities commence immediately after construction.
4. Environmental offsets should be developed as package	The offset package has been prepared using the BioBanking methodology and accordingly complements OEH and the NSW Governments approach to biodiversity conservation. It complements other government programs and biodiversity conservation initiatives, in general, by contributing to regional

Principles for the use of environmental offsets	Attributes of offset package
	biodiversity security, habitat connectivity, managing weed and pest species and conservation of EECs and threatened species habitat. The BioBanking methodology also operates using similar ecological principles as the EPBC Act and associated offsetting guidelines. This offset package also aims to conserve habitat for threatened species known to occur and that may potentially occur such as the Regent Honeyeater, Swift Parrot and the widely foraging Grey-headed Flying Fox. The biobank sites will no longer be subject to development pressure as they will be managed for conservation in perpetuity. Further, ongoing funding for management of these sites will also minimise indirect impacts from neighbouring or future development and improve each sites biodiversity values, through time.
5. Offsets should, as a minimum, be commensurate with the magnitude of the impact and deliver outcomes considered '*like for like*'	The offset package conserves in perpetuity the same vegetation types as that being impacted by the development. The offsets package also seeks to improve the biodiversity value of the biobank sites through active rehabilitation and management, thereby improving the condition and viability of these vegetation types, and the species they support, through time. In addition, the offset package conserves suitable foraging habitat for the Regent Honeyeater, Swift Parrot and Grey-headed Flying-fox. Again, the condition and viability of this habitat will improve through time.
6. Offsets should be located as close to the site of impact as possible.	The Greta Biobank site is immediately adjacent to the proposed development site. The location of the offset sites was carefully considered to maintain the ecological function of the ecological communities present by encompassing all the variation in floristics and soil profiles as those being impacted. The additional Branch Lane biobank site is in the same CMA sub region as the development area. This biobank site has similar suites of vegetation types as the development site, in better condition. It supports a similar suite of native flora and fauna, including threatened biota. The site is also relatively large, with good connectivity to surrounding vegetation in the locality. With improved management of these sites, the viability of both the ecological communities and the individual threatened species populations they support will be maintained in perpetuity.
7. Offsets to be delivered in a timely manner and be long lasting	The biobank sites will be conserved in perpetuity as soon as the BioBanking Agreements are enacted and the credits required for the development retired. This will immediately place a conservation covenant on title over the approx 136 ha included in the biobank sites. Rehabilitation and management actions will commence

Principles for the use of environmental offsets	Attributes of offset package
	immediately after relevant agreements are enacted (see Dot point 3), funded via the Greta Train Support Facility development. Details of this program will be included in the biobanking agreement and Management Actions Plans for each of the biobank sites.
8. Offsets should be enforceable, monitored and audited.	This offset package is enforced by the Ministers Conditions of Approval included in the Project Approval. Conservation and management of the offset sites would be enforced through biobanking agreements. Details of the Monitoring and Reporting obligations under the NSW BioBanking scheme are included in Section 6.5

8.3 Alignment with Conditions of Approval

8.3.1 NSW Department of Planning and Industry Conditions

This offsets package has been prepared to address Condition 12 for the Project which states: "Prior to commencement of construction, or unless otherwise agreed to by the Director-General, the Proponent shall develop and submit a Biodiversity Offset Package for the approval of the Director-General. The package shall detail how the ecological values lost as a result of the Project will be offset, and the final offset measures that will be used to meet the offset requirements". The alignment of the Offset package with the specific requirements of Condition 12 is presented in Table 25 below.

Table 25 Comparison of the offset package with DP&I Conditions of Approval

Condition	Offsets Package
The Biodiversity Offset Package shall be developed in consultation with the DECCW and DSEWPC and shall include, but not necessarily be limited to:	Formal consultation included: - Meetings with the OEH and DP&I environmental assessment units - Meetings with the DSEWPaC environmental assessment unit There were additional ongoing informal discussions throughout the preparation of the offset package with OEH representatives from the BioBanking Unit. These discussions involved seeking clarification of the use of the BioBanking methodology and the application of the OEH (2011) Interim Offset Policy.
a) The identification of the extent and types of habitat that would be lost or degraded as a result of the final design of the project	Impacts were calculated using SKM (2009a, 2009b) ecological assessment data and the BioBanking credit calculator as described in Section 4.1 and Section 5.2.
b) the objectives and biodiversity	The offsets package would achieve the

Condition	Offsets Package
outcomes to be achieved, including those to achieve a neutral or net benefit outcome for all threatened species and endangered ecological communities;	conservation of an approximately 20 hectare biobank site at Greta, containing vegetation and habitats equivalent to those within the development footprint. The offsets package would also conserve a biobank site at The Branch with very high conservation value. These biobank sites would be appropriately titled, managed and funded in perpetuity to achieve improvements in biodiversity value through conservation and active rehabilitation and management. The offset contribution included in this offset package was calculated using the BioBanking Assessment methodology and includes greater than the required number of biodiversity credits to offset impacts of the Project. The biodiversity values to be conserved are an appropriate match for the impacts of the Project within the framework of the DECCW (2011) policy, including representative habitat resources for all threatened biota that will be subject to impacts. Therefore the offsets package will achieve a net benefit outcome for all threatened species and endangered ecological communities.
c) *details of final land offsets that will be obtained and managed to ensure that the objectives and outcomes identified in b) are achieved;*	The Offset Package includes the conservation of: - A 20.33 hectare offset site at Greta under a biobank agreement as described in Sections 4.2 and 5.3 - Additional biodiversity credits generated from approximately 116 hectares of habitat within an overall 280 hectare offset site at The Branch under a biobank agreement as described in Sections 4.3 and 5.4 The specific offset package contributions comprise the purchase and retirement of the 1085 biodiversity credits that are presented in Table 18.
d) *details of other biodiversity offset measures that will be implemented to offset any residual habitat/community loss and how these measures will ensure that the objectives and outcomes identified in b) are achieved;*	The offsets package used the BioBanking methodology and DECCW (2010) policy to calculate offsets for removal of habitat. Based on this approach the credits that would be purchased and retired at the biobank sites would more than compensate for the impacts of the Project. Overall the offset package would deliver an improved biodiversity outcome for the region and no additional contributions are required.
e) *details of the proposed long term management of any offset sites and the long term funding for management locations;*	The biobank sites would be managed according to the requirements of the biobanking agreement and Management Actions Plan for the sites. The management framework for the biobank sites is presented in Section 7. The precise content of

Condition	Offsets Package
	the Management Actions Plan will be developed in consultation with the OEH BioBanking unit during the process of finalising the biobanking agreements for the two offset sites.
f) the proposed monitoring requirements for land offsets and other biodiversity offset measures proposed to ensure that objectives and outcomes identified in b) are being achieved, including: *(i) the monitoring of the condition of species and ecological communities at offset locations;* *(ii) the methodology for the monitoring program(s), including the number and location of offset monitoring sites, and the sampling frequency at these sites;* *(iii) contingency procedures or corrective actions to be followed should monitoring indicate that the identified objectives and outcomes are not being achieved; and* *(iv) provisions for the annual reporting of the monitoring results as determined in consultation with the DECCW; and*	The biobank sites would be monitored according to the requirements of the biobanking agreement and Management Actions Plan for the sites. The monitoring and reporting framework for the biobank sites is presented in Section 6. The precise content of the Management Actions Plan will be developed in consultation with the OEH BioBanking unit. This will include the monitoring of the plot/transects that were sampled as part of this assessment.
g) progress to date of the implementation of the provisions of the Package and timing and responsibilities for the implementation of outstanding provisions of the Package.	The following provisions of the offset package have been completed: - Estimation of biodiversity credits required to offset impacts of the Project development - Estimation of biodiversity credits generated by conservation and management of the biobank sites - Comparison of development and biobank credit profiles, including application of the OEH (2011) variation criteria and demonstration that the biobank sites are appropriate to offset impacts of the Project development area. Outstanding provisions of the offsets package are summarised below along with timing and responsibilities for each task: - Approval of this offset package by the DP&I in consultation with OEH and DSEWPaC - Pacific National to complete and submit an application for a biobanking agreement for the Greta biobank site

Condition	Offsets Package
	- The landowner to complete and submit an application for a biobanking agreement for the Branch Lane biobank site - Biodiversity credits for both biobank sites to be generated and listed on the register. Pacific National to purchase and retire the number and type of credits specified in Table 18. An application to transfer credits and to retire credits must be made to OEH and approved.
Any land offset must be enduring and be secured by transfer to the DECCW estate or an alternative conservation mechanism which protects and manages the land in perpetuity. *Where land offsets cannot solely achieve compensation for the loss of habitat, additional measures must be provided to collectively deliver an improved or maintained biodiversity outcome for the region.*	The biobank sites would be secured under biobank agreements that would ensure that the land is conserved and managed in perpetuity. A biobank agreement provides for protection of the property, funding of management and monitoring of its condition in perpetuity. The offset package used the BioBanking methodology and OEH (2011) Interim Offset Policy to calculate offsets for removal of habitat. Based on this approach, the credits that would be purchased and retired at the biobank sites would more than compensate for the impacts of the Project. Overall the offset package would deliver an improved biodiversity outcome for the region and no additional contributions are required.

8.3.2 Commonwealth Department of Sustainability Water Environment Populations and Communities' Conditions

The offset package for the Project has been prepared to comply with the Minister's Conditions of Approval as stated in the DSWEPaC (undated) letter. The conditions which pertain to the preparation of this offset package are summarised in Table 26 along with a summary of how each condition has been addressed in this offset package.

Table 26 Comparison of the offset package with DSEWPaC Conditions of Approval

Condition	Offsets Package
12. The person taking the action must submit a Biodiversity Offset Package for the Minister's approval to provide for the conservation and management in perpetuity of areas defined on the map at Annexure 1 as "Biobank site". The Biodiversity Offset Package must be approved by the Minister in writing prior to substantial commencement of the action and must include: *i. The registration of a conservation*	This offset package includes the Annexure 1 as "Biobank site" as the Greta biobank. The Greta biobank will be conserved under a biobanking agreement, which will provide for the protection of the site in perpetuity; prevent any future development activities; and ensure the active management of the vegetation and habitats within the site.

Condition	Offsets Package
covenant under relevant nature conservation legislation on the areas referred to in this condition (Condition 12) within 18 months of the approval of the Biodiversity Offset Package, which must: *a) provide for the protection of these areas in perpetuity;* *b) prevent any future development activities; and* *c) ensure the active management of the vegetation on-site.*	
ii. Measures to be implemented to rehabilitate native vegetation within the areas referred to in this condition (Condition 12);	Measures to rehabilitate vegetation within the Greta biobank site are described in Section 7.3.
iii. A summary of management measures consistent with advice from a suitably qualified expert, to be implemented on the areas referred to in this condition (Condition 12), and a summary of key milestones, monitoring, performance indicators, corrective actions and timeframes for the completion of all actions outlined in the Package; and	The management framework for the Greta biobank site is described in Section 6.
13. The Biodiversity Offset Package outlined in Condition 12 must also provide for the conservation and management in perpetuity of an area of habitat for listed threatened species and ecological communities equal or greater in size to than that determined by the NSW Biodiversity Banking and Offsets Scheme methodology. The Biodiversity Offset Package must be approved by the Minister in writing prior to substantial commencement of the action and must include *i. The identification of the proposed offset site or sites;*	The offset package includes the conservation of an area of land greater than that required by the BioBanking methodology as described in Section 6. The offset package includes a total 57 credit surplus above that calculated using the BioBanking methodology. The offset package is based on the conservation of the Greta biobank, described above, and an additional offset site: the Branch Lane biobank as shown in Figure 3.
ii. The proposed offset site or sites referred to in Condition 13(i) must contain	The Branch Lane biobank contains habitat of greater quality than that to be removed within the

Condition	Offsets Package
habitat of equal or greater quality to that to be removed within the development footprint for the Grey Headed Flying Fox, the Regent Honeyeater, the Swift Parrot and other listed threatened species likely to be impacted by the action;	development area because it contains similar vegetation types and habitat resources but is part of a large patch within a contiguous area of habitat of many 1000s of hectares (refer Section 4.3).
iii. For each hectare of suitable habitat for the species described in Condition 13(ii) to be impacted by the action, the proposed offset site or sites must protect a minimum of 5 hectares of suitable habitat (5:1 ratio);	The Greta and Branch Lane biobanks together contains 135 hectares of habitat for these threatened biota to offset the removal of 20.47 hectares of habitat within the development area (6.66:1 ratio).
iv. For each Slaty Red gum (Eucalyptus glaucina) *impacted by the action, the proposed offset site or sites must protect a minimum of 4 Slaty Red Gum specimens (4:1 ratio);*	There are no *Eucalyptus glaucina* nor *E. glaucina* hybrids within the development area.
v. The offset site or sites referred to in Condition 13(i) must be located within 50km of the site for the action, unless otherwise agreed to by the Minister;	The Branch Lane biobank is located approximately 60 km from the development area as shown on Figure 3. The preferred offset site for the Project was well within 50 km of the development area but was not available because the landowner did not wish to participate. The Branch Lane biobank site was the next closest potential offset site that was available for this Project. This minor inconsistency with the Condition does not significantly detract from the overall suitability of the Branch Lane biobank site as described in this Offset Package. Further, the Branch Lane biobank is contiguous with native vegetation and habitat that is well within 50 km of the development area.
vi. The offset site or sites referred to in Condition 13(i) must be protected by a conservation covenant registered on the title of the offset site or sites under relevant nature conservation legislation within 12 months of the approval of the Biodiversity Offset Package; vii. The covenant referred to in Condition 13(v) must provide for: *a) The protection of the land in perpetuity;* *b) The prevention of any future development activities; and*	The Branch Lane biobank will be conserved under a biobanking agreement, which will provide for the protection of the site in perpetuity; prevent any future development activities; and ensure the active management of the vegetation and habitats within the site.

Condition	Offsets Package
c) The active management of the land;	
viii. A summary of management measures consistent with advice from a suitably qualified expert, to be implemented on the offset site or sites referred to in Condition 13(i) and a summary of key milestones, monitoring, performance indicators, corrective actions and timeframes for the completion of all actions outlined in the Package.	The management framework for the Branch Lane biobank is described in Section 6.

8.4 Matters of National Environmental Significance

The offset package for the Project will conserve offset sites containing native vegetation and habitats equivalent to those within the development footprint using the framework of BioBanking. This approach will ensure that any impacts on MNES arising from the development are addressed by the offset package.

No threatened flora or EECs listed under the EPBC Act were identified in the subject site or are otherwise of relevance to this assessment. There is habitat for a number of threatened fauna listed under the EPBC Act within the development area, including the Swift Parrot, Regent Honeyeater, Spotted-tailed Quoll and Grey-headed Flying-fox. None of these threatened fauna species are of the type that require Species Credits within the BioBanking methodology. Offsets for removal of habitat for these species will be linked to ecosystem credits associated with the vegetation types that are to be removed and to be conserved in the biobank sites.

Ecosystem credits required for the development have been matched to an appropriate number and type of ecosystem credits at the biobank sites. The BioBanking methodology ensures that vegetation types and habitats within the biobank site are an appropriate 'like for like' match with those within the development and that the offset ratios are sufficient to improve or maintain biodiversity values. In terms of hectares of habitat, this equates to the conservation of 136 hectares of habitat to offset the removal of 20.47 hectares or an offsets ratio of 6.66: 1.

The offset package includes a detailed comparison of the threatened fauna species that are predicted to occur within the development area and those associated with habitats to be conserved at the biobank sites. All threatened biota and their habitats known or predicted to occur in the development area are also predicted to occur in the biobank sites.

8.5 Additional Assessment

This report is an offset package that presents BioBanking calculations for the Greta and Branch Lane biobank sites. Biodiversity credit calculations were obtained by entering survey results collected according to the BioBanking methodology into the credit calculator. The credit calculations generated in this report provide an appropriate estimate of the credit profile of the biobank sites in order to meet the offsetting requirements for the Project. However DECCW may require additional information to issue a biobanking agreement and to generate biodiversity credits.

The owners of the biobank sites would submit a Final BioBanking Assessment Report as part of the documentation required in order to obtain a biobanking agreement.

Information required to support the application for the biobanking agreement is presented below:

- biobanking agreement application form
- Final BioBanking Assessment Report, including additional information required to support the application
- Copy of the biobanking agreement credit report
- Copy of the .xml file for the proposal from the credit calculator
- A digital map (identifying the development site, boundary, vegetation zones, species polygons and any management zones where an increase in gain in Site Value is requested)
- Copy of draft management actions plan (prepared in accordance with the biobanking agreement template)
- Credit Pricing Spreadsheets outlining the minimum fund deposit for the trust and estimates of potential credit pricing
- Proof of ownership of the property
- Any other information required by the biobanking agreement application form or specified by the OEH BioBanking unit.

9. Disclaimer

This Biodiversity Offsets Package for the proposed Greta Train Facility ("Report"):

- has been prepared by GHD Pty Ltd ("GHD") for Pacific National Pty Ltd;
- may only be used and relied on by Pacific National Pty Ltd;
- must not be copied to, used by, or relied on by any person other than Pacific National Pty Ltd without the prior written consent of GHD;
- may only be used for the purpose of gaining necessary project approvals (and must not be used for any other purpose).

GHD and its servants, employees and officers otherwise expressly disclaim responsibility to any person other than Pacific National Pty Ltd arising from or in connection with this Report.

To the maximum extent permitted by law, all implied warranties and conditions in relation to the services provided by GHD and the Report are excluded unless they are expressly stated to apply in this Report.

The services undertaken by GHD in connection with preparing this Report:

- were limited to those specifically detailed in section 4 of this Report;

GHD expressly disclaims responsibility for any error in, or omission from, this Report arising from or in connection with any of the Assumptions listed throughout section 4 being incorrect.

Subject to section 4 of the Report, the opinions, conclusions and any recommendations in this Report are based on conditions encountered and information reviewed at the time of preparation and may be relied on for a period of 6 months, after which time, GHD expressly disclaims responsibility for any error in, or omission from, this Report arising from or in connection with those opinions, conclusions and any recommendations.

10. References

Department of Environment and Conservation and Department of Primary Industries (DEC/DPI) (2005) *Draft Guidelines for Threatened Species Assessment*, Department of Environment and Climate Change (NSW).

Department of Environment and Climate Change (DECC) (2007). *BioBanking Biodiversity Banking and Offsets Scheme, Scheme Overview*.

Department of Environment, Climate Change and Water (DECCW) (2010d). *Principles for the use of biodiversity offsets in NSW*. < http://www.environment.nsw.gov.au/biocertification/offsets.htm >. Department of Environment, Climate Change and Water (DECC) (NSW).

Department of Environment, Climate Change and Water (DECCW) (2010a) *Vegetation Types Database.* http://www.environment.nsw.gov.au/BioBanking/VegTypeDatabase.htm (viewed on the 05/07/2010).

