



# Department of Infrastructure and Regional Development

Western Sydney Airport EIS Biodiversity Offset Package

August 2016

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Appendix A - Potential offset sites

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### **Glossary of terms**

Term	Definition
Affected threatened biota	Threatened species, populations or communities listed under the EPBC Act, which are likely to suffer a significant impact as a result of a proposal and which require biodiversity offsets having regard to the EPBC Act Offsets policy.
Airport site	The site for Sydney West Airport as defined in the Airports Act.
BBAM	The NSW BioBanking Assessment Methodology (OEH, 2014).
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 NSW Environment Minister under Part 7A of the TSC Act for establishing a biobank site.
BioBanking Trust Fund	The Trust Fund established under Part 7A of the TSC Act to hold funds from the sale of credits.
Biodiversity credit	A unit of biodiversity value to measure specific development impacts or conservation gains in accordance with the BBAM. Includes ecosystem credits or species credits.
Biodiversity credit report	The report set out in Appendix B. Specifies the number and type of biodiversity credits: required to offset the impacts of a development to obtain a Biobanking statement; or required to offset the impacts of a Major Project in accordance with the FBA; or that would be generated through conservation and management of a biobank site under a BioBanking agreement.
Biodiversity offset delivery plan	The biodiversity offset delivery plan which will set out the specific actions to be taken to meet the offset conditions for the airport as set out in the Airport Plan. Its development will be guided by the framework established in this biodiversity offset package.
Biodiversity offset package	This report, which outlines the approach to the delivery of biodiversity offsets for the proposed airport, including an estimate of the quantum of offsets required, options to deliver these offsets, an estimate of the costs involved and the additional steps required to finalise their delivery.
Biodiversity offsets	Specific measures that are put in place to compensate for impacts on biodiversity values.
Biodiversity values	The composition, structure and function of ecosystems, including native species, populations and ecological communities, and their habitats.
CEEC	Critically endangered ecological community.
Construction impact zone (CIZ)	Includes the area of bulk earthworks in the northern half of the airport site (particularly for the establishment of the runway, terminal and aviation support facilities) together with areas of disturbance for ancillary infrastructure in the southern half of the airport site (e.g. drainage channels).
	The construction impact zone does not include the long term development such as the second runway or ancillary development outside the airport site boundary which will be subject to separate approvals. A full description is provided in Chapter 6 of the EIS.

Term	Definition
Department of Infrastructure and Regional Development	The Australian Government Department responsible for proposing Stage 1 of the Western Sydney Airport.
DoEE	The Commonwealth Department of the Environment and Energy. Previously the Department of the Environment.
DPI	The NSW Department of Primary Industries.
DSEWPaC	The former Department of Sustainability Environment Water Populations and Communities, now the Commonwealth Department of the Environment and Energy.
Ecosystem credit	The class of biodiversity credits created or required for the impact on EECs, CEECs and threatened species habitat for species that can be reliably predicted to occur within a vegetation type according to the BBAM.
EEC	Endangered ecological community listed under the EPBC Act.
Environmental conservation zone	The area at the airport site that would be provided as an environmental conservation zone, as outlined in the land use plan in the revised draft Airport Plan (see Chapter 4 of the EIS).
EPBC Act	The Commonwealth Environment Protection and Biodiversity Conservation Act 1999.
EPBC Act listed biota	Threatened species and communities and migratory species listed under the EPBC Act.
FBA	The Framework for Biodiversity Assessment (OEH, 2014a). The methodology to assess impacts on biodiversity that is used to assess all biodiversity values on the development site for a Major Project under the NSW <i>Environmental Planning and Assessment Act 1979</i> (EPA Act) and in accordance with The NSW Biodiversity Offsets Policy for Major Projects (OEH, 2014a).
FM Act	The Fisheries Management Act 1994 (NSW).
Interim biogeographic regionalisation of Australia (IBRA) bioregion and IBRA subregions	A bioregion defined in a national system of bio-regionalisation. For this study this is as defined in the Interim Biogeographic Regionalisation for Australia (Thackway and Cresswell, 1995) and mapped in DSEWPaC (2011).
Longer term development	The longer term stage in the development of the proposed airport, including parallel runways and facilities for up to 82 million passengers annually.
Main Construction Works	Main Construction Works means substantial physical works on the airport site (including large scale vegetation clearance, bulk earthworks and the carrying out of other physical works, and the erection of buildings and structures) described in Part 3 of the Airport Plan, other than Preparatory Activities (see definition below for Preparatory Activities).