Department of Environment, Climate Change and Water (DECCW) (2010b) *Threatened Species Profile Database.* http://www.environment.nsw.gov.au/biobanking/biobankingtspd.htm (viewed on the 05/07/2010).

Department of Environment, Climate Change and Water (DECCW) (2010c) *List of BioBanking assessors* http://www.environment.nsw.gov.au/biobanking/Assessorlist.htm

Department of Environment and Climate Change (DECC) (2009a) *BioBanking Assessment Methodology and Credit Calculator Operation Manual*. State of NSW and Department of Environment and Climate Change, Sydney.

Department of Environment, Climate Change and Water NSW. (2009b). *Draft National Recovery Plan for the Grey-headed Flying-fox* Pteropus poliocephalus. Prepared by Dr Peggy Eby. Department of Environment, Climate Change and Water NSW, Sydney.

DECCW (2009c), *Lower Hunter Regional Conservation Plan*, Department of Environment, Climate Change and Water NSW, Sydney.

Department of Environment and Conservation (DEC) (2005) *Guidelines for Threatened species assessment*.

Department of Environment and Water (DEW) (2007). *Use of Environmental Offsets Under the Environment Protection and Biodiversity Conservation Act 1999 – Discussion Paper.*

Department of Environment and Climate Change (DECC) (2008b) *Descriptions for NSW (Mitchell) Landscapes Version 2 (2002) Based on descriptions compiled by Dr. Peter Mitchell*. DECC, NSW.

Department of Planning (2011a) *Conditions of Consent.*

Department of Planning (2011b) *Director General's Environmental Assessment Section 75I of the* Environmental Planning and Assessment Act 1979.

Department of sustainability, Environment, Water, Populations and Communities (DSEWPaC) (2012), *Flying-foxes and national environmental law* <http://www.environment.gov.au/biodiversity/threatened/species/flying-foxes.html>

GHD (2010a) *Greta Provisioning Facility Biodiversity Offsets Study, Stage 1.*

GHD (2010b) *Greta Provisioning Facility Biodiversity Offsets Study, Stage 2.*

GHD (2012) *Greta Provisioning Facility EPBC Act Biodiversity Offset Assessment*.

Hunter Councils (2002) *Lower Hunter Central Coast Regional Environmental Mapping Survey (LHCCREMS).* Hunter Councils, NSW.

Monteath and Powers Pty Ltd (2010a) *Environmental Assessment for Pacific National Train Support Facility at Greta in the Cessnock City Council Local Government Area.*

Monteath and Powers Pty Ltd (2010b) *Submissions and Preferred project report for or Pacific National Train Support Facility at Greta in the Cessnock City Council Local Government Area.*

Office of Environment and Heritage (OEH) (2011) *NSW OEH interim policy on assessing and offsetting biodiversity impacts of Part 3A, State significant development (SSD) and State significant infrastructure (SSI) projects*.

Sinclair Knight Mertz (SKM) (2010a) *Train Support Facility, Greta, NSW Ecological Impact Assessment*.

Sinclair Knight Mertz (SKM) (2010b) Addendum Report Train Support Facility Greta, NSW Ecological Impact Assessment.

Abigroup (2011) *Greta Train Support Facility Flora and Fauna Management Plan.*

Appendix A

Greta Biobank Site BioBanking Credit Reports

BioBanking Credit Calculator

BioBanking credit report

This report identifies the number and type of credits required at a BIOBANK SITE.

Date of report: 31/10/2012 Time: 12:51:32PM Tool version: 2.0

Biobank details

Proposal ID:	0073/2012/0288B
Proposal name:	Greta biobank
Proposal address:	Mansfield Street Greta NSW 2334
Proponent name:	Pacific National
Proponent address:	PO Box 2298 Dangar NSW 2309
Proponent phone:	02 4927 4919
Assessor name:	Ben Harrington
Assessor address:	Level 15 133 Castlereagh St SYDNEY NSW 2000
Assessor phone:	9239 7189
Assessor accreditation:	0073

Additional information required for approval:

- ☐ Use of local benchmark
- ☐ Expert report
- ☐ Change threatened species response to gain (Tg value)

Ecosystem credits summary

Vegetation type	Area (ha)	Credits required	Red flag
Grey Ironbark - Spotted Gum - Grey Box open forest on hills of the Hunter Valley, Sydney Basin	7.45	67	No
Forest Red Gum - Grey Gum dry open forest on hills of the lower Hunter Valley, Sydney Basin	9.85	82	No
Forest Red Gum - Grey Gum dry open forest on hills of the lower Hunter Valley, Sydney Basin	3.00	31	No
Total	20.30	180	

Credit profiles

1. Forest Red Gum - Grey Gum dry open forest on hills of the lower Hunter Valley, Sydney Basin, (HU544)

Number of ecosystem credits required	31
CMA sub-region	Hunter
Minimum percent native vegetation cover class	31-70%
Minimum adjacent remnant area class	

2. Forest Red Gum - Grey Gum dry open forest on hills of the lower Hunter Valley, Sydney Basin, (HU544)

Number of ecosystem credits required	82
CMA sub-region	Hunter
Minimum percent native vegetation cover class	31-70%
Minimum adjacent remnant area class	>100 ha

3. Grey Ironbark - Spotted Gum - Grey Box open forest on hills of the Hunter Valley, Sydney Basin, (HU556)

Number of ecosystem credits required	67
CMA sub-region	Hunter
Minimum percent native vegetation cover class	31-70%
Minimum adjacent remnant area class	>100 ha

Species credits

Additional management actions

Additional management actions are required for:

Vegetation type or threatened species	Management action details
Forest Red Gum - Grey Gum dry open forest on hills of the lower Hunter Valley, Sydney Basin	Cat and/or Fox control
Forest Red Gum - Grey Gum dry open forest on hills of the lower Hunter Valley, Sydney Basin	Exclude miscellaneous feral species
Grey Ironbark - Spotted Gum - Grey Box open forest on hills of the Hunter Valley, Sydney Basin	Cat and/or Fox control
Grey Ironbark - Spotted Gum - Grey Box open forest on hills of the Hunter Valley, Sydney Basin	Exclude miscellaneous feral species
Grey Ironbark - Spotted Gum - Grey Box open forest on hills of the Hunter Valley, Sydney Basin	Feral and/or native herbivore control/ exclusion (eg rabbit, goats, deer etc)
Grey Ironbark - Spotted Gum - Grey Box open forest on hills of the Hunter Valley, Sydney Basin	Maintain or reintroduce flow regimes (aquatic flora)

Appendix B

Branch Lane Biobank Site BioBanking Credit Reports

BioBanking Credit Calculator

BioBanking credit report

This report identifies the number and type of credits required at a BIOBANK SITE.

Date of report: 7/08/2012 Time: 2:12:51PM Tool version: 2.0

Biobank details

Proposal ID:	0073/2012/0080B
Proposal name:	Branch Lane Biobank
Proposal address:	Branch Lane Karuah NSW 2324
Proponent name:	
Proponent address:	TBC TBC NSW
Proponent phone:	(02) 4352 4352
Assessor name:	Ben Harrington
Assessor address:	Level 15 133 Castlereagh St SYDNEY NSW 2000
Assessor phone:	9239 7189
Assessor accreditation:	0073

Additional information required for approval:

- ☐ Use of local benchmark
- ☐ Expert report
- ☐ Change threatened species response to gain (Tg value)

Ecosystem credits summary

Vegetation type	Area (ha)	Credits required	Red flag
Spotted Gum - Grey Ironbark forest dry open forest of the lower foothills of the Barrington Tops, North Coast	238.60	1,870	No
Tallowwood - Brush Box - Sydney Blue Gum moist shrubby forest on coastal foothills of the southern North Coast	38.38	316	No
Spotted Gum - Grey Ironbark forest dry open forest of the lower foothills of the Barrington Tops, North Coast	3.23	32	No
Total	280.21	2,218	

Credit profiles

1. Tallowwood - Brush Box - Sydney Blue Gum moist shrubby forest on coastal foothills of the southern North Coast, (HU642)

Number of ecosystem credits required	316
CMA sub-region	Karuah Manning
Minimum percent native vegetation cover class	31-70%
Minimum adjacent remnant area class	>100 ha

2. Spotted Gum - Grey Ironbark forest dry open forest of the lower foothills of the Barrington Tops, North Coast, (HU630)

Number of ecosystem credits required	32
CMA sub-region	Karuah Manning
Minimum percent native vegetation cover class	31-70%
Minimum adjacent remnant area class	

3. Spotted Gum - Grey Ironbark forest dry open forest of the lower foothills of the Barrington Tops, North Coast, (HU630)

Number of ecosystem credits required	1,870
CMA sub-region	Karuah Manning
Minimum percent native vegetation cover class	31-70%
Minimum adjacent remnant area class	>100 ha

Species credits

Additional management actions

Additional management actions are required for:

Vegetation type or threatened species	Management action details
Spotted Gum - Grey Ironbark forest dry open forest of the lower foothills of the Barrington Tops, North Coast	Cat and/or Fox control
Spotted Gum - Grey Ironbark forest dry open forest of the lower foothills of the Barrington Tops, North Coast	Exclude miscellaneous feral species
Spotted Gum - Grey Ironbark forest dry open forest of the lower foothills of the Barrington Tops, North Coast	Feral and/or native herbivore control/ exclusion (eg rabbit, goats, deer etc)
Spotted Gum - Grey Ironbark forest dry open forest of the lower foothills of the Barrington Tops, North Coast	Maintain or reintroduce flow regimes (aquatic flora)
Tallowwood - Brush Box - Sydney Blue Gum moist shrubby forest on coastal foothills of the southern North Coast	Cat and/or Fox control
Tallowwood - Brush Box - Sydney Blue Gum moist shrubby forest on coastal foothills of the southern North Coast	Exclude miscellaneous feral species
Tallowwood - Brush Box - Sydney Blue Gum moist shrubby forest on coastal foothills of the southern North Coast	Feral and/or native herbivore control/ exclusion (eg rabbit, goats, deer etc)
Tallowwood - Brush Box - Sydney Blue Gum moist shrubby forest on coastal foothills of the southern North Coast	Maintain or reintroduce flow regimes (aquatic flora)

Appendix C

Species Lists

Table 27 Greta Subject Site Flora Species

Family	Scientific Name	Common Name	NSW Status	EPBC Act Status	Vegetation Type / Condition		
					HU544_Low	HU544_Mod/Good	HU556_Mod/Good
Acanthaceae	*Brunoniella pumilio*	Dwarf Blue Trumpet	U			x	
Adiantaceae	*Cheilanthes sieberi*	Rock Fern	U				x
	Cheilanthes sp.	Mulga Fern, Rock Fern	U		x	x	x
Anthericaceae	*Laxmannia gracilis*	Slender Wire Lily	U			x	x
Asteraceae	*Asteraceae sp.**		U				x
	Cassinia arcuata	Sifton Bush	U		x		
	Chrysocephalum apiculatum	Common Everlasting	U			x	x
	Epaltes australis	Spreading Nut-heads	U				x
	*Hypochaeris glabra**	Smooth Catsear	U		x		
	*Senecio madagascariensis**	Fireweed	U		x	x	
	Vittadinia cuneata	A Fuzzweed	U				x
	Vittadinia sp.	Fuzzweed	U			x	x
Cactaceae	*Opuntia sp.**		U				x
Casuarinaceae	*Allocasuarina luehmannii*	Bulloak	U			x	x
Celastraceae	*Maytenus silvestris*	Narrow-leaved Orangebark	U			x	x
Chenopodiaceae	*Einadia hastata*	Berry Saltbush	U				x

Family	Scientific Name	Common Name	NSW Status	EPBC Act Status	Vegetation Type / Condition		
					HU544_Low	HU544_ Mod/Good	HU556_ Mod/Good
	Einadia nutans	Climbing Saltbush	U			x	x
Commelinaceae	*Commelina ensifolia*	Scurvy Grass	U				x
Cyperaceae	*Carex breviculmis*		U			x	x
	Fimbristylis dichotoma	Common Fringe-sedge	U			x	x
	Lepidosperma laterale	Variable Sword-sedge	U			x	
	Lepidosperma sp.		U				x
Dilleniaceae	*Hibbertia monogyna*		U			x	x
	Hibbertia obtusifolia	Hoary guinea flower	U			x	x
	Hibbertia sp.		U			x	x
Ericaceae	*Leucopogon juniperinus*	Prickly Beard-heath	U				x
	Lissanthe strigosa	Peach Heath	U			x	x
	Melichrus urceolatus	Urn Heath	U			x	x
Euphorbiaceae	*Breynia oblongifolia*	Coffee Bush	U			x	x
Euphorbiaceae	*Phyllanthus hirtellus*	Thyme Spurge	U			x	x
Fabaceae (Faboideae)	*Chorizema parviflorum*	Eastern Flame Pea	U			x	x
	Daviesia ulicifolia	Gorse Bitter Pea	U			x	x
	Glycine clandestina	Twining glycine	U			x	x

Family	Scientific Name	Common Name	NSW Status	EPBC Act Status	Vegetation Type / Condition		
					HU544_Low	HU544_ Mod/Good	HU556_ Mod/Good
	Glycine microphylla	Small-leaf Glycine	U			x	x
	Glycine tabacina	Variable Glycine	U			x	
	Mirbelia platylobioides		U				x
Fabaceae (Mimosoideae)	*Acacia falcata*		U			x	
	Acacia longifolia		U		x		
	Acacia parvipinnula	Silver-stemmed Wattle	U			x	x
Haemodoraceae	*Haemodorum sp.*		U			x	
Juncaceae	*Juncus sp.*	A Rush	U		x		
	Juncus usitatus		U		x		
Lobeliaceae	*Pratia purpurascens*	Whiteroot	U			x	x
Loganiaceae	*Logania pusilla*		U			x	
Lomandraceae	*Lomandra filiformis*	Wattle Matt-rush	U			x	x
	Lomandra glauca	Pale Mat-rush	U			x	x
	Lomandra longifolia	Spiny-headed Mat-rush	U				x
	Lomandra micrantha subsp. tuberculata	Small-flowered Mat-rush	U			x	
	Lomandra multiflora	Many-flowered Mat-rush	U			x	x

Family	Scientific Name	Common Name	NSW Status	EPBC Act Status	Vegetation Type / Condition		
					HU544_Low	HU544_ Mod/Good	HU556_ Mod/Good
Loranthaceae	*Dendrophthoe vitellina*		U				x
Luzuriagaceae	*Eustrephus latifolius*	Wombat Berry	U			x	
Myrtaceae	*Angophora floribunda*	Rough-barked Apple	U			x	x
	Baeckea virgata		U			x	
	Corymbia maculata	Spotted Gum	U			x	x
	Eucalyptus crebra	Narrow-leaved Ironbark	U			x	x
	Eucalyptus punctata	Grey Gum	U			x	x
	Eucalyptus tereticornis	Forest Red Gum	U		x	x	x
	Leptospermum sp.	Tea-tree	U			x	
	Melaleuca decora		U			x	
	Melaleuca nodosa		U			x	
Oleaceae	*Olea europaea**	African Olive	U			x	x
Oxalidaceae	*Oxalis exilis*		U			x	x
Phormiaceae	*Dianella longifolia*	Blueberry Lily	U			x	x
	Stypandra glauca	Nodding Blue Lily	U				x
Plantaginaceae	*Plantago lanceolata**	Lamb's Tongues	U		x	x	
Poaceae	*Aristida ramosa*	Purple Wiregrass	U		x	x	x

Family	Scientific Name	Common Name	NSW Status	EPBC Act Status	Vegetation Type / Condition		
					HU544_Low	HU544_ Mod/Good	HU556_ Mod/Good
	Aristida sp.	A Wiregrass	U			x	x
	Aristida vagans	Threeawn Speargrass	U			x	x
	Austrodanthonia sp.	A Wallaby Grass	U			x	
	*Axonopus fissifolius**	Narrow-leafed Carpet Grass	U		x		
	*Bothriochloa decipiens**	Pitted Bluegrass	U		x		
	Cymbopogon refractus	Barbed Wire Grass	U		x	x	x
	Cynodon dactylon	Common Couch	U		x	x	x
	Dichelachne micrantha	Shorthair Plumegrass	U			x	
	Echinopogon caespitosus	Bushy Hedgehog-grass	U		x	x	x
	Echinopogon ovatus	Forest Hedgehog Grass	U			x	
	Entolasia marginata	Bordered Panic	U				x
	Entolasia stricta	Wiry Panic	U			x	x
	Eragrostis brownii	Brown's Lovegrass	U			x	x
	Eragrostis leptostachya	Paddock Lovegrass	U		x	x	x
	Imperata cylindrica	Blady Grass	U			x	
	Microlaena stipoides	Weeping Grass	U		x	x	x
	Paspalidium distans		U			x	x

Family	Scientific Name	Common Name	NSW Status	EPBC Act Status	Vegetation Type / Condition		
					HU544_Low	HU544_ Mod/Good	HU556_ Mod/Good
	*Paspalum dilatatum**	Paspalum	U		x		
	*Setaria pumila**	Pale Pigeon Grass	U			x	x
	Sporobolus elongatus	Slender Rat's Tail Grass	U		x	x	
	Tetrarrhena juncea	Wiry Ricegrass	U				x
Proteaceae	*Grevillea montana*		U			x	x
	Grevillea robusta	Silky Oak	U			x	x
	Hakea sericea	Needlebush	U		x	x	x
	Persoonia linearis	Narrow-leaved Geebung	P13			x	x
Ranunculaceae	*Clematis glycinoides*	Headache Vine	U			x	
Rubiaceae	*Pomax umbellata*	Pomax	U			x	x
	*Richardia brasiliensis**	Mexican Clover	U			x	
	*Richardia stellaris**		U		x		
Solanaceae	*Cestrum parqui**	Green Cestrum	U			x	
Thymelaeaceae	*Pimelea linifolia*	Slender Rice Flower	U			x	x
Verbenaceae	*Lantana camara**		U			x	x
Xanthorrhoeaceae	*Xanthorrhoea sp.*		P13				x

Table 28 Greta Subject Site Fauna Species

Family	Scientific Name	Common Name	NSW Status	EPBC Act Status	Observation Type
Birds					
Acanthizidae	*Acanthiza reguloides*	Buff-rumped Thornbill	P		Seen
Accipitridae	*Aquila audax*	Wedge-tailed Eagle	P		Seen
Alcedinidae	*Todiramphus sanctus*	Sacred Kingfisher	P		Seen
Anatidae	*Anas superciliosa*	Pacific Black Duck	P		Seen
Artamidae	*Cracticus nigrogularis*	Pied Butcherbird	P		Heard
	Cracticus tibicen	Australian Magpie	P		Seen
	Cracticus torquatus	Grey Butcherbird	P		Seen
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike	P		Seen
Columbidae	*Geopelia humeralis*	Bar-shouldered Dove	P		Heard
Coraciidae	*Eurystomus orientalis*	Dollarbird	P		Seen
Corcoracidae	*Corcorax melanorhamphos*	White-winged Chough	P		Seen
Corvidae	*Corvus coronoides*	Australian Raven	P		Seen
Estrildidae	*Taeniopygia bichenovii*	Double-barred Finch	P		Seen
Meliphagidae	*Lichenostomus chrysops*	Yellow-faced Honeyeater	P		Seen
	Manorina melanocephala	Noisy Miner	P		Seen

Family	Scientific Name	Common Name	NSW Status	EPBC Act Status	Observation Type
	Philemon corniculatus	Noisy Friarbird	P		Seen
Monarchidae	*Grallina cyanoleuca*	Magpie-lark	P		Seen
Oriolidae	*Oriolus sagittatus*	Olive-backed Oriole	P		Seen
Pardalotidae	*Pardalotus striatus*	Striated Pardalote	P		Seen
Pomatostomidae	*Pomatostomus temporalis temporalis*	Grey-crowned Babbler	V		Seen
Psittacidae	*Platycercus eximius*	Eastern Rosella	P		Seen
Psophodidae	*Cinclosoma punctatum*	Spotted Quail-thrush	P		Seen
Rhipiduridae	*Rhipidura albiscapa*	Grey Fantail	P		Seen
	Rhipidura leucophrys	Willie Wagtail	P		Seen
Mammals					
Leporidae	*Oryctolagus cuniculus**	Rabbit	U		Scat
Macropodidae	*Macropus giganteus*	Eastern Grey Kangaroo	P		Seen
	Macropus rufogriseus	Red-necked Wallaby	P		Seen
Reptiles					
Chelidae	*Chelodina longicollis*	Eastern Snake-necked Turtle	P		Seen
Varanidae	*Varanus sp.*	Goanna	P		Tracks

Table 29 Branch Lane Biobank Flora Species

			Vegetation Type/ Condition		
Family	Scientific Name	Common Name	HU630_ Low	HU630_ Mod/Good	HU642_ Mod/Good
Fabaceae (Mimosoideae)	*Acacia binervia*	Coast Myall			x
Fabaceae (Mimosoideae)	*Acacia implexa*	Hickory Wattle	x	x	x
Fabaceae (Mimosoideae)	*Acacia irrorata*	Green Wattle		x	
Fabaceae (Mimosoideae)	*Acacia spp.*	Wattle		x	
Fabaceae (Mimosoideae)	*Acacia myrtifolia*	Red-stemmed Wattle	x		
Fabaceae (Mimosoideae)	*Acacia ulicifolia*	Prickly Moses		x	
Adiantaceae	*Adiantum aethiopicum*	Common Maidenhair		x	x
Adiantaceae	*Adiantum formosum*	Giant Maidenhair		x	x
Casuarinaceae	*Allocasuarina torulosa*	Forest Oak		x	x
Zingiberaceae	*Alpinia caerulea*	Native Ginger			x
Amaranthaceae	*Alternanthera denticulata*	Lesser Joyweed		x	
Commelinaceae	*Aneilema acuminatum*				x
Myrtaceae	*Angophora costata*	Sydney Red Gum		x	x
Poaceae	*Anisopogon avenaceus*	Oat Speargrass	x		
Aphanopetalaceae	*Aphanopetalum resinosum*	Gum Vine			x

			Vegetation Type/ Condition		
Family	Scientific Name	Common Name	HU630_ Low	HU630_ Mod/Good	HU642_ Mod/Good
Poaceae	*Aristida vagans*	Threeawn Speargrass		x	
Poaceae	*Austrodanthonia spp.*	A Wallaby Grass		x	
Poaceae	*Axonopus fissifolius**	Narrow-leafed Carpet Grass	x		
Myrtaceae	*Backhousia myrtifolia*	Grey Myrtle			x
Proteaceae	*Banksia marginata*	Silver Banksia			
Asteraceae	*Bidens pilosa**	Cobbler's Pegs	x	x	
Pittosporaceae	*Billardiera scandens*	Hairy Apple Berry		x	
Blechnaceae	*Blechnum cartilagineum*	Gristle Fern			x
Rutaceae	*Boronia polygalifolia*	Dwarf Boronia		x	
Phyllanthaceae	*Breynia oblongifolia*	Coffee Bush		x	x
Acanthaceae	*Brunoniella australis*	Blue Trumpet		x	
Pittosporaceae	*Bursaria spinosa*	Native Blackthorn			
Anthericaceae	*Caesia parviflora var. Parviflora*			x	
Anthericaceae	*Caesia spp.*			x	
Myrtaceae	*Callistemon salignus*	Willow Bottlebrush			
Cyperaceae	*Carex appressa*	Tall Sedge	x	x	x
Cyperaceae	*Carex spp.*			x	

			Vegetation Type/ Condition		
Family	Scientific Name	Common Name	HU630_ Low	HU630_ Mod/Good	HU642_ Mod/Good
Vitaceae	*Cayratia clematidea*	Native Grape		x	x
Gentianaceae	*Centaurium tenuiflorum**	Branched Centaury, Slender centaury		x	
Apiaceae	*Centella asiatica*	Indian Pennywort		x	
Adiantaceae	*Cheilanthes sieberi*	Rock Fern	x	x	
Asteraceae	*Chrysocephalum apiculatum*	Common Everlasting		x	
Lauraceae	*Cryptocarya microneura*	Murrogun			x
Asteraceae	*Cirsium vulgare**	Spear Thistle	x	x	
Vitaceae	*Cissus antarctica*	Water Vine		x	x
Vitaceae	*Cissus hypoglauca*	Giant Water Vine		x	x
Ranunculaceae	*Clematis aristata*	Old Man's Beard		x	
Lamiaceae	*Clerodendrum tomentosum*	Hairy Clerodendrum		x	x
Commelinaceae	*Commelina cyanea*	Native Wandering Jew			
Asteraceae	*Conyza bonariensis**	Flaxleaf Fleabane	x		
Myrtaceae	*Corymbia maculata*	Spotted Gum		x	x
Poaceae	*Cynodon dactylon*	Common Couch	x		
Orchidaceae	*Cymbidium suave*	Snake Orchid		x	x

Family	Scientific Name	Common Name	Vegetation Type/ Condition		
			HU630_ Low	HU630_ Mod/Good	HU642_ Mod/Good
Poaceae	*Cymbopogon refractus*	Barbed Wire Grass		x	
Cyperaceae	*Cyperus brevifolius**		x		
Cyperaceae	*Cyperus polystachyos*				
Apiaceae	*Daucus glochidiatus*	Native Carrot			
Fabaceae (Faboideae)	*Daviesia acicularis*				
Fabaceae (Faboideae)	*Daviesia genistifolia*	Broom Bitter Pea		x	
Orchidaceae	*Dendrobium aemulum*	Ironbark Orchid		x	x
Fabaceae (Faboideae)	*Desmodium brachypodum*	Large Tick-trefoil		x	
Fabaceae (Faboideae)	*Desmodium rhytidophyllum*		x	x	x
Fabaceae (Faboideae)	*Desmodium varians*	Slender Tick-trefoil	x	x	x
Phormiaceae	*Dianella caerulea*	Blue Flax-lily	x		
Phormiaceae	*Dianella caerulea var. producta*			x	x
Phormiaceae	*Dianella longifolia var. longifolia*	A Blue Flax Lily		x	
Phormiaceae	*Dianella revoluta*	Blueberry Lily		x	
Poaceae	*Dichelachne micrantha*	Shorthair Plumegrass		x	
Convolvulaceae	*Dichondra repens*	Kidney Weed	x	x	
Poaceae	*Digitaria parviflora*	Small-flowered Finger Grass		x	

Family	Scientific Name	Common Name	Vegetation Type/ Condition		
			HU630_ Low	HU630_ Mod/Good	HU642_ Mod/Good
Poaceae	*Digitaria spp.**	A Finger Grass		x	
Fabaceae (Faboideae)	*Dillwynia sieberi*			x	
Ebenaceae	*Diospyros australis*	Black Plum		x	x
Blechnaceae	*Doodia aspera*	Prickly Rasp Fern		x	x
Poaceae	*Echinopogon caespitosus*	Bushy Hedgehog-grass		x	
Poaceae	*Echinopogon ovatus*	Forest Hedgehog Grass	x		
Poaceae	*Entolasia marginata*	Bordered Panic		x	x
Poaceae	*Entolasia stricta*	Wiry Panic		x	x
Poaceae	*Eragrostis brownii*	Brown's Lovegrass			
Poaceae	*Eragrostis cilianensis**	Stinkgrass			
Myoporaceae	*Eremophila debilis*	Amulla		x	
Myrtaceae	*Eucalyptus acmenoides*	White Mahogany		x	x
Myrtaceae	*Eucalyptus globoidea*	White Stringybark		x	
Myrtaceae	*Eucalyptus microcorys*	Tallowwood		x	
Myrtaceae	*Eucalyptus propinqua*	Small-fruited Grey Gum		x	x
Myrtaceae	*Eucalyptus punctata*	Grey Gum		x	x
#N/A	*Eucalyptus resinifera*	Red Mahogany			

Family	Scientific Name	Common Name	Vegetation Type/ Condition		
			HU630_ Low	HU630_ Mod/Good	HU642_ Mod/Good
Myrtaceae	*Eucalyptus saligna*	Sydney Blue Gum			
Myrtaceae	*Eucalyptus siderophloia*	Grey Ironbark		x	x
Myrtaceae	*Eucalyptus spp.*		x	x	
Asteraceae	*Euchiton gymnocephalus*	Creeping Cudweed			
Asteraceae	*Euchiton sphaericus*	Star Cudweed	x		
Luzuriagaceae	*Eustrephus latifolius*	Wombat Berry	x	x	x
		"Fern"			x
Moraceae	*Ficus coronata*	Creek Sandpaper Fig			x
Moraceae	*Ficus rubiginosa*	Port Jackson Fig			x
Cyperaceae	*Gahnia spp.*		x	x	
Rubiaceae	*Galium gaudichaudii*	Rough Bedstraw		x	
Rubiaceae	*Galium propinquum*	Maori Bedstraw		x	
Asteraceae	*Gamochaeta spp.**				
Luzuriagaceae	*Geitonoplesium cymosum*	Scrambling Lily		x	x
Geraniaceae	*Geranium solanderi*	Native Geranium	x	x	
Phyllanthaceae	*Glochidion ferdinandi*	Cheese Tree		x	x
Fabaceae (Faboideae)	*Glycine clandestina*	Twining glycine		x	

			Vegetation Type/ Condition		
Family	Scientific Name	Common Name	HU630_ Low	HU630_ Mod/Good	HU642_ Mod/Good
Fabaceae (Faboideae)	*Glycine microphylla*	Small-leaf Glycine	x	x	
Fabaceae (Faboideae)	*Glycine tabacina*	Variable Glycine	x	x	
Amaranthaceae	*Gomphrena celosioides**	Gomphrena Weed	x		
Haloragaceae	*Gonocarpus tetragynus*	Poverty Raspwort	x	x	
Goodeniaceae	*Goodenia heterophylla*			x	x
		"Grass 1"		x	
		"Grass 2"		x	
Araceae	*Gymnostachys anceps*	Settler's Twine		x	x
Fabaceae (Faboideae)	*Hardenbergia violacea*	False Sarsaparilla	x	x	
Menispermaceae	*Sarcopetalum harveyanum*	Pearl Vine			x
Dilleniaceae	*Hibbertia aspera*	Rough Guinea Flower		x	
Dilleniaceae	*Hibbertia dentata*	Twining Guinea Flower		x	x
Dilleniaceae	*Hibbertia monogyna*			x	
Dilleniaceae	*Hibbertia spp.*			x	
Fabaceae (Faboideae)	*Hovea linearis*		x		
Clusiaceae	*Hypericum gramineum*	Small St John's Wort	x	x	
Asteraceae	*Hypochaeris radicata**	Catsear		x	

			Vegetation Type/ Condition		
Family	Scientific Name	Common Name	HU630_ Low	HU630_ Mod/Good	HU642_ Mod/Good
Dennstaedtiaceae	*Hypolepis muelleri*	Harsh Ground Fern			x
Hypoxidaceae	*Hypoxis hygrometrica*	Golden Weather-grass		x	
Poaceae	*Imperata cylindrica*	Blady Grass	x	x	
Fabaceae (Faboideae)	*Indigofera australis*	Australian Indigo		x	
Fabaceae (Faboideae)	*Jacksonia scoparia*	Dogwood		x	
Juncaceae	*Juncus spp.*	A Rush			
Juncaceae	*Juncus usitatus*		x		
Myrtaceae	*Kunzea ambigua*	Tick Bush		x	
Asteraceae	*Lagenophora stipitata*	Common Lagenophora		x	
Verbenaceae	*Lantana camara**	Lantana		x	x
Sterculiaceae	*Lasiopetalum macrophyllum*	Shrubby Velvet-bush		x	
Asteraceae	*Lagenophora stipitata*	Common Lagenophora		x	
Cyperaceae	*Lepidosperma laterale*	Variable Sword-sedge		x	x
Cyperaceae	*Lepidosperma spp.*			x	
Myrtaceae	*Leptospermum polygalifolium*	Tantoon	x	x	
Lindsaeaceae	*Lindsaea microphylla*	Lacy Wedge Fern		x	
Arecaceae	*Livistona australis*	Cabbage Palm		x	x

			Vegetation Type/ Condition		
Family	Scientific Name	Common Name	HU630_ Low	HU630_ Mod/Good	HU642_ Mod/Good
Lomandraceae	*Lomandra filiformis subsp. coriacea*	Wattle Matt-rush		x	x
Lomandraceae	*Lomandra filiformis subsp. Filiformis*			x	
Lomandraceae	*Lomandra gracilis*				
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush	x	x	x
Lomandraceae	*Lomandra multiflora*	Many-flowered Mat-rush		x	
Lomandraceae	*Lomandra obliqua*			x	
Myrtaceae	*Lophostemon confertus*	Brush Box		x	x
Zamiaceae	*Macrozamia flexuosa*			x	
Zamiaceae	*Macrozamia spiralis*			x	
Celastraceae	*Maytenus silvestris*	Narrow-leaved Orangebark		x	x
Myrtaceae	*Melaleuca linariifolia*	Flax-leaved Paperbark			
Myrtaceae	*Melaleuca nodosa*				
Myrtaceae	*Melaleuca styphelioides*	Prickly-leaved Tea Tree		x	x
Poaceae	*Microlaena stipoides*	Weeping Grass	x	x	x
Ericaceae	*Monotoca scoparia*			x	
Rubiaceae	*Morinda jasminoides*	Sweet Morinda		x	x
		"Morpho 1"			

Family	Scientific Name	Common Name	Vegetation Type/ Condition		
			HU630_ Low	HU630_ Mod/Good	HU642_ Mod/Good
		"Morpho 2"			
Myrsinaceae	*Myrsine variabilis*			x	x
Oleaceae	*Notelaea longifolia*	Large Mock-olive		x	
Oleaceae	*Notelaea venosa*	Veined Mock-olive			x
Rubiaceae	*Opercularia diphylla*	Stinkweed		x	
Rubiaceae	*Opercularia hispida*	Hairy Stinkweed			
Rubiaceae	*Opercularia spp.*			x	
Rubiaceae	*Opercularia varia*	Variable Stinkweed		x	
Poaceae	*Oplismenus aemulus*		x	x	x
Poaceae	*Oplismenus imbecillis*			x	
Apocynaceae	*Marsdenia rostrata*	Milk Vine			x
		Orchid spp.		x	
Oxalidaceae	*Oxalis corniculata**	Creeping Oxalis		x	
Oxalidaceae	*Oxalis perennans*			x	
Bignoniaceae	*Pandorea pandorana*	Wonga Wonga Vine		x	x
Poaceae	*Panicum simile*	Two-colour Panic			
Apocynaceae	*Parsonsia straminea*	Common Silkpod		x	x

Family	Scientific Name	Common Name	Vegetation Type/ Condition		
			HU630_ Low	HU630_ Mod/Good	HU642_ Mod/Good
Poaceae	*Paspalum dilatatum**	Paspalum	x		
Passifloraceae	*Passiflora herbertiana*			x	x
Poaceae	*Pennisetum clandestinum**	Kikuyu Grass	x		
Proteaceae	*Persoonia linearis*	Narrow-leaved Geebung		x	
Phyllanthaceae	*Phyllanthus hirtellus*	Thyme Spurge		x	
Thymelaeaceae	*Pimelea linifolia*	Slender Rice Flower		x	
Pittosporaceae	*Pittosporum multiflorum*	Orange Thorn			x
Pittosporaceae	*Pittosporum revolutum*	Rough Fruit Pittosporum		x	x
Pittosporaceae	*Pittosporum undulatum*	Sweet Pittosporum		x	x
Plantaginaceae	*Plantago debilis*	Shade Plantain		x	
Plantaginaceae	*Plantago lanceolata**	Lamb's Tongues	x		
Polypodiaceae	*Platycerium bifurcatum*	Elkhorn Fern			x
Orchidaceae	*Plectorrhiza tridentata*	Tangle Orchid			
Lamiaceae	*Plectranthus parviflorus*			x	x
Poaceae	*Poa labillardierei*	Tussock		x	
Poaceae	*Poa sieberiana*	Tussock		x	x
Fabaceae (Faboideae)	*Podolobium ilicifolium*	Prickly Shaggy Pea		x	

Family	Scientific Name	Common Name	Vegetation Type/ Condition		
			HU630_ Low	HU630_ Mod/Good	HU642_ Mod/Good
Araliaceae	*Polyscias sambucifolia*	Elderberry Panax		x	x
Lobeliaceae	*Pratia purpurascens*	Whiteroot	x	x	x
Lamiaceae	*Prostanthera incisa*	Cut-leaved Mint-bush			
Acanthaceae	*Pseuderanthemum variabile*	Pastel Flower		x	x
Dennstaedtiaceae	*Pteridium esculentum*	Bracken		x	
Orchidaceae	*Pterostylis spp.*	Greenhood		x	x
Fabaceae (Faboideae)	*Pultenaea daphnoides*	Large-leaf Bush-pea		x	
Fabaceae (Faboideae)	*Pultenaea linophylla*			x	
Fabaceae (Faboideae)	*Pultenaea villosa*	Hairy Bush-pea		x	
Polypodiaceae	*Pyrrosia rupestris*	Rock Felt Fern			x
Ranunculaceae	*Ranunculus lappaceus*	Common Buttercup	x		
Ranunculaceae	*Ranunculus plebeius*	Forest Buttercup			
Myrtaceae	*Rhodamnia rubescens*	Scrub Turpentine		x	
Rosaceae	*Rubus moluccanus var. trilobus*	Molucca Bramble		x	x
Adoxaceae	*Sambucus australasica*	Native Elderberry			x
Menispermaceae	*Sarcopetalum harveyanum*	Pearl Vine			x
Cunoniaceae	*Schizomeria ovata*	Crabapple		x	

Family	Scientific Name	Common Name	Vegetation Type/ Condition		
			HU630_ Low	HU630_ Mod/Good	HU642_ Mod/Good
Cyperaceae	*Schoenus spp.*				
Flacourtiaceae	*Scolopia braunii*	Flintwood			x
Asteraceae	*Senecio hispidulus*	Hill Fireweed		x	
Asteraceae	*Senecio madagascariensis**	Fireweed	x		
Asteraceae	*Senecio spp.**	Groundsel, Fireweed		x	
Poaceae	*Setaria parviflora**		x		
Poaceae	*Setaria sphacelata**	South African Pigeon Grass	x		
Poaceae	*Setaria pumila**	Pale Pigeon Grass			
Malvaceae	*Sida rhombifolia**	Paddy's Lucerne	x		
Asteraceae	*Sigesbeckia orientalis*			x	
Brassicaceae	*Sisymbrium spp.**				
Smilacaceae	*Smilax australis*	Lawyer Vine		x	x
Smilacaceae	*Smilax glyciphylla*	Sweet Sarsparilla			
Solanaceae	*Solanum nigrum**	Black-berry Nightshade			
Solanaceae	*Solanum pungetium*	Eastern Nightshade		x	
Solanaceae	*Solanum stelligerum*	Devil's Needles		x	
Asteraceae	*Solenogyne bellioides*	Solengyne		x	

Family	Scientific Name	Common Name	Vegetation Type/ Condition		
			HU630_ Low	HU630_ Mod/Good	HU642_ Mod/Good
Poaceae	*Sporobolus fertilis**	Giant Parramatta Grass	x		
Caryophyllaceae	*Stellaria media**	Common Chickweed			
Caryophyllaceae	*Stellaria spp.**	Prickly Starwort		x	
Menispermaceae	*Stephania japonica*	Snake vine			x
Moraceae	*Streblus brunonianus*	Whalebone Tree			x
Symplocaceae	*Symplocos spp.*				x
Myrtaceae	*Syncarpia glomulifera*	Turpentine		x	x
Myrtaceae	*Syzygium australe*	Brush Cherry			x
Asteraceae	*Taraxacum officinale**	Dandelion	x	x	
Poaceae	*Themeda australis*	Kangaroo Grass	x	x	
Anthericaceae	*Thysanotus tuberosus*	Common Fringe-lily		x	
Fabaceae (Faboideae)	*Trifolium spp.**	A Clover	x		
Fabaceae (Faboideae)	*Trifolium subterraneum**	Subterranean Clover	x		
Fabaceae (Faboideae)	*Trifolium tomentosum**	Woolly Clover			
Ericaceae	*Trochocarpa laurina*	Tree Heath		x	x
Apocynaceae	*Tylophora barbata*	Bearded Tylophora			
Verbenaceae	*Verbena bonariensis**	Purpletop	x		

Family	Scientific Name	Common Name	Vegetation Type/ Condition		
			HU630_ Low	HU630_ Mod/Good	HU642_ Mod/Good
Asteraceae	*Vernonia cinerea*			x	x
Violaceae	*Viola betonicifolia*	Native Violet, Showy Violet	x	x	
Violaceae	*Viola hederacea*	Native Violet, Showy Violet		x	
Campanulaceae	*Wahlenbergia gracilis*	Sprawling Bluebell			
Monimiaceae	*Wilkiea huegeliana*	Veiny Wilkiea			x
Xanthorrhoeaceae	*Xanthorrhoea minor*			x	
Xanthorrhoeaceae	*Xanthorrhoea spp.*				
Rubiaceae	*Psychotria loniceroides*	Hairy Psychotria		x	x
Rutaceae	*Zieria smithii*	Sandfly Zieria			x

Table 30 Branch Lane Biobank Fauna Species

Family	Scientific Name	Common Name	NSW Status	EPBC Act Status	Observation Type
Frogs					
Hylidae	*Litoria fallax*	Eastern Dwarf Tree Frog	P		Heard
Hylidae	*Litoria tyleri*	Tyler's Tree Frog	P		Heard
Myobatrachidae	*Crinia signifera*	Common Eastern Froglet	P		Heard
Myobatrachidae	*Limnodynastes peronii*	Brown-striped Frog	P		Heard
Myobatrachidae	*Pseudophryne coriacea*	Red-backed Toadlet	P		Heard
Birds					
Acanthizidae	*Acanthiza lineata*	Striated Thornbill	P		Heard
Acanthizidae	*Gerygone albogularis*	White-throated Gerygone	P		Heard
Acanthizidae	*Sericornis frontalis*	White-browed Scrubwren	P		Heard
Accipitridae	*Accipiter cirrocephalus*	Collared Sparrowhawk	P		Seen
Accipitridae	*Accipiter fasciatus*	Brown Goshawk	P		Seen
Alcedinidae	*Dacelo novaeguineae*	Laughing Kookaburra	P		Heard
Alcedinidae	*Todiramphus sanctus*	Sacred Kingfisher	P		Heard
Ardeidae	*Egretta novaehollandiae*	White-faced Heron	P		Seen
Artamidae	*Cracticus nigrogularis*	Pied Butcherbird	P		Heard

Family	Scientific Name	Common Name	NSW Status	EPBC Act Status	Observation Type
Artamidae	*Cracticus tibicen*	Australian Magpie	P		Seen
Artamidae	*Cracticus torquatus*	Grey Butcherbird	P		Heard
Artamidae	*Strepera graculina*	Pied Currawong	P		Heard
Cacatuidae	*Calyptorhynchus funereus*	Yellow-tailed Black-cockatoo	P		Seen
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike	P		Heard
Campephagidae	*Coracina tenuirostris*	Cicadabird	P		Heard
Centropodidae	*Centropus phasianinus*	Pheasant Coucal	P		Heard
Cisticolidae	*Cisticola exilis*	Golden-headed Cisticola	P		Heard
Climacteridae	*Cormobates leucophaea*	White-throated Treecreeper	P		Heard
Columbidae	*Leucosarcia picata*	Wonga Pigeon	P		Seen
Columbidae	*Macropygia amboinensis*	Brown Cuckoo-dove	P		Heard
Columbidae	*Phaps chalcoptera*	Common Bronzewing	P		Seen
Corcoracidae	*Corcorax melanorhamphos*	White-winged Chough	P		Heard
Corvidae	*Corvus coronoides*	Australian Raven	P		Heard
Cuculidae	*Cacomantis flabelliformis*	Fan-tailed Cuckoo	P		Heard
Cuculidae	*Eudynamys orientalis*	Eastern Koel	P		Heard
Estrildidae	*Neochmia temporalis*	Red-browed Finch	P		Seen
Falconidae	*Falco berigora*	Brown Falcon	P		Seen

Family	Scientific Name	Common Name	NSW Status	EPBC Act Status	Observation Type
Maluridae	*Malurus cyaneus*	Superb Fairy-wren	P		Heard
Maluridae	*Malurus lamberti*	Variegated Fairy-wren	P		Seen
Meliphagidae	*Acanthorhynchus tenuirostris*	Eastern Spinebill	P		Heard
Meliphagidae	*Entomyzon cyanotis*	Blue-faced Honeyeater	P		Seen
Meliphagidae	*Lichenostomus chrysops*	Yellow-faced Honeyeater	P		Heard
Meliphagidae	*Manorina melanocephala*	Noisy Miner	P		Heard
Meliphagidae	*Meliphaga lewinii*	Lewin's Honeyeater	P		Heard
Meliphagidae	*Myzomela sanguinolenta*	Scarlet Honeyeater	P		Heard
Meliphagidae	*Philemon corniculatus*	Noisy Friarbird	P		Heard
Monarchidae	*Grallina cyanoleuca*	Magpie-lark	P		Seen
Monarchidae	*Myiagra rubecula*	Leaden Flycatcher	P		Seen, Heard
Neosittidae	*Daphoenositta chrysoptera*	Varied Sittella	V		Seen, Heard
Pachycephalidae	*Colluricincla harmonica*	Grey Shrike-thrush	P		Heard
Pachycephalidae	*Pachycephala pectoralis*	Golden Whistler	P		Heard
Pachycephalidae	*Pachycephala rufiventris*	Rufous Whistler	P		Heard
Pardalotidae	*Pardalotus punctatus*	Spotted Pardalote	P		Heard
Petroicidae	*Eopsaltria australis*	Eastern Yellow Robin	P		Heard
Petroicidae	*Microeca fascinans*	Jacky Winter	P		Seen

Family	Scientific Name	Common Name	NSW Status	EPBC Act Status	Observation Type
Pomatostomidae	*Pomatostomus temporalis temporalis*	Grey-crowned Babbler (eastern subspecies)	V		Heard
Psittacidae	*Alisterus scapularis*	Australian King-parrot	P		Seen
Psittacidae	*Glossopsitta concinna*	Musk Lorikeet	P		Heard
Psittacidae	*Platycercus eximius*	Eastern Rosella	P		Seen
Psittacidae	*Trichoglossus haematodus*	Rainbow Lorikeet	P		Seen
Psophodidae	*Psophodes olivaceus*	Eastern Whipbird	P		Heard
Ptilonorhynchidae	*Ailuroedus crassirostris*	Green Catbird	P		Heard
Rallidae	*Gallirallus philippensis*	Buff-banded Rail	P		Seen
Rhipiduridae	*Rhipidura albiscapa*	Grey Fantail	P		Heard
Rhipiduridae	*Rhipidura leucophrys*	Willie Wagtail	P		Seen
Timaliidae	*Zosterops lateralis*	Silvereye	P		Heard
Mammals					
Macropodidae	*Macropus rufogriseus*	Red-necked Wallaby	P		Seen
Reptiles					
Agamidae	*Physignathus lesueurii*	Eastern Water Dragon	P		Seen
Scincidae	*Bellatorias major*	Land Mullet	P		Seen
Scincidae	*Lampropholis sp.*	unidentified grass skink	P		Seen
Varanidae	*Varanus varius*	Lace Monitor	P		Seen

Appendix D

Expert Reports

CLIENTS | PEOPLE | PERFORMANCE

Pacific National

Greta Train Facility - BioBanking Offsets Package

Expert Report - Forest Owls

June 2011

INFRASTRUCTURE | MINING & INDUSTRY | DEFENCE | PROPERTY & BUILDINGS | ENVIRONMENT

Contents

Table Index

Figure Index

1. Introduction

1.1 Background

GHD has been engaged by Pacific National Pty Ltd to undertake and complete an assessment using the BioBanking assessment methodology as part of the proposed Train Provisioning Facility at Greta, in the Hunter Valley NSW. The results from this assessment and the BioBanking credit calculator predicted the site may have potential breeding habitat for large Forest Owls; namely the Powerful Owl, Barking Owl and Masked Owl, and assigned Tg scores accordingly. Site conditions, previous recordings of these species and the results of previous field surveys indicate the site may only have potential foraging habitat and, as such, this Expert Report has been prepared to support a modification to the Tg scores.

1.2 Reasons for the Expert Report

An expert report may be prepared under section 4.4 of the BioBanking assessment methodology instead of undertaking a threatened species survey at a development site. The Biobanking Operational Manual (DECC 2009) states that the "*use of an expert report rather than a targeted survey may be beneficial where it is highly likely or highly unlikely that a species may occur on site, and/or the reliability of recording a species through survey is particularly low".*

The purposes of using an expert report instead of a survey are to determine whether:

- *The species is unlikely to be present at the development site; in this case no further assessment of the species is required. An expert report cannot determine that a species is unlikely to be present if the land is within an identified population for that species, unless the expert report is approved by the Director General.*
- *The species is likely to be present at the development site. In this case the expert report must provide an estimate of the number of individuals or area of habitat to be impacted by the development (depending on whether the species is flora or fauna)…; and*
- *The species is likely to be present at the biobank site. In this case the expert report must provide an estimate of the number of individuals or area of habitat on the biobank site (depending on whether the species is flora or fauna)…"*

An expert report may only be used for those threatened species and populations to which species credits apply, not for any threatened species to which ecosystems apply.

In this case, an expert report has been provided in relation to the Large Forest Owls through the provision of the first point above, although in this case the expert report has not been prepared to determine the species is not present on the site, rather that the species may use the site for foraging purposes only and not for breeding. Accordingly, the Expert Report has been provided to support the adjustments made to the Tg scores.

1.3 Qualifications and Experience of Experts

The Biobanking Operational Manual states that:

"*The person who prepares an expert report must be accredited under 142B(1)(b) of the methodology or have the relevant experience and/or qualifications to provide expert opinion in relation to the biodiversity values (in this case, threatened species) to which the expert report relates.*"

1.3.1 GHD Expert

Mark Aitkens BApplSc (Environmental Biology)

Mark Aitkens is an ecologist of fifteen years consulting experience in the preparation of ecological impact assessments for small to State significant developments. This experience has involved the development and maintenance of specialist skills in survey design/ implementation, data handling/ analysis/ interpretation and reporting. Mark's professional development has included training in spatial and remote sensing sciences (GIS) and BioBanking and the use of statistics in vegetation classification.

Mark has prepared ecological and environmental assessments under Part 3A, 4 and 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) throughout NSW. Mark has prepared Environmental Assessment reports, Environmental Impact Statements, Species Impact Statements, Review of Environmental Factors and Statement of Environmental Effects under the EP&A Act and Referrals/ Control Actions under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Mark also routinely prepares environmental management plans, bush fire protection assessments and Ecological Impact Assessments compliant with Section 5A of the EP&A Act, Part 3A Major Projects and Part 3 Rezoning Applications.

As project ecologist Mark assessed the ecological impacts of Stages 1 and 2 of the Moolarben Coal Project at Ulan within a Part 3A context and Controlled Action under the EPBC Act. This project involved the completion of a detailed seasonal baseline survey for a 100 km^2 study area in the upper Hunter Valley. Part of this baseline study involved the completion of over 50 nights of owl call playback surveys resulting in the detection of the Powerful Owl. Extensive Elliott trapping and spotlighting surveys were also completed together with detailed vegetation mapping to aid habitat characterisation for the purpose of impact evaluation.

Mark routinely conducts targeted call playback surveys for forest owls in accordance with the draft DEC survey guidelines throughout the NSW east coast. These works have resulted in the detection of the Powerful Owl, Masked Owl and Sooty Owl. Mark has extensive field based knowledge and experience in identifying suitable owl habitat through the completion of numerous surveys, within central Hunter Valley experience demonstrated at the following locations:

- Cessnock
- Denman
- Lovedale (recorded Powerful Owl)
- Luskintyre
- Muswellbrook
- North Rothbury
- Sawyers Gully
- Sedgefield
- Singleton

- Stanhope

This experience has given Mark a sound understanding of the ecology, habitats and behaviour of Forest Owls, meaning he is a suitably qualified ecologist to prepare this expert report.

2. Species Information

The information contained in this Expert Report pertains to the following owl species:

- Powerful Owl (*Ninox strenua*).
- Masked Owl (*Tyto novaehollandiae*).
- Barking Owl (*Ninox connivens*).

Each of these species has a Tg score of 0.33 within a spectrum of possible scores between 0 and 1. This score is an indication of the species recovery potential for lands identified as having suitable breeding and foraging habitat. The implied recovery potential is low relative to other threatened fauna. The main reasons for the low Tg score are:

- Owls are high order consumers/ predators (i.e. reliant on a consistent supply of foraging resources such as high order browsers (e.g. possums), which are generally found in larger habitat areas in good condition).
- Large spatial habitat requirements for home range formation and connection with neighbouring populations (i.e. breeding viability and genetic flow).
- Mature forests with sufficient roost/ breeding habitat (e.g. large tree hollows).

2.1 Ecology

2.1.1 Powerful Owl

The Powerful Owl lives in forests and woodlands occurring in the coastal, escarpment, tablelands and western slopes environments of NSW (Kavanagh 2002b, Soderquist et al. 2002 cited in DEC 2006). This species is a nocturnal, solitary and sedentary species. They occur in a number of vegetation types ranging from woodland and open sclerophyll forest to tall open wet forest and rainforest. However, this species does prefer large tracts of vegetation. Powerful Owls nest in large tree hollows (at least 0.5 m deep), in large eucalypts (diameter at breast height of 80-240 cm) that are at least 150 years old with breeding taking place from late summer to late autumn.

Pairs of Powerful Owls are believed to have high fidelity to a small number of hollow-bearing nest trees and will defend a large home range of 400 - 1,450 ha. It forages within open and closed woodlands as well as open areas. The Powerful Owl prefers large forest or woodland blocks of more than 200 ha and avoids small patches and strips (Kavanagh & Stanton 2002 cited in NSW Scientific Committee, 2008), and is thus inferred to be adversely affected by habitat fragmentation (NSW Scientific Committee, 2008).

Ecological factors required for reproduction include:

- Mature forest stands containing large hollow-bearing trees.
- Dense understorey shrubs for fledglings to climb and shelter within.
- High density of arboreal marsupial prey species, many of which are hollow-dependent (From Schodde and Mason 1980, McNabb 1996, Kavanagh 1997, Higgins 1999 cited in DEC, 2006).

Specific habitat requirements:

- Eucalypt forests and woodlands on productive sites on gentle terrain.
- A mosaic of moist and dry types, with mesic gullies and permanent streams.
- Presence of leafy sub-canopy trees or tall shrubs for roosting.
- Presence of large old trees to provide nest hollows (From Debus 1994a, NSW NPWS 1994, McNabb 1996, Kavanagh 1997 cited in DEC, 2006).

2.1.2 Masked Owl

The Masked Owl lives in eucalypt forests and woodlands from the coast, where it is most abundant, to the western plains (Kavanagh 2002b cited in DEC, 2006). This species occurs in dry eucalypt woodlands at altitudes from sea level to 1100 m and roosts and breeds in hollows and sometime caves in moist eucalypt forested gullies. It hunts along the edges of forests and roadsides and has a home range covering between 500 ha and 1000 ha. Prey for this species are principally terrestrial mammals but arboreal species may also be taken.

Ecological factors required for reproduction include:

- Mature forest or woodland stands with large hollow-bearing trees.
- Dense trees or shrubs for fledglings to shelter within.
- High density of small terrestrial mammal prey species, only a few of which have any strong relationships with old-growth forest or woodland attributes.

(From Schodde and Mason 1980, Debus and Rose 1994, Kavanagh 1996, Kavanagh and Murray 1996, Debus 1997, Mooney 1997, Higgins 1999 cited in DEC, 2006).

Specific habitat requirements:

- Dry eucalypt forests and woodlands on productive sites on gentle terrain.
- High density of old hollow-bearing trees.
- Grassy understorey with a mosaic of sparse and dense ground cover.

(From Debus and Rose 1994, NSW NPWS 1994, Kavanagh et al. 1995, Kavanagh 1996, Kavanagh and Murray 1996 cited in DEC, 2006).

2.1.3 Barking Owl

Barking Owls have been recorded in remnants of forest and woodland and in clumps of trees at farms, towns and golf courses. The habitat of the Barking Owl is typically dominated by eucalypts, often Red Gum species and, in the tropics, paperbarks species. It usually roosts in or under dense foliage in large trees including rainforest species of streamside gallery forests, River She-oak *Casuarina cunninghamiana*, other *Casuarina* and *Allocasuarina* species, eucalypts, *Angophora* or *Acacia* species. Roost sites are often near watercourses or wetlands. It typically breeds in hollows of large eucalypts or paperbarks, usually near watercourses or wetlands (NPWS, 2003).

The nest site is a large open hollow, often vertical or sloping, in the trunk or sometimes a spout of a eucalypt or Melaleuca, usually a live tree though occasionally a dead tree. Nest-hollow entrances are 2-35 m above the ground with a diameter of 20-46 cm and depth of 20-300 cm (NPWS, 2003).

2.2 Life Cycle

2.2.1 Powerful Owl

The Powerful Owl live as monogamous, sedentary life-long pairs in large permanent home ranges (DEC, 2006). A clutch of usually two eggs is laid in autumn to winter, with a single attempt per year. The incubation period is 38 days, the nestling period two months, and the post-fledging dependence period lasts several months, sometimes up to the start of the next breeding season. Breeding productivity is 0.4-1.4 young per pair per year, depending on habitat quality (low in dry, fragmented inland forest, high in productive coastal forest). The generation length of the Powerful Owl is estimated as 10 years (Garnett & Crowley 2000 cited in NSW Scientific Committee, 2008).

2.2.2 Masked Owl

The Masked Owl lives as monogamous, sedentary life-long pairs in large permanent home ranges. Laying is irregular and unpredictable, occurring from late summer to spring but mostly March to July. The clutch is 1-4 eggs in the wild and a single clutch is laid per year or sometimes there is no breeding within a year. In captivity, the owl has a high reproductive potential when food is unlimited: up to seven eggs per clutch and four broods per year, of up to five young each. The incubation period is 5 weeks. There are no data on egg success. Successful wild broods of 1-3 young fledge; fledging success is 1-2 young per attempt (Debus 1993 cited in DEC, 2006).

2.2.3 Barking Owl

The Barking Owl eats a variety of birds, mammals and large insects. It eats some of the common native and introduced birds such as rosellas and starlings, eats more birds than other large forest owls and eats many insects in the warmer post-breeding months. However, vertebrates seem to be important in its diet during winter and breeding. Rabbits are frequent prey in rabbit-infested areas where there are few other suitably-sized mammals but where possible, the owl appears to prefer native arboreal mammals such as small gliding possums, caught in the tree canopy. These mammals and some of the owl's important bird prey species such as parrots are dependent on tree hollows for at least part of their life cycle. Despite the large number of anecdotal records of dietary items, there has been no systematic study of the diet of the species, particularly the function of dietary preference during breeding (NPWS, 2003).

Barking Owls are presumed to breed as well-dispersed pairs in traditional, permanent territories, although there have been no long-term studies based on marked birds. They are strictly seasonal breeders, laying a single small clutch of 1-3 (usually 2) eggs in late winter or spring. In NSW, laying takes place in August-October or in November for replacement clutches if the first clutch fails. The incubation period lasts 36-37 days and the nestling period is 35-36 days. The young are unable to fly strongly in the first few weeks out of the nest. In successful nests, broods of usually one or two (rarely three) young fledge. Fledged young can be seen with their parents from October to January. They are dependent on the adults for up to 4 months and begin to disperse at the end of summer. Although owls are expected to be long-lived, the longevity of the Barking Owl is unknown (NPWS, 2003).

2.3 Abundance and Distribution

2.3.1 Powerful Owl

The Powerful Owl's estimated global extent of occurrence is 450 000 km^2, with high reliability, and its estimated global area of occupancy is 50 000 km2, with low reliability (Garnett & Crowley 2000 cited in NSW Scientific Committee, 2008). As over half of the species' distribution falls in NSW, Extent of Occurrence (EOO) is thus about 250 000 km2 and Area of Occupancy (AOO) is about 30 000 km^2 (NSW Scientific Committee, 2008).

The Powerful Owl occupies the eastern one-third of the State, although records are sparse inland (on the western slopes of the Great Dividing Range) and most concentrated on the coast and tablelands (Debus and Chafer 1994, DEC Atlas of NSW Wildlife cited in DEC, 2006). There is no seasonal variation in distribution.

The Powerful Owl is more than twice as abundant in north-eastern NSW as in south-eastern NSW and on the western slopes (Kavanagh and Peake 1993b, Kavanagh 1995, Kavanagh and Bamkin 1995, Kavanagh et al. 1995, Kavanagh and Stanton 1998 cited in DEC, 2006). Although the species is widespread throughout its range, its habitat has been reduced or fragmented by clearing for agriculture, pine plantations, mining and major infrastructure, urban developments, and by reductions in habitat quality. It has been estimated that Powerful Owl populations and the area they occupy may have declined by approximately 20-50% since European settlement, with possible contraction of the inland limits of its range (Debus and Chafer 1994, Lunney et al 2000 cited in DEC, 2006).

Currently, the majority of potential habitat for this species is restricted to conservation reserves and state forests, although the Powerful Owl also occurs within large areas of forest on other public lands and on private land, including suburban bushland. The Powerful Owl has been recorded in many national parks and state forests throughout its range in NSW (Debus 1994a, NSW NPWS 1994, Kavanagh 1997, DEC Atlas of NSW Wildlife cited in DEC, 2006). The eastern NSW population is continuous or almost so, with a slight interruption at the lower Hunter Valley. Some inland populations may be isolated (Debus and Chafer 1994 cited in DEC, 2006).

2.3.2 Masked Owl

The Masked Owl is abundant on the coast and sparse throughout inland districts (Kavanagh 2002b cited in DEC, 2006), with the species entire extent covering approximately 90% of NSW, excluding the most arid north-western corner (Debus and Rose 1994 cited in DEC, 2006). There is no seasonal variation in distribution (DEC, 2006).

Generally, the Masked Owl appears to be less common than the Powerful and Sooty Owls in heavily-forested areas. In such environments, it is more than twice as abundant in north-eastern NSW as in south-eastern NSW and on the western slopes (Kavanagh and Peake 1993b, Kavanagh 1995, Kavanagh and Bamkin 1995, Kavanagh et al. 1995, Kavanagh and Stanton 1998 cited in DEC, 2006). The habitat for this species appears to be widespread throughout its range and there are increasing numbers of records occurring on private land (DEC, 2006).

However, its habitat in woodland and dry forests appears to have been greatly reduced or fragmented by clearing for agriculture and urban development resulting in widespread local extinctions in the inland regions (Debus and Rose 1994 cited in DEC, 2006). Its decline in western regions has also been attributed to the collapse of native mammal populations in inland areas.

In wetter forests, the abundance of this species may have been reduced by intensive logging (Kavanagh and Bamkin 1995 cited in DEC, 2006). It has been estimated that Masked Owl populations and the area they occupy may have declined by approximately 20-50% since European settlement, with possible contraction of the inland extent of its range (Debus and Rose 1994, Lunney et al. 2000 cited in DEC, 2006).

Potential habitat for the Masked Owl is mostly in conservation reserves and state forests, although this species is also found throughout large areas of forest or woodland on other public lands and on private land, including suburban bushland. The Masked Owl has been recorded in many national parks and state forests throughout its range in NSW (Debus 1994a, NSW NPWS 1994, Kavanagh 1997, DEC Atlas of NSW Wildlife cited in DEC, 2006). The eastern NSW population is continuous but some inland populations may be isolated (Debus and Rose 1994 cited in DEC, 2006).

There is high mortality of such juveniles in a rural landscape with high fox density, and low success to independence and dispersal (Debus 1997 cited in DEC, 2006).

2.3.3 Barking Owl

The distribution of the Barking Owl is described in detail in Higgins (1999) (cited in NPWS, 2003). It occurs in Australia, East Indonesia and New Guinea. In Australia, the Barking Owl is found in northern, eastern and southwestern Australia from the Pilbara and Kimberley, across the Top End and down through Queensland and the eastern Lake Eyre Basin to southern Victoria, with an isolated population in the south-west corner of WA (NPWS, 2003).

In NSW, it is widespread on the coastal plain and foothills and the inland slopes and plains. It is sparse on the higher parts of the tablelands and in the arid zone west of the Darling River and rare or absent in the dense, wet forests of the eastern fall of the Great Dividing Range. It is rare in the ACT with one record every 2-3 years (Taylor and COG 1992 cited in NPWS, 2003). It has declined in density in cleared and settled parts of the state (Debus 1997 cited in NPWS, 2003).

Historically, the species was considered common in NSW but in recent decades it has become uncommon to rare. Recent surveys have found it much less numerous than the Powerful Owl in forested areas of eastern NSW. It has declined to the point where it is now absent or rare in some areas where it was found regularly in past decades (NPWS, 2003).

2.4 Key Regional Habitat Features

Large forest owls respond to geomorphology, moisture regime, vegetation structure and consequent site productivity rather than specific floristics. Using broad scale surveys, owl habitat has been characterised only to the level of broad vegetation systems (rainforest, wet sclerophyll forest, dry sclerophyll forest) rather than to specific forest types. The owls appear to prefer mid to late successional, mixed-age or multi-aged forest greater than 60 years old (DEC, 2006).

2.4.1 Powerful Owl

The breeding habitat of the Powerful Owl is predicted to be associated with “Hollows >45 cm diameter that are 6m or more above the ground in living or dead trees.” (OEH, 2011a). Foraging habitat is associated with most of the Hunter Central Rivers BioMetric Vegetation Types found within the following vegetation formations:

- Dry sclerophyll forests (shrub/grass sub-formation).
- Dry sclerophyll forests (shrubby sub-formation).
- Grassy woodlands.
- Miscellaneous ecosystems.
- Rainforests.
- Wet sclerophyll forests (grassy sub-formation).
- Wet sclerophyll forests (shrubby sub-formation).

Groves of mid-canopy trees or tall shrubs in sheltered gullies provide key shelter, roosting and refuge habitat for the Powerful Owl (OEH, 2011a).

2.4.2 Masked Owl

The breeding habitat of the Masked Owl is predicted to be associated with “Living or dead trees with hollows >40 cm diameter, cliffs or caves” (OEH, 2011a). Foraging habitat is associated with most of the Hunter Central Rivers BioMetric Vegetation Types found within the following vegetation formations:

- Dry sclerophyll forests (shrub/grass sub-formation).
- Dry sclerophyll forests (shrubby sub-formation).
- Grasslands.
- Grassy woodlands.
- Miscellaneous ecosystems.
- Wet sclerophyll forests (grassy sub-formation).
- Wet sclerophyll forests (shrubby sub-formation).

Trees, crevices in cliffs or caves and sometimes in buildings provide key shelter, roosting and refuge habitat for the Masked Owl (OEH, 2011a).

2.4.3 Barking Owl

The breeding habitat of the Barking Owl is predicted to be associated with “Living or dead trees with hollows >20 cm diameter that are > 4 m above the ground” (OEH, 2011a). Foraging habitat, which is described as “Within or along edges of eucalypt forest or woodland” (OEH, 2011a), is associated with most of the Hunter Central Rivers BioMetric Vegetation Types found within the following vegetation formations:

- Dry sclerophyll forests (shrub/grass sub-formation).
- Dry sclerophyll forests (shrubby sub-formation).

- Forested Wetlands.
- Freshwater Wetlands.
- Grasslands.
- Grassy woodlands.
- Wet sclerophyll forests (grassy sub-formation).

There are no specific shelter, roosting or refuge habitat requirements for the Barking Owl other than for those generally described in the associated vegetation types.

3. Description of the Site

3.1 Description of the Site

The subject site, including the location of the proposed facility, is Lot 1 DP 1129191 and has frontage onto Mansfield Street, Greta, NSW. It is geographically located in the Hunter Valley in the Local Government Area of Cessnock near the Township of Greta. The Township of Greta is located approximately 50 kilometres northwest of Newcastle and 20 kilometres north of Cessnock. The proposed development extends northwest from near Greta Railway Station for a distance of about 2.4 kilometres and extends southwest to the proposed corridor for the new freeway. The location of the site is illustrated in Figure 3-1.

The subject site is dominated by intact native vegetation in good condition. It occurs within an approximately 100 hectare parcel of open space administered by Pacific National. Historical land uses appear to include timber getting, grazing, stock keeping, and railway infrastructure adjoins the site. Disturbed areas include stock fences, a horse racing/exercising track, dirt tracks, farm dams, borrow pits and construction lay down areas. The southern portion of the site is affected by mine subsidence.

3.2 Landscape Context

The site is located within the Central Hunter Foothills Mitchell Landscape. This is characterised by undulating lowlands, rounded to steep hills with rock outcrop on ridges on Permian lithic sandstone, conglomerate, shale and coal, general elevation 40 to 300m with a few higher peaks, local relief 30 to 120m. Red-brown to yellow brown harsh texture-contrast soils on slopes, dark coloured clays in valleys and limited accumulations of sand and gravel in streams. Woodlands to open forest of Spotted Gum (*Corymbia maculata*), Forest Redgum (*Eucalyptus tereticornis*), Narrow-leaved Ironbark (*Eucalyptus crebra*), Red Ironbark (*Eucalyptus fibrosa*), and Rough-barked Apple (*Angophora floribunda*) with Kangaroo Grass (*Themeda australis*) and Wallaby Grass (*Austrodanthonia* sp) (DEC, 2008).

3.3 Surrounding Land Uses

The site is located south of the village of Greta and is bound by the Main Northern Railway and residential properties to the north and rural land to the east, south and west. Native vegetation cover to the south is characterised by a large connected remnants of varying condition, with vegetation cover to the north being largely cleared as a consequence of prior agriculture activity, urban development and construction of major infrastructure corridors.

3.4 Climate

The climate of the Hunter Valley region stretches about 160km from the ocean at Newcastle to the west, and although the climate varies considerable the average temperatures remain fairly consistent. Summers average temperature is approximately 30 degrees, Spring and Autumn ranges from 22-27 degrees and winter temperatures fall between 18-19 degrees. The average annual rainfall for the area, based on the weather station at Cessnock, is approximately 757 mm.

3.5 Hydrology

Site topography is generally undulating (maximum grade 5-10%) with variable north, east and west facing slopes associated with north flowing drainages. Runoff from the site is via overland flow into three broad north flowing open depressions of ephemeral character. Water leaves the site in a northerly direction where it flows beneath the Main Northern Railway into Anvil Creek, which is a semi-permanent to permanent creek lined mostly by Swamp Oak (*Casuarina glauca*).

3.6 Geology and Topography

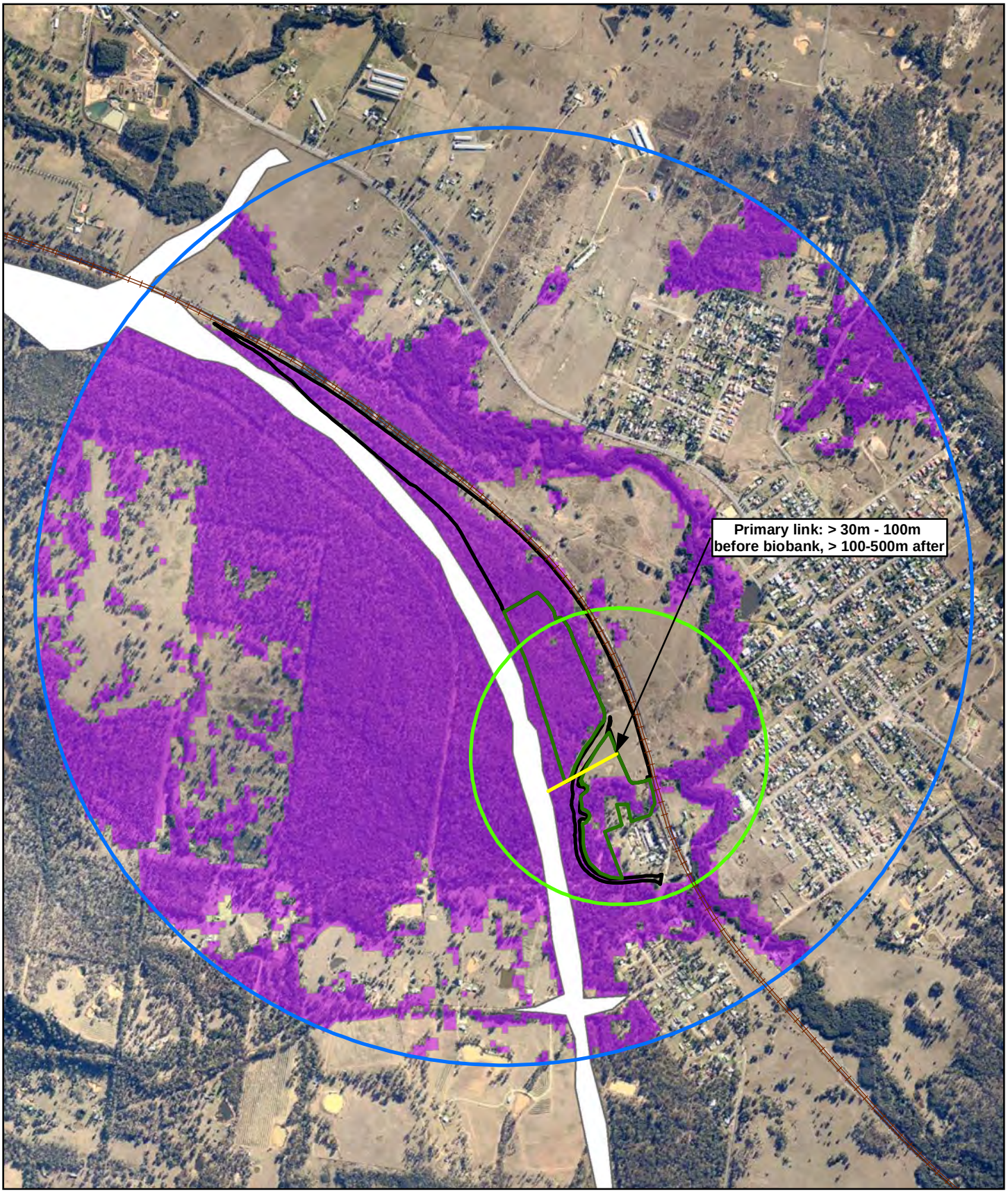
SKM provided contours over the site using aerial mapping. The contours show the general grade of the site running west to east with a significant water course which passes through the site on the southern end. As the property slopes from the railway line up to the F3 corridor, the proposed sidings will require some cut to be performed upon the site to ensure that railway grades are achieved after leaving the main rail line.

The construction of the Hunter Expressway on the western boundary, once completed, will provide a significant barrier on the western extent of the site.

There are no cliff lines, large boulders or extensive areas of caves, overhangs and fissures within the site. There are no rock outcrops with platey rock fragments and fissures (GHD, 2011).

3.7 Vegetation Cover

Native vegetation of the site comprises dry sclerophyll open forest. The presence of mature trees and saplings indicates that the site has never been completely cleared of its pre-European eucalypt canopy cover; although the consistent sub benchmark native plant species richness is indicative of prior/ sustained disturbances. Disturbance at the site includes past over storey removal, management of the mid-stratum vegetation, disturbance of the ground layer in parts by agriculture and mine subsidence (i.e. formation of pot holes and associated altered drainage patterns).



LEGEND

- 100ha Biobank Assesment Circle
- 1000ha Assesment Circle
- Biobank site
- Development area
- Vegetation cover
- Hunter Expressway
- Primary Link
- Railways

1:20,000 (at A4)

0 95 190 380 570 760

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 56

N

GHD

CLIENTS | PEOPLE | PERFORMANCE

Pacific National
Greta Provisioning Facility
Biodiversity Offsets Package

Greta subject site
landscape assessment

Job Number	22-15502
Revision	A
Date	23 May 2011

Figure 1

G:\22\15502\GIS\Maps\MXD\22_15502_Z012_Greta_Landscape_AssessmentaCircles_F3Updare.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 2010; Navigate StreetMap: StreetMap - Jan 2010. Created by: qjchung

The vegetation types occupying the site are detailed in Table 1 below.

Table 1 Vegetation Type and Condition

Vegetation Type	ID	Conservation Significance	Description	Condition
Grey Ironbark - Spotted Gum - Grey Box open forest on hills of the Hunter Valley, Sydney Basin	HU556	EEC.	As per detailed description below.	Moderate
Forest Red Gum - Grey Gum dry open forest on hills of the lower Hunter Valley, Sydney Basin	HU544	EEC	As per detailed description below.	Moderate

The following vegetation type descriptions are those presented in the Environmental Assessment report for the project (SKM, 2010).

3.7.1 Grey Ironbark - Spotted Gum - Grey Box open forest on hills of the Hunter Valley, Sydney Basin [HU556]

This community has strong affinities to the listed EEC Lower Hunter Spotted Gum - Ironbark Forest. This community is associated with higher elevated slopes of the study area. The community supports an open canopy ranging between 15-20 m dominated by Spotted Gum (*Corymbia maculata*) and Narrow-leaved Ironbark (*Eucalyptus crebra*), with other species being co-dominant in areas including Broad-leaved Ironbark (*E. fibrosa*), Grey Gum (*E. punctata x canaliculata*) and Forest Red Gum (*E. tereticornis*). Some areas support a high abundance of regenerating trees with larger trees interspersed. A low-moderate abundance of Bulloak (*Allocasuarina luehmannii*) is present throughout this community.

The understorey varies throughout the study area comprising a mix of shrub and groundcovers varying in density. A moderately dense shrub layer is present dominated by a diversity of species, including Black Thorn (*Bursaria spinosa*), Gorse Bitter-pea (*Daviesia ulicifolia*), Needlebush (*Hakea sericea*), Narrow-leaved Geebung (*Persoonia linearis*), Rice Flower (*Pimelea linifolia* subsp. *linifolia*), Swamp Wattle (*Acacia elongata*) and Coffee Bush (*Breynia oblongifolia*). The dominant shrub species within this community varies throughout the study area and ranges from 1-3 m in height.

The groundcover of this community includes a relatively high diversity of flora species varying in density with the degree of soil moisture and shelter. Common grass species in this map unit include Purple Wiregrass (*Aristida ramosa*), Three-awn Spear-grass (*A. vagans*), Barbed-wire Grass (*Cymbopogon refractus*), Wiry Panic (*Entolasia stricta*) and Weeping Grass (*Microlaena stipoides*) varying in dominance. Common forb species include a diversity of herbs and graminoids such as Many-flowered Mat-rush (*Lomandra multiflora*), Mulga Fern (*Cheilanthes sieberi*), White Root (*Pratia purpurascens*), *Lomandra filiformis* and Poverty Raspwort (*Gonocarpus tetragynus*).

A sparse cover of weed species is present throughout most likely as a result of past agricultural practices, and weeds are most abundant on the edges of this community adjoining the rail corridor. Common weed species include Flatweed (*Hypocharis radicata*), Stinking Roger (*Tagetes minuta*) and African Olive (*Olea europaea* subsp. *cuspidata*).” (SKM, 2010).

3.7.2 Forest Red Gum - Grey Gum dry open forest on hills of the lower Hunter Valley, Sydney Basin (HU554]

This community is associated with lower elevated areas of the study area, including open depressions and slopes surrounding drainage lines. The community supports an open canopy ranging between 15-20 m dominated by Forest Red Gum and Narrow-leaved Ironbark with other species being co-dominant in areas including Rough-barked Apple (*Angophora floribunda*), Grey Box, Grey Gum and Spotted Gum. Some areas support a high abundance of regenerating trees with larger trees interspersed. A moderate abundance of small-medium sized trees (4-8 m high) are present including *Melaleuca decora*, Prickly-leaved Paperbark (*Melaleuca nodosa*) and Bulloak is present throughout this community, particularly along drainage lines.

The understorey varies throughout the study area comprising a mix of shrub and groundcovers varying in density. A sparse to moderately dense shrub layer is present 1-3 m in height dominated by similar species to map unit 1. Dominant shrub species include Gorse Bitter-pea, Needlebush, Narrow-leaved Geebung, Coffee Bush, Rice Flower, *Acacia falcata*, Silver-stemmed Wattle (*Acacia parvipinnula*) and *Leptopsermum parvifolium*.

The groundcover of this community includes a relatively high diversity of flora species varying in density with the degree of soil moisture and shelter. The most dominant grass species are Weeping Grass and Barbed-wire Grass with other grasses occurring in lower abundance including Paddock Lovegrass (*Eragrostis leptostachya*), *Paspalidium distans* and Tufted Hedgehog Grass (*Echinopogon caespitosus* var. *caespitosus*). Common forb species include a diversity of herbs and graminoids such as Rough Raspwort (*Halogris heterophylla*), White Root, Mat-rush (*Lomandra longifolia*) and Blue Bottle-daisy (*Lagenophora stipitata*).

A sparse cover of weed species is present throughout this community most likely as a result of past agricultural practices, and weeds are most abundant on the edges of this community adjoining the rail corridor and along the major drainage line at the southern end of the study area. Common weed species include several pasture species such as Carpet Grass (*Axonopus affinis*), *Lantana camara*, Flatweed and African Olive." (SKM, 2010).

3.8 Habitat

3.8.1 Vegetation Condition

The structure and floristics of the tree canopy and shrub midstorey is well developed in the western parts of the site with decreasing condition noted in the eastern parts where grazing, mine subsidence and prior clearing works have been more prominent. Tree canopy cover is notably lower in the eastern parts of the site particularly in areas that adjoin active subsidence.

Floristic species richness is generally below benchmark levels for both vegetation types, although less so for the Grey Ironbark - Spotted Gum - Grey Box open forest on hills of the Hunter Valley, Sydney Basin [HU556]. This finding is consistent with a regenerating vegetation patch responding to prior disturbance regimes and/or responding to current environmental factors (e.g. absence of fire).

3.8.2 Tree Hollows

The site comprises a mix of hollow-bearing trees ranging from small limb hollows in relatively young trees to an established large trunk hollows in mature/senescent trees. However, the occurrence of the latter hollow type is restricted to one large tree (*Eucalyptus canaliculata*) near the centre of the site, with the opening likely to be suitable for the owls. The majority of tree-hollows are of a small size suitable for arboreal mammals and microchiropteran bats, with few hollow-bearing trees of suitable character for the forest owls (>20cm opening).

3.8.3 Foraging Resources

The tree-hollow profile of the site provides suitable habitat for small to medium sized arboreal mammals and parrots (i.e. potential foraging resources). SKM (2010) reported the presence of the Squirrel Glider (*Petaurus norfolcensis*) and Common Brushtail Possum (*Trichosurus vulpecula*) as the dominant arboreal mammal fauna (SKM, 2010), these being suitable prey for the Powerful Owl and Masked Owl. Larger forest birds such as the Currawong (*Strepera graculina*) and White-winged Chough (*Corcorax melanorhamphos*) are also likely to occur on site and would also represent suitable prey.

The vegetation structure is suited to the occurrence of bird species commonly found in dry sclerophyll forests and woodlands. This in connection with the vegetation edges, which now coincide with the Main North Railway and the Hunter Expressway, may provide suitable foraging habitat for the forest owls. However, the productivity of the site (fertility) is considered low with highest areas of productivity associated with small drainage lines.

3.9 Connectivity

The site is no longer connected with large undisturbed tracts of native vegetation to the west due to the construction of the Hunter Expressway. In addition, urban development, rail, roads and rural land uses to the north have further impacted on connectivity in the locality. Both the Hunter Expressway and the Main North railway are considered hostile barriers for the purpose of the BioBanking assessment. The location of such barriers and the isolation of small habitat areas are considered to be a negative influence on the localised distribution of owl species (NSW Scientific Committee, 2008).

3.10 Prior Field Surveys

Flora and fauna surveys have been undertaken on the site by SKM (2010). Surveys were conducted over four consecutive nights in Spring, 2009, and included diurnal and nocturnal census. Methods relevant to the Spotted-tailed Quoll included trapping and spotlighting.

Site surveys of the Greta biobank portion of the subject site were conducted by GHD according to the BioBanking methodology to supplement the Project ecological assessment discussed above. Plot and transect surveys were conducted on site in accordance with the procedures provided in DECC (2009) (cited in SKM, 2010). The Site Value was determined by assessing ten 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. A total of eight plots were sampled within the Greta biobank site. No systematic targeted surveys for threatened fauna species were conducted. Opportunistic observations of fauna were recorded.

A summary of combined survey effort by SKM and GHD is provided in Table 2 below.

Table 2 Survey Effort

Date	Company	Survey Methods	Survey Effort
14 to 18 September 2009	SKM	Elliot B traps (ground)	48 trap nights
14 to 18 September 2009	SKM	Cage traps (ground)	24 trap nights
14 to 18 September 2009	SKM	Spotlighting	8 person hours
1 and 2 February 2011	GHD	20 m x 50 m BioBanking plot / transect surveys within the Greta biobank site. Targeted search for *Eucalyptus glaucina*, opportunistic fauna and threatened plant observations within the entire subject site.	2 ecologists for 2 days 8 plot / transects
29 April 2011	GHD	Supplementary targeted search for *Eucalyptus glaucina*, including plotting of intergrades with *E. tereticornis,* opportunistic fauna and threatened plant observations within the entire subject site.	2 ecologists for 1 day
16 May 2011	GHD	Collection of detailed plot data for inserting into the biobanking credit calculator.	2 ecologist for 1 day

4. Expert Assessment and Conclusion

4.1 Habitat Suitability

Both vegetation types present within the site contain suitable foraging resources for the Powerful Owl, Masked Owl and Barking Owl although the productivity of these vegetation types is regarded as low (i.e. negative influence on foraging habitat suitability). There is evidence of partial habitat suitability for breeding activity (i.e. tree hollows) for each of these species, however the value of this habitat is substantially diminished by remnant size (i.e. limited production of suitable foraging resources), the small size of hollows and presence of hostile gaps (i.e. Main North Railway and Hunter Expressway) and cleared lands to the north. While forest owls are capable of negotiating hostile gaps, it is generally accepted that isolated small vegetation remnants are unsuitable for large forest owls (NSW Scientific Committee, 2008). A description of the sites habitat values and how they relate to foraging, shelter and breeding habitat for these owls is provided in the following sections.

4.1.1 Foraging and Shelter Habitat

The literature indicates that the Powerful Owl, Masked Owl and Barking Owl are reliant on large tracts of native vegetation cover to provide a viable habitat area and for the establishment of interconnecting home ranges for individuals/ pairs. Vegetation cover may consist of dry/ wet/ swamp sclerophyll forests, woodlands and closed forest (i.e. rainforest and riparian forest) although closed forests and wet sclerophyll forests appear to be preferentially used by the Powerful Owl with woodlands preferentially used by Masked Owls and Barking Owls.

The site contains dry sclerophyll forests. The structural integrity of this vegetation is largely intact for the tree canopy strata, midstorey and groundcover stratum. However there is evidence of structural and floristic modifications in the vegetation cover throughout the sites eastern parts. The degraded vegetation structure exhibited in the eastern parts of the site is considered likely to have a negative impact on foraging values through reduced productivity, which could be directly attributed to the limited development of tree hollows in this area (i.e. shelter for prey species). This is exacerbated by the sites small size and isolation from large vegetation patches as a consequence of hostile gaps such as the Main North Railway and Hunter Expressway.

By contrast the western parts of the site exhibit improved vegetation structure and floristic diversity. Hollow development in this area is also proportionally higher indicating the potential for relatively higher productivity. These two factors are considered to contribute to the presence of suitable foraging habitat, with the effects of vegetation isolation being the main negative influence.

4.1.2 Breeding Habitat

The presence of tree hollows indicates the potential availability of suitable breeding habitat for each owl species within the site. In the case of the Powerful Owl and Masked Owl, only large hollows would be used). The site possesses only one tree with such hollows, identified near the centre of the site. However, surveys completed for the ecological assessment SKM (2010) and this biobanking assessment (GHD 2011) found no evidence of active or recent use. A few additional potential roost hollows for the Barking Owl may exist within the western parts of the site.

Areas of proximal suitable habitat would be used for foraging purposes, which would be restricted to the site as a consequence of surrounding hostile gaps. It follows that the suitability of this proximal habitat area as an adjunct to a hollow with active breeding is substantially limited by the vegetation remnant size (i.e. an area substantially less than the required home range for a forest owl), the small size of available hollows and its high edge to area ratio. The latter is an indirect indicator of condition and function of the vegetation patch, with high edge to area ratios implying simplified species richness and diversity (i.e. resources are either limited through reduced productivity and/or imbalanced).

4.2 Local records

There are few Wildlife Atlas database records of the Powerful Owl, Masked Owl and Barking Owl within a 10 km radius of the site (OEH, 2011b). The nearest records of the Powerful Owl and Barking Owl are approximately 2 km west of the site near the intersection of Wine Country Drive and Tuckers Lane. These records are not recent (circa 1977) and coincide with vegetation remnants of the Rothbury and North Rothbury locality, which have experienced progressive unabated land clearing over the last 34 years. More recent records of the Powerful Owl and Barking Owl (circa 2004) are associated with Werikata National Park some 10km south of the site. Barking Owls have also being recorded in Belford National Park located approximately 8km to the west of the site. The lack of records is consistent with the published distributions and abundance for these species (NPWS, 2003; DEC, 2006; NSW Scientific Committee, 2008).

No recent records of the Masked Owl occur within the locality. The only records of the Masked Owl are old (circa 1970) from an unspecified site within 10km of the Lochinvar township. Masked Owls are genuinely rare throughout heavily modified landscapes of the Hunter Valley, with increased incidence of occurrence primarily restricted to the northern/southern hinterland (e.g. Quorrobolong and Dungog) and near coastal environments surrounding Lake Macquarie. Habitat loss, modification, patch size and fragmentation are likely to be the main reasons for the loss of Masked Owls from the central parts of the Hunter Valley, although their natural occurrence and abundance in this part of the Hunter Valley is likely to have always been limited due to the poor productivity of the native vegetation types of this area.

Field survey results for the Train Provisioning Facility support the results of the Wildlife Atlas database query (SKM, 2010). Targeted surveys conducted by SKM (2010) did not identify any owl species within the site. There is general consistency between the Wildlife Atlas Database records for owls in the locality and the absence of suitable habitat throughout lands north from the Main Northern Railway.

4.3 Likelihood of Occurrence

Table 3 provides a summary of the sites habitat quality for the Powerful Owl, Masked Owl and Barking Owl within each vegetation type found within the site.

Table 3 Habitat Suitability for the Powerful Owl, Masked Owl and Barking Owl within the Site

Vegetation Type	Habitat Quality	Likelihood of Occurrence
Grey Ironbark - Spotted Gum - Grey Box open forest on hills of the Hunter Valley, Sydney Basin	**Low, due to:** ◗ the limited number of trees with hollows of a suitable size for breeding; ◗ there are no recent records (less than 5 years) of these species in the locality; ◗ there is no evidence of recent or historical occupation of the site by forest owls and previous records from the locality are located within large patches of forest; and ◗ the relatively small area of habitat on the site and existing habitat fragmentation	**Unlikely – breeding/ nesting habitat** **Possible - foraging habitat**
Forest Red Gum - Grey Gum dry open forest on hills of the lower Hunter Valley, Sydney Basin	**Low, due to:** ◗ the limited number of trees with hollows of a suitable size for breeding; ◗ there are no recent records (less than 5 years) of these species in the locality; ◗ there is no evidence of recent or historical occupation of the site by forest owls and previous records from the locality are located within large patches of forest; and ◗ the relatively small area of habitat on the site and existing habitat fragmentation.	**Unlikely – breeding/ nesting habitat** **Possible - foraging habitat**

5. Summary and Conclusion

It is considered unlikely that the Powerful Owl, Masked Owl or Barking Owl would be resident or nest on the subject site given:

- the limited number of trees supporting hollows of a suitable size for breeding;
- there are no recent records (less than 5 years) of these species in the locality (OEH, 2011b; SKM, 2010) and previous records are limited in number and most from pre 1980;
- there is no evidence of recent or historical occupation of the site by forest owls and previous records from the locality are located within large patches of forest; and
- the relatively small area of habitat on the site and existing habitat fragmentation (i.e. owls preferentially occupy large vegetation blocks).

Only one suitably sized hollow occurs on site and this showed no evidence of current or previous owl occupation during the field investigations. The small remnant size provides limited proximal foraging habitat to the potential breeding hollow on site and the sites' fragmentation from larger vegetation remnants further reduces the availability of and access to foraging resources. Smaller tree-hollows are present but the potential for the development to impact on future breeding habitat is considered low as the isolation of the site from large vegetation patches will remain unabated. Further, there is no reasonable potential for the expansion of the sites habitat area through the natural regeneration of native vegetation or otherwise within available adjoining cleared lands, due to the presence of hostile gaps created by the Main North Railway and Hunter Expressway.

Notwithstanding the site contains potential foraging habitat for the forest owls and may form part of a larger home range for these species. However, the isolation of small areas of habitat from preferred large vegetation blocks through hostile gaps such as the Main North Railway and Hunter Expressway, is likely to restrict the use of the site to occasional or infrequent foraging activity only.

On the basis of these considerations, it is concluded that whilst the site may contribute to potential foraging habitat for the Powerful Owl, Masked Owl and Barking Owl in the locality, it is unlikely to support breeding habitat for any of these species. In this respect, an adjustment to the Tg score from 0.33 to 0.75 is considered suitable for the biobanking credit calculations for the development at Greta and better reflects the current and likely future habitat values of the site for the Powerful, Masked and Barking Owls.

.

6. References

DEC (2006). *Recovery Plan for Large Forest Owls*. Department of Environment and Conservation, NSW. (http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10485

DECC (2008) *NSW (Mitchell) Landscapes Version 3 (2002) Based on descriptions compiled by Dr. Peter Mitchell*. Department of Environment and Climate Change, NSW.

GHD (2011) *Biodiversity Offsets Package – Greta Train Facility* GHD Pty Ltd

NPWS (2003). *Draft Recovery Plan for the Barking Owl*. New South Wales National Parks and Wildlife Service, Hurstville, NSW.

NSW Scientific Committee (2008) Powerful Owl *Ninox strenua*. Review of current information in NSW. September 2008. Unpublished report arising from the Review of the Schedules of the *Threatened Species Conservation Act 1995*. NSW Scientific Committee, Hurstville.

OEH (2011a). Threatened Species Profiles for the Powerful Owl, Masked Owl, Barking Owl. Accessed May 2011.

OEH (2011b). NSW Wildlife Atlas Database. Office of Environment and Heritage NSW. Data supplied by OEH, May 2011.

SKM (2010) Ecological Impact Assessment for the Greta Train Provisioning Facility. Report prepared for Pacific National Pty Ltd.

GHD

PO Box 2875 Port Macquarie NSW 2444
T: (02) 6586 8700 F: (02) 6586 8701 E: pqqmail@ghd.com.au

Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	M. Aitkens	J. Tipping D. Williams	*J. Tipping* *D. Williams*	P. Parker		02/06/11

CLIENTS | PEOPLE | PERFORMANCE

Pacific National

Report on Greta Train Facility - BioBanking Offsets Package

Expert Report - Spotted-tailed Quoll

June 2011

INFRASTRUCTURE | MINING & INDUSTRY | DEFENCE | PROPERTY & BUILDINGS | ENVIRONMENT

Contents

Table Index

Figure Index

1. Introduction

1.1 Background

GHD has been engaged by Pacific National to undertake an assessment using the Biobanking assessment methodology as part of a proposed Train Support Facility at Greta, in the Hunter Valley, New South Wales (the Project). The results from this assessment and the BioBanking credit calculator predicted the site may have potential breeding habitat for the Spotted-tailed Quoll and assigned Tg scores accordingly. Site conditions, previous recordings of this species and the results of previous field surveys indicate the site may only have potential foraging habitat and, as such, this Expert Report has been prepared to support a modification to the Tg score.

1.2 Reasons for the Expert Report

An expert report may be prepared under section 4.4 of the Biobanking assessment methodology instead of undertaking a threatened species survey at a development site. The Biobanking Operational Manual (DECC 2009) states that the "*use of an expert report rather than a targeted survey may be beneficial where it is highly likely or highly unlikely that a species may occur on site, and/or the reliability of recording a species through survey is particularly low*".

The purposes of using an expert report instead of a survey are to determine whether:

- *The species is unlikely to be present at the development site; in this case no further assessment of the species is required. An expert report cannot determine that a species is unlikely to be present if the land is within an identified population for that species, unless the expert report is approved by the Director General.*
- *The species is likely to be present at the development site. In this case the expert report must provide an estimate of the number of individuals or area of habitat to be impacted by the development (depending on whether the species is flora or fauna)…; and*
- *The species is likely to be present at the biobank site. In this case the expert report must provide an estimate of the number of individuals or area of habitat on the biobank site (depending on whether the species is flora or fauna)…"*

An expert report may only be used for those threatened species and populations to which species credits apply, not for any threatened species to which ecosystems apply.

In this case, an expert report has been provided in relation to the Spotted-tailed Quoll (*Dasyurus maculatus*) under the provision of the first point above, although in this case the expert report has not been prepared to determine the species is not present on the site, rather that the species may use the site for foraging purposes and is unlikely to use the site for breeding or denning. Accordingly, the Expert Report has been provided to support the adjustments made to the Tg scores.

1.3 Qualifications and Experience of Experts

The BioBanking Operational Manual states that:

"*The person who prepares an expert report must be accredited under 142B(1)(b) of the methodology or have the relevant experience and/or qualifications to provide expert opinion in relation to the biodiversity values (in this case, threatened species) to which the expert report relates."*

1.3.1 GHD Expert

Kirsten Crosby

Dr Kirsten Crosby is a Senior Ecologist with GHD's Ecology Service Line. Kirsten has over ten years' ecological survey experience including five years in commercial environmental consultancy. Kirsten provides a range of services including: flora and fauna surveys; threatened species assessments; environmental impact assessments; and opportunity and constraints analyses. Kirsten has a strong background in animal ecology and identification, and has field experience throughout NSW, ACT, and parts of QLD and VIC using a wide range of survey techniques, including Elliot trapping, cage trapping, harp netting, pitfalling, infra-red cameras, spotlighting and call playback.

Kirsten has experience with urban development (including subdivisions and land release masterplans), infrastructure projects (roads, water and electricity), and mining and energy (coal mines, sand quarries and wind farms). She has managed ecology teams to prepare comprehensive and detailed reports, including Part 3A Environmental Assessments and impact assessments under Part 4 and 5 (NSW EP&A Act), Species Impact Statements (NSW TSC Act), and Referrals (Commonwealth EPBC Act). Kirsten also has experience in preparing policy documents for the Commonwealth Department of the Environment, Heritage, Water and the Arts.

Kirsten undertook her PhD field research in north-west Queensland. While her research focused on the evolution and biogeography of brush-tailed possums and cuscuses, she carried out bird, frog, reptile and general mammal surveys as well. Following completion of her PhD, Kirsten worked as a technical officer and occasional lecturer at the University of New South Wales. Kirsten managed student fauna surveys in the Sydney area (botany and marine studies), Smiths Lake on the NSW North Coast (mammal, bird and invertebrate surveys), and western New South Wales (bird and mammal surveys). Kirsten has lectured undergraduate classes in Invertebrate Biology, Vertebrate Zoology, Life in Arid Lands, and Palaeontology.

Through undertaking surveys and assessments throughout NSW and other areas, Kirsten has developed a strong understanding of the life history and habitat requirements of threatened species including the Spotted-tailed Quoll.

2. Species Information

2.1 Life Cycle

Detailed studies of three Spotted-tailed Quoll populations have been undertaken in south-eastern Australia. Matings were estimated to occur between late June and early August and births between mid-July and late August. Pouch litter size varied from four to six, with the average number of young weaned ranging between two to four, but possibly as low as one or two. Females reach adult weight (average 1.73kg) at two years, while males do not reach adult weight (average 2.81kg) until three years. Females did not breed before two years of age and were recorded breeding up to four years of age. A proportion of females did not appear to breed in consecutive years. The maximum age recorded was five years (Belcher, 2003).

Home ranges of Spotted-tailed Quolls are known to be extensive, with males occupying large, overlapping ranges (of at least 757 ha) and females occupying smaller, non-overlapping territories (of at least 175 ha) in the north-eastern tablelands of NSW (Glen and Dickman, 2006a). At Limeburners Creek Nature Reserve on the mid north coast, adult females had discrete home range areas, ranging in size up to 1511 ha, and adult males had much larger home ranges ranging in size up to 3401 ha. Male home ranges were found to overlap extensively with other males, and intersect between two to four female home ranges (Andrew, 2005).

Spotted-tailed Quolls undertake extensive movements on a daily and weekly basis, with maximum recorded daily movements being approximately 5 km for females and 8.5 km for males. Over longer periods males were recorded travelling over 20 km in nine days (Andrew, 2005).

2.2 Distribution and Abundance

The Spotted-tailed Quoll is a large marsupial carnivore that occurs in forested habitat in south-eastern Australia (Belcher, 2003). The subspecies *Dasyurus maculatus maculatus* was formerly distributed in south-eastern Queensland (as far north as Bundaberg and as far west as Chinchilla), eastern New South Wales, Victoria, South Australia, Tasmania (including some of the Bass Strait Islands). Its range has contracted severely in Queensland, and it is extinct in South Australia (Burnett and Dickman, 2008).

This species is patchily distributed as far west as Warrumbungles National Park with a number of localized areas where it is reasonably abundant, mostly in wet forests. Most abundant populations are believed to be in north-eastern New South Wales, where they are most commonly encountered on the north coast and ranges from the Hunter Valley, Taree, Port Macquarie to Coffs Harbour and the gorges and escarpments of the New England Tableland (Burnett and Dickman, 2008).

The total population of Spotted-tailed Quolls is in the order of 20,000 mature individuals. Populations in south-east Queensland, western Victoria (Otways and far south-west of Victoria), and coastal areas of southern New South Wales are known to be declining. The species is mostly uncommon (although it is present in good numbers in some areas, such as the Chaelundi Forests of Northern NSW) (Burnett and Dickman, 2008).

A number of studies have investigated distribution and abundance of Spotted-tailed quolls in NSW. Results of these are summarised below:

- In Werrikimbe National Park (northern NSW), 40 individual Spotted-tailed Quolls were trapped along 40 km of road (representing a 240 km² area), in 2000–01 (TSSC, 2004).
- In Tallaganda State Forest (southern NSW), in an area of 43 km² six individuals were recorded in 1997, seven in 1998, eight in 1999 and one in 2000 (TSSC, 2004).
- In Badja State Forest (southern NSW), in an area of 60 km², 11 individuals were recorded in 1996 and zero in 2000–01 (TSSC, 2004).
- Surveys in 2002–05 including dietary analysis and live-trapping recorded the species in the lower catchment of Jacobs River in the Byadbo Wilderness Area of southern Kosciuszko National Park (Dawson, 2005).
- In 2003 and 2004 a search for latrine sites confirmed the occurrence of the species at three locations in Namadgi National Park (ACT Government, 2005).

2.3 Ecology and Habitat Requirements

Spotted-tailed Quoll is found in forests, woodlands, wet forest alliance, rainforest, coastal heaths and coastal wet scrub, estuarine areas, and rocky headlands (Burnett and Dickman, 2008). This species' habitat appear to be characterised by relatively high (> 600 mm/yr) and predictable seasonal rainfall (Long and Nelson, 2004).

Spotted-tailed Quolls are mostly active on the ground or on fallen logs, but are also partly arboreal. The species tends to use hollow logs as dens in north-eastern NSW, but will also den in rock crevices, burrows, tree hollows and artificial structures (Glen and Dickman, 2006a). In a study in south-eastern Australia, rock dens were preferred over hollow logs, and the species was recorded using Wombat (*Vombatus ursinus*) and European Rabbit (*Oryctolagus cuniculus*) burrows (Belcher and Darrant, 2004). Individual quolls have been recorded using up to nine different dens in north-eastern NSW and up to 15 dens in south-eastern NSW, rarely using the same shelter location on successive days (with the exception of maternal dens) Glen and Dickman, 2006a; Belcher and Darrant, 2004).

The Spotted-tailed Quoll is an opportunistic predator, consuming a wide variety of species and apparently varying its diet to take advantage of short-term fluctuations in prey abundance. Medium-sized mammals (500–6999g), particularly hollow-nesting species, have been found to form the bulk of the diet of Spotted-tailed Quolls in the northern tablelands of New South Wales. The most frequently consumed vertebrates were the Greater Glider (*Petauroides volans*), European Rabbit, bandicoots (*Perameles nasuta* and/or *Isoodon macrourus*), Red-necked Pademelon (*Thylogale thetis*), Common Ringtail Possum (*Pseudocheirus peregrinus*), and brushtail possums (*Trichosurus vulpecula* and/or *T. caninus*). Insects were also eaten frequently, but birds and reptiles occurred relatively infrequently in the diet. Insects and reptiles were consumed more frequently, and mammals less frequently, in summer than in winter (Glen and Dickman, 2006b).

Very large areas of habitat are required to support viable populations due to the large home ranges of the species and the non-overlapping nature of female ranges (Glen and Dickman, 2006a). Habitat that is critical to the survival of the species includes large patches of forest with adequate denning resources and relatively high densities of medium-sized mammalian prey (Long and Nelson, 2004).

3. Description of the Site

3.1 Description of the Site

The subject site, including the location of the proposed facility, is Lot 1 DP 1129191 and has frontage onto Mansfield Street, Greta, NSW. It is geographically located in the Hunter Valley in the Local Government Area of Cessnock near the Township of Greta. The Township of Greta is located approximately 50 kilometres northwest of Newcastle and 20 kilometres north of Cessnock. The proposed development extends northwest from near Greta Railway Station for a distance of about 2.4 kilometres and extends southwest to the proposed corridor for the new freeway. The location of the site is illustrated in Figure 1.

The subject site is dominated by intact native vegetation in good condition. It occurs within an approximately 100 hectare parcel of open space administered by Pacific National. Historical land uses appear to include timber getting, grazing, stock keeping, and railway infrastructure adjoins the site. Disturbed areas include stock fences, a horse racing/exercising track, dirt tracks, farm dams, borrow pits and construction lay down areas. The southern portion of the site is affected by mine subsidence.

3.2 Landscape Context

The site is located within the Central Hunter Foothills Mitchell Landscape. This is characterised by undulating lowlands, rounded to steep hills with rock outcrop on ridges on Permian lithic sandstone, conglomerate, shale and coal, general elevation 40 to 300m with a few higher peaks, local relief 30 to 120m. Red-brown to yellow brown harsh texture-contrast soils on slopes, dark coloured clays in valleys and limited accumulations of sand and gravel in streams. Woodlands to open forest of Spotted Gum (*Corymbia maculata*), Forest Redgum (*Eucalyptus tereticornis*), Narrow-leaved Ironbark (*Eucalyptus crebra*), Red Ironbark (*Eucalyptus fibrosa*), and Rough-barked Apple (*Angophora floribunda*) with Kangaroo Grass (*Themeda australis*) and Wallaby Grass (*Austrodanthonia* sp) (DEC, 2002).

3.3 Surrounding Land Uses

The site is located south of the village of Greta and is bound by the Main Northern Railway and residential properties to the north and rural land to the east, south and west. Native vegetation cover to the south is characterised by a large connected remnants of varying condition, with vegetation cover to the north being largely cleared as a consequence of prior agriculture activity, urban development and construction of major infrastructure corridors.

3.4 Climate

The climate of the Hunter Valley region stretches about 160km from the ocean at Newcastle to the west, and although the climate varies considerable the average temperatures remain fairly consistent. Summers average temperature is approximately 30 degrees, Spring and Autumn ranges from 22-27 degrees and winter temperatures fall between 18-19 degrees. The average annual rainfall for the area, based on the weather station at Cessnock, is approximately 757 mm.

3.5 Hydrology

Site topography is generally undulating (maximum grade 5-10%) with variable north, east and west facing slopes associated with north flowing drainages. Runoff from the site is via overland flow into three broad north flowing open depressions of ephemeral character. Water leaves the site in a northerly direction where it flows beneath the Main Northern Railway into Anvil Creek, which is a semi-permanent to permanent creek lined mostly by Swamp Oak (*Casuarina glauca*).

3.6 Geology and Topography

SKM provided contours over the site using aerial mapping. The contours show the general grade of the site running west to east with a significant water course which passes through the site on the southern end. As the property slopes from the railway line up to the F3 corridor, the proposed sidings will require some cut to be performed upon the site to ensure that railway grades are achieved after leaving the main rail line.

The construction of the Hunter Expressway on the western boundary, once completed, will provide a significant barrier on the western extent of the site.

There are no cliff lines, large boulders or extensive areas of caves, overhangs and fissures within the site. There are no rock outcrops with platey rock fragments and fissures (GHD, 2011).

3.7 Vegetation Cover

Native vegetation of the site comprises dry sclerophyll open forest. The presence of mature trees and saplings indicates that the site has never been completely cleared of its pre-European eucalypt canopy cover; however the consistent sub benchmark native plant species richness is indicative of prior/ sustained disturbances. Disturbance at the site includes past over storey removal, management of the mid-stratum vegetation, disturbance of the ground layer in parts by agriculture and mine subsidence.

The vegetation types on the site are detailed in Table 1.

Table 1 Vegetation Type and Condition

Vegetation Type	ID	Conservation Significance	Description	Condition
Grey Ironbark - Spotted Gum - Grey Box open forest on hills of the Hunter Valley, Sydney Basin	HU556	EEC.	As per detailed description below.	Moderate
Forest Red Gum - Grey Gum dry open forest on hills of the lower Hunter Valley, Sydney Basin	HU544	EEC	As per detailed description below.	Moderate

The following descriptions are those presented in the Environmental Assessment report for the project (SKM, 2010).

3.7.1 Grey Ironbark - Spotted Gum - Grey Box open forest on hills of the Hunter Valley, Sydney Basin [HU556]

This community has strong affinities to the listed EEC Lower Hunter Spotted Gum - Ironbark Forest. This community is associated with higher elevated slopes of the study area. The community supports an open canopy ranging between 15-20 m dominated by Spotted Gum (*Corymbia maculata*) and Narrow-leaved Ironbark (*Eucalyptus crebra*), with other species being co-dominant in areas including Broad-leaved Ironbark (*E. fibrosa*), Grey Gum (*E. punctata x canaliculata*) and Forest Red Gum (*E. tereticornis*). Some areas support a high abundance of regenerating trees with larger trees interspersed. A low-moderate abundance of Bulloak (*Allocasuarina luehmannii*) is present throughout this community.

The understorey varies throughout the study area comprising a mix of shrub and groundcovers varying in density. A moderately dense shrub layer is present dominated by a diversity of species, including Black Thorn (*Bursaria spinosa*), Gorse Bitter-pea (*Daviesia ulicifolia*), Needlebush (*Hakea sericea*), Narrow-leaved Geebung (*Persoonia linearis*), Rice Flower (*Pimelea linifolia* subsp. *linifolia*), Swamp Wattle (*Acacia elongata*) and Coffee Bush (*Breynia oblongifolia*). The dominant shrub species within this community varies throughout the study area and ranges from 1-3 m in height.

The groundcover of this community includes a relatively high diversity of flora species varying in density with the degree of soil moisture and shelter. Common grass species in this map unit include Purple Wiregrass (*Aristida ramosa*), Three-awn Spear-grass (*A. vagans*), Barbed-wire Grass (*Cymbopogon refractus*), Wiry Panic (*Entolasia stricta*) and Weeping Grass (*Microlaena stipoides*) varying in dominance. Common forb species include a diversity of herbs and graminoids such as Many-flowered Mat-rush (*Lomandra multiflora*), Mulga Fern (*Cheilanthes sieberi*), White Root (*Pratia purpurascens*), *Lomandra filiformis* and Poverty Raspwort (*Gonocarpus tetragynus*).

A sparse cover of weed species is present throughout most likely as a result of past agricultural practices, and weeds are most abundant on the edges of this community adjoining the rail corridor. Common weed species include Flatweed (*Hypocharis radicata*), Stinking Roger (*Tagetes minuta*) and African Olive (*Olea europaea* subsp. *cuspidata*)." (SKM, 2010).

3.7.2 Forest Red Gum - Grey Gum dry open forest on hills of the lower Hunter Valley, Sydney Basin (HU554]

This community is associated with lower elevated areas of the study area, including open depressions and slopes surrounding drainage lines. The community supports an open canopy ranging between 15-20 m dominated by Forest Red Gum and Narrow-leaved Ironbark with other species being co-dominant in areas including Rough-barked Apple (*Angophora floribunda*), Grey Box, Grey Gum and Spotted Gum. Some areas support a high abundance of regenerating trees with larger trees interspersed. A moderate abundance of small-medium sized trees (4-8 m high) are present including *Melaleuca decora*, Prickly-leaved Paperbark (*Melaleuca nodosa*) and Bulloak is present throughout this community, particularly along drainage lines.

The understorey varies throughout the study area comprising a mix of shrub and groundcovers varying in density. A sparse to moderately dense shrub layer is present 1-3 m in height dominated by similar species to map unit 1.

Dominant shrub species include Gorse Bitter-pea, Needlebush, Narrow-leaved Geebung, Coffee Bush, Rice Flower, *Acacia falcata*, Silver-stemmed Wattle (*Acacia parvipinnula*) and *Leptopsermum parvifolium*.

The groundcover of this community includes a relatively high diversity of flora species varying in density with the degree of soil moisture and shelter. The most dominant grass species are Weeping Grass and Barbed-wire Grass with other grasses occurring in lower abundance including Paddock Lovegrass (*Eragrostis leptostachya*), *Paspalidium distans* and Tufted Hedgehog Grass (*Echinopogon caespitosus* var. *caespitosus*). Common forb species include a diversity of herbs and graminoids such as Rough Raspwort (*Halogris heterophylla*), White Root, Mat-rush (*Lomandra longifolia*) and Blue Bottle-daisy (*Lagenophora stipitata*).

A sparse cover of weed species is present throughout this community most likely as a result of past agricultural practices, and weeds are most abundant on the edges of this community adjoining the rail corridor and along the major drainage line at the southern end of the study area. Common weed species include several pasture species such as Carpet Grass (*Axonopus affinis*), *Lantana camara*, Flatweed and African Olive." (SKM, 2010).

3.8 Habitat

3.8.1 Vegetation Condition

The structure and floristics of the tree canopy and shrub midstorey is well developed in the western parts of the site with decreasing condition noted in the eastern parts where grazing, mine subsidence and prior clearing works have been more prominent. Tree canopy cover is notably lower in the eastern parts of the site particularly in areas that adjoin active subsidence.

Floristic species richness is generally below benchmark levels for both vegetation types, although the less so for the Grey Ironbark - Spotted Gum - Grey Box open forest on hills of the Hunter Valley, Sydney Basin [HU556]. This finding is consistent with a regenerating vegetation patch responding to prior disturbance regimes and/or responding to current environmental factors (e.g. absence of fire).

3.8.2 Tree Hollows and Logs

SKM (2010) found tree hollows to be moderately abundant in the remnant forests in the northern half of the site with densities of up to 5 hollow-bearing trees per hectare recorded, while densities of around 1-2 hollow bearing trees per hectare were recorded in the southern third of the site. Tree hollows represent important local habitat for hollow-dependent fauna, including bats, birds and mammals, possibly including the Spotted-tailed Quoll.

Areas of moderate and good condition vegetation within the development footprint are equivalent to undisturbed vegetation for the majority of biobank site attribute variables including levels of woody debris (GHD, 2011).

3.8.3 Foraging Resources

SKM (2010) reported the presence of the Squirrel Glider (*Petaurus norfolcensis*) and Common Brushtail Possum and European Rabbits were also recorded. These species are potential prey for the Spotted-tailed Quoll, as are a range of birds, reptiles and insects also present at the site.

3.9 Connectivity

The main Hunter east-west railway lies to the north and east of the subject site and beyond that rural-residential land and the township of Greta. The train line to the east of the site would comprise a hostile gap for many fauna species known or likely to occur at the site, including the Spotted-tailed Quoll.

The subject site previously adjoined over 500 hectares of vegetated open space to the west and south-west. The Hunter Expressway is currently being constructed through this vegetated corridor to the immediate west of the site. The footprint for the Hunter Expressway will significantly reduce the extent of this vegetated corridor and interrupt east-west movement opportunities for the Spotted-tailed Quoll. The Hunter Expressway would probably include fauna crossings as part of the design, however the precise location and intended function of these crossings relative to the subject site is not known. Therefore for the purpose of this assessment the Hunter Expressway is assumed to comprise a 'hostile gap', that is a complete barrier to fauna movement. In this context, there is a narrow (approximately 50 metres to 300 metres wide) north-south fauna movement corridor running through the subject site. This corridor is interrupted by Hunter Expressway infrastructure to the north but is connected to fauna movement corridors to the south and from there to additional contiguous vegetation to the south (GHD, 2011).

3.10 Prior Field Surveys

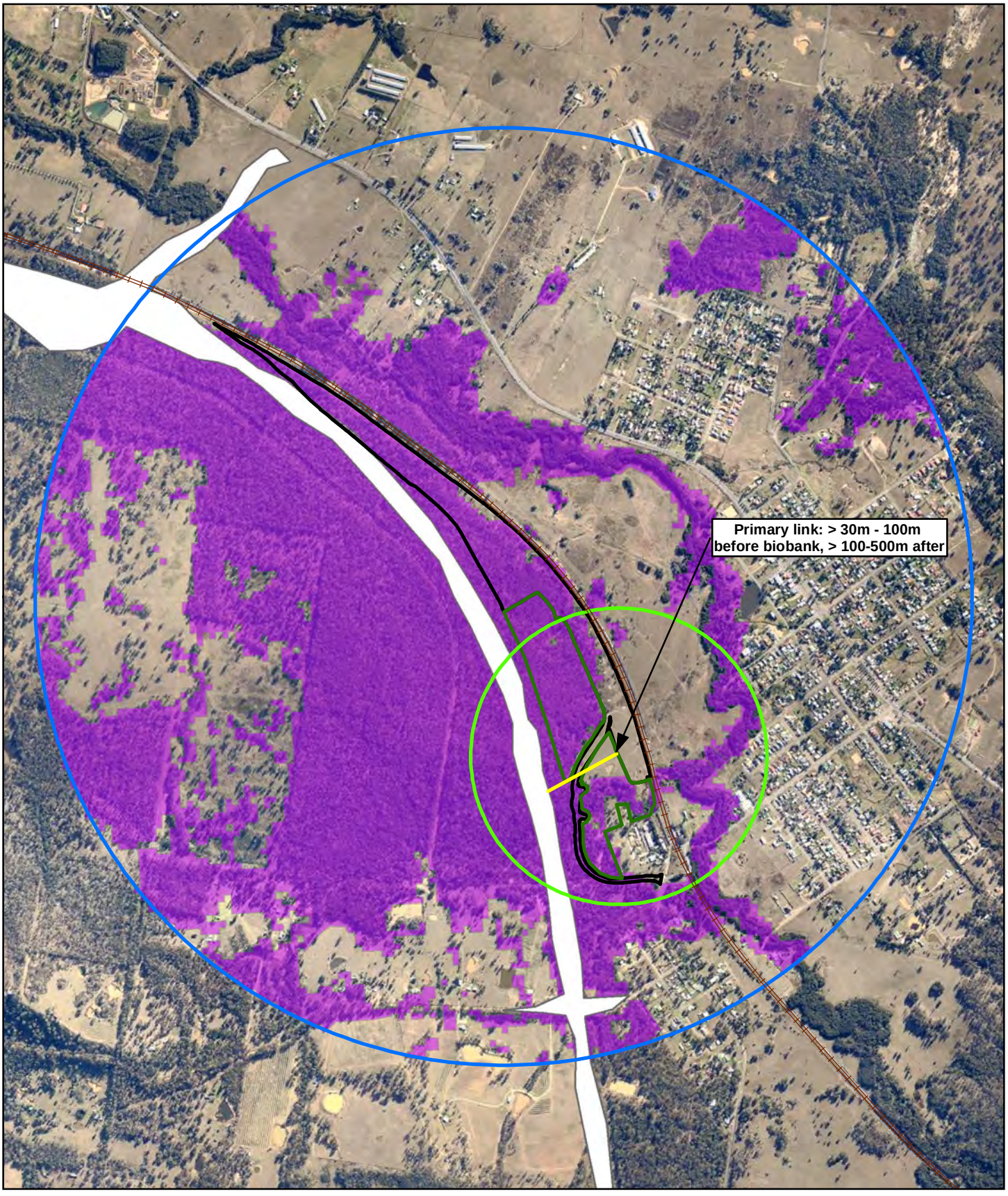
Flora and fauna surveys have been undertaken on the site by SKM (2010). Surveys were conducted over four consecutive nights in Spring, 2009, and included diurnal and nocturnal census. Methods relevant to the Spotted-tailed Quoll included trapping and spotlighting.

Site surveys of the Greta biobank portion of the subject site were conducted by GHD according to the BioBanking methodology to supplement the Project ecological assessment discussed above. Plot and transect surveys were conducted on site in accordance with the procedures provided in DECC (2009). The Site Value was determined by assessing ten 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. A total of eight plots were sampled within the Greta biobank site. No systematic targeted surveys for threatened fauna species were conducted. Opportunistic observations of fauna were recorded.

A summary of combined survey effort by SKM and GHD is provided in Table 2 below.

Table 2 Survey Effort

Date	Company	Survey Methods	Survey Effort
14 to 18 September 2009	SKM	Elliot B traps (ground)	48 trap nights
14 to 18 September 2009	SKM	Cage traps (ground)	24 trap nights
14 to 18 September 2009	SKM	Spotlighting	8 person hours
1 and 2 February 2011	GHD	20 m x 50 m BioBanking plot / transect surveys within the Greta biobank site. Targeted search for *Eucalyptus glaucina*, opportunistic fauna and threatened plant observations within the entire subject site.	2 ecologists for 2 days 8 plot / transects
29 April 2011	GHD	Supplementary targeted search for *Eucalyptus glaucina*, including plotting of intergrades with *E. tereticornis,* opportunistic fauna and threatened plant observations within the entire subject site.	2 ecologists for 1 day



LEGEND

- 100ha Biobank Assesment Circle
- 1000ha Assesment Circle
- Biobank site
- Development area
- Vegetation cover
- Hunter Expressway
- Primary Link
- Railways

1:20,000 (at A4)

0 95 190 380 570 760

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 56

N

GHD

CLIENTS | PEOPLE | PERFORMANCE

Pacific National
Greta Provisioning Facility
Biodiversity Offsets Package

Greta subject site
landscape assessment

Job Number	22-15502
Revision	A
Date	23 May 2011

Figure 1

G:\22\15502\GIS\Maps\MXD\22_15502_Z012_Greta_Landscape_AssessmentaCircles_F3Updare.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 2010; Navigate StreetMap: StreetMap - Jan 2010. Created by: qjchung

4. Expert Assessment and Conclusion

4.1 Potential Habitat in the Site

The Spotted-tailed Quoll is found in a wide variety of habitat types, characterised by relatively high (> 600 mm/yr) and predictable seasonal rainfall. This species dens in a range of habitat features, including hollow logs, burrows and rocky outcrops (Long and Nelson, 2004). The subject site (an approximately 100 hectare parcel) is dominated by intact native forest vegetation in good condition. Annual rainfall for the area is over 750 mm/yr. Woody debris and moderate numbers of hollow-bearing trees are present. There are no rock outcrops present (GHD, 2011). SKM (2010) reported the presence of the Squirrel Glider (*Petaurus norfolcensis*) and Common Brushtail Possum (*Trichosurus vulpecula*) as the dominant arboreal mammal fauna, these being suitable prey species of the Spotted-tailed Quoll. Native vegetation at the site is therefore considered to be potential habitat for the Spotted-tailed Quoll.

4.2 Local Records

There are eight records of the Spotted-tailed Quoll in the locality. Six are to the north of the main Hunter east-west railway, and two to the south-west. Records range in date between 1980 and 2006.

4.3 Likelihood of Occurrence

Spotted-tailed Quolls have home ranges ranging between 175 and 3400 hectares, depending on the sex of the animal and habitat quality. Very large areas of habitat are therefore required to support viable populations (Glen and Dickman, 2006a), and habitat critical to the survival of the species includes forest with adequate denning resources and relatively high densities of medium-sized mammalian prey (Long and Nelson, 2004).

The site is currently located on the edge of a large vegetated corridor, with the main Hunter east-west railway forming a semi-permeable barrier to the north and east. The footprint for the Hunter Expressway currently under construction will significantly reduce the extent of the vegetated corridor and interrupt east-west movement opportunities for the Spotted-tailed Quoll. A narrow (approximately 50 metres to 300 metres wide) north-south fauna movement corridor runs through the subject site. This corridor is interrupted by Hunter Expressway infrastructure to the north but is connected to fauna movement corridors to the south and from there to additional contiguous vegetation to the south (GHD, 2011).

The subject site could possibly be part of the home range of one or two individual Spotted-tailed Quolls. The site provides potential den sites, and prey species are also present. Young males may also use the site for dispersal from their mothers' territories, however this movement would be constrained by the existing railway and the expressway under construction. Given the above movement issues, and the habitat present on site, it is considered that the site represents potential occasional habitat for one or two Spotted-tailed Quolls, but is not considered to be habitat critical to the survival of the species.

4.4 Conclusion

The Spotted-tailed Quoll may potentially occur on occasion within the subject site due to the:

- Presence of local records;
- Presence of suitable forest habitat;
- Presence of suitable denning and breeding habitat; and
- Presence of prey species.

The subject site is not considered to be important habitat for the species as the subject site patch will be isolated between the two hostile barriers (the main Hunter east-west railway and the Hunter Expressway), leaving its long term viability questionable. While potential habitat will remain, it is unlikely to be used for breeding and dispersal as the habitat area is not part of a large tract of vegetation and is isolated to a large degree by surrounding development.

No species credits are required as the Spotted-tailed Quoll is not a species of the type which requires calculation of species credits. Spotted-tailed Quolls (if present) would occur within ecosystem credits at the development site and are also predicted to occur in ecosystem credits generated at the biobank site. 413 ecosystem credits for the Forest Red Gum - Grey Gum dry open forest on hills of the lower Hunter Valley, Sydney Basin (HU544) and 623 ecosystem credits for the Grey Ironbark - Spotted Gum - Grey Box open forest on hills of the Hunter Valley, Sydney Basin (HU556) are present at the Greta biobank site.

5. References

ACT Government (2005). Spotted-tailed Quoll (*Dasyurus maculatus*) - a vulnerable species, Action Plan No. 30. Canberra: Environment ACT. Available from: http://www.tams.act.gov.au/live/environment/native_plants_and_animals/threatened_species_and_ecological_communities_in_the_act/threatened_species_action_plans

Andrew, D.L (2005). Ecology of the tiger quoll *Dasyurus maculatus maculatus* in coastal New South Wales. MSc thesis, School of Biological Sciences, University of Wollongong, 2005. http://ro.uow.edu.au/theses/686

Belcher, C. A. (2003). Demographics of tiger quoll (*Dasyurus maculatus maculatus*) populations in south-eastern Australia. *Australian Journal of Zoology* 51: 611 – 626.

Belcher, C. A. and Darrant, J. P. (2004). Den use by the spotted-tailed quoll *Dasyurus maculatus* in south-eastern Australia. *Australian Mammology* 28: 59 – 64.

Burnett, S. and Dickman, C. (2008). *Dasyurus maculatus*. In: IUCN 2010. IUCN Red List of Threatened Species. Version 2010.4. <www.iucnredlist.org>. Downloaded on 30 May 2011.

Dawson, J.P. (2005). Impact of wildfire on the spotted-tailed quoll *Dasyurus maculatus* in Kosciuszko National Park. M.Sc. Thesis. University College (Australian Defence Force Academy), University of New South Wales.

Department of Environment and Climate Change (DECC) (2009). BioBanking Assessment Methodology and Credit Calculator Operation Manual. State of NSW and Department of Environment and Climate Change, Sydney.

Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) (2011). *Dasyurus maculatus maculatus* (SE mainland population) in Species Profile and Threats Database, Department of Sustainability, Environment, Water, Population and Communities, Canberra. Available from: http://www.environment.gov.au/sprat

GHD (2011). Report for Greta Provisioning Facility Biodiversity Offsets Strategy - Stage 1.

GHD (2011). Greta Provisioning Facility Biodiversity Offsets Package.

Glen, A. S. and Dickman, C.R. (2006a). Home range, denning behaviour and microhabitat use of the carnivorous marsupial *Dasyurus maculatus* in eastern Australia. *Journal of Zoology*: 347–354.

Glen, A. S. and Dickman, C.R. (2006b). Diet of the spotted-tailed quoll (*Dasyurus maculatus*) in eastern Australia: effects of season, sex and size. *Journal of Zoology* 269: 241–248.

Long, K. I. and Nelson, J. L. (2004). Recovery Plan for *Dasyurus maculatus* (Spotted-tailed Quoll) 2005 – 2009. Department of the Environment and Heritage, Canberra.

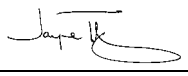
Sinclair Knight Mertz (SKM) (2010a). Train Support Facility, Greta, NSW Ecological Impact Assessment.

Sinclair Knight Mertz (SKM) (2010b). Addendum Report Train Support Facility Greta, NSW Ecological Impact Assessment.

Threatened Species Scientific Committee (TSSC) (2004). Commonwealth Listing Advice on *Dasyurus maculatus maculatus* (Spot-tailed Quoll, Spotted-tailed Quoll, Tiger Quoll). Available from: http://www.environment.gov.au/biodiversity/threatened/species/tiger-quoll.html

PO Box 2875 Port Macquarie NSW 2444
T: (02) 6586 8700 F: (02) 6586 8701 E: pqqmail@ghd.com.au

Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0.	B Harrington	J Tipping	*J Tipping*	P Parker	*P Parker*	23/05/2011
1.	B Harrington	D Williams	*D Williams*	P Parker	*P Parker*	01/06/2011
2	B Harrington	D Williams	D Williams	P Parker	P Parker	23/09/2011
3	B Harrington	J Tipping	J Tipping	P. Parker	P Parker	06/09/2012
4	B Harrington	J Tipping		P. Parker		27/09/2012

-
T: 2 9239 7100 F: 2 9239 7199 E: sydmail@ghd.com.au

Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0.	B Harrington	J Tipping	*J Tipping*	P Parker	*P Parker*	23/05/2011
1.	B Harrington	D Williams	*D Williams*	P Parker	*P Parker*	01/06/2011
2	B Harrington	D Williams	D Williams	P Parker	P Parker	23/09/2011
3	B Harrington	J Tipping	J Tipping	P. Parker	P Parker	06/09/2012
4	B Harrington	J Tipping	*J Tipping*	P. Parker	*P Parker*	27/09/2012
5	B Harrington	J Tipping	*J Tipping*	D Williams	*D Williams*	30/01/13