Term	Definition
MNES	'Matters of national environmental significance' listed under the EPBC Act, including for example, threatened biota, migratory species, World Heritage/National Heritage sites and Ramsar wetland sites.
NSW-listed biota	Threatened species, populations and communities listed under the NSW TSC Act or FM Act.
OEH	The NSW Office of Environment and Heritage.
PMST	Protected Matters Search Tool, a database administered by DoEE that contains known and predicted records of matters of national environmental significance listed under the EPBC Act.
Potential offset areas	The areas within the potential offset sites that have been identified in this offset package that would be suitable to offset impacts on affected threatened biota listed under the EPBC Act. Only includes vegetation and habitat which is appropriate to offset impacts on the affected threatened biota having regard to the EPBC Act Offset Policy and which are linked to biodiversity credits which are available for sale.
Potential offset sites	The potential offset sites that have been identified in this offset package in order to offset biodiversity impacts.
Preparatory Activities	<ul> <li>Preparatory Activities mean the following:</li> <li>(a) day to day site and property management activities;</li> <li>(b) site investigations, surveys (including dilapidation surveys), monitoring, and related works (e.g. geotechnical or other investigative drilling, excavation, or salvage);</li> <li>(c) establishing construction work sites, site offices, plant and equipment, and related site mobilisation activities (including access points, access tracks and other minor access works, and safety and security measures such as fencing); and</li> <li>(d) enabling preparatory activities such as: <ul> <li>i. demolition or relocation of existing structures (including buildings, services, utilities and roads) provided they are demolished or relocated in accordance with applicable environmental impact mitigation measures specifically referable to demolition or relocation of the relevant structures;</li> <li>ii. the relocation of cemeteries in accordance with an approved cemeteries relocation management plan; and</li> <li>iii. application of environmental impact mitigation measures.</li> </ul> </li> </ul>
Revised Draft Airport Plan	The draft plan developed in accordance with the requirements of the <i>Airports Act 1996</i> , setting out the Australian Government's requirements for the initial development of the proposed airport.
Species credit	The class of biodiversity credits created or required for the impact on threatened species that cannot be reliably predicted to use an area of land based on habitat surrogates according to the BBAM.
Species credit-type threatened species	Threatened species that are linked to species credits according to the BBAM (rather than ecosystem credits) because they cannot be reliably predicted to use an area of land based on habitat surrogates according to the BBAM.

Term	Definition
Stage 1 construction impact zone	The disturbance footprint for construction of the Stage 1 development, including the anticipated extent of vegetation clearing and grubbing, earthworks, drainage works and the permanent infrastructure that would be constructed for Stage 1 of the airport.
Stage 1 development	The initial stage in the development of the proposed airport, including a single runway and facilities for 10 million annual passengers. (the EIS assumes the airport could be operating at this level approximately 5 years after operations commence which for assessment purposes has been assumed to be 2030).
TEC	Threatened ecological community listed under the EPBC Act and/or the TSC Act.
The EPBC Act Offsets Policy	The Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy (DSEWPaC 2012).
The locality	Land within a 10 km radius of the airport site.
The offsets assessment guide	The spreadsheet offset calculator that accompanies the <i>Environment Protection and</i> <i>Biodiversity Conservation Act 1999 Environmental Offsets Policy</i> (DSEWPaC 2012)
The proposed airport	The proposed Western Sydney Airport.
The region	A bioregion defined in a national system of bio-regionalisation. For this study, this is the Sydney Basin Bioregion as defined in the Interim Biogeographic Regionalisation for Australia (Thackway and Cresswell 1995).
Threatened biota	Threatened species, populations or communities listed under the EPBC Act, TSC Act or FM Act.
TSC Act	The NSW Threatened Species Conservation Act 1995.
Western Sydney Airport	The proposed airport. The airport is referred to as Sydney West Airport under the Airports Act.

## 1. Introduction

## 1.1 Background

Planning investigations to identify a site for a second Sydney airport first commenced in 1946, with a number of comprehensive studies—including two previous environmental impact statements for a site at Badgerys Creek—having been completed over the last 30 years.

More recently, the *Joint Study on Aviation Capacity in the Sydney Region* (Department of Infrastructure and Transport, 2012) and *A Study of Wilton and RAAF Base Richmond for civil aviation operations* (Department of Infrastructure and Transport, 2013) led to the Australian Government announcement on 15 April 2014 that Badgerys Creek will be the site of a new airport for Western Sydney. The airport is proposed to be developed on approximately 1,768 hectares of land acquired by the Commonwealth in the 1980s and 1990s. Airport operations are expected to commence in the mid-2020s.

The proposed airport would provide both domestic and international services, with development staged in response to demand. The initial development of the proposed airport (referred to as the Stage 1 Development) would include a single, 3,700 metre runway coupled with landside and airside facilities such as passenger terminals, cargo and maintenance areas, car parks and navigational instrumentation capable of facilitating the safe and efficient movement of approximately 10 million passengers per year as well as freight operations. To maximise the potential of the site, the airport is proposed to operate on a 24-hour basis. Consistent with the practice at all federally leased airports; non-aeronautical commercial uses could be permitted on the airport site subject to relevant approvals.

While the proposed Stage 1 development does not currently include a rail service, planning for the proposed airport preserves flexibility for several possible rail alignments, including a potential express service. A joint scoping study is being undertaken with the NSW Government to determine rail needs for Western Sydney and the airport. A potential final rail alignment will be determined through the joint scoping study with the New South Wales Government, with any enabling work required during Stage 1 expected to be subject to a separate approval and environmental assessment process.

As demand increases, additional aviation infrastructure and aviation support precincts are expected to be developed until the first runway reaches capacity at around 37 million passenger movements. At this time, expected to be around 2050, a second parallel runway is expected to be required. In the longer term, approximately 40 years after operations commence and in accordance with relevant planning approval processes, the airport development is expected to fully occupy the airport site, with additional passenger and transport facilities for around 82 million passenger movements per year.

On 23 December 2014, the Australian Government Minister for the Environment determined that the construction and operation of the airport would require assessment in accordance with the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act). Guidelines for the content of an environmental impact statement (EIS) were issued in January 2015. Approval for the construction and operation of the proposed airport will be controlled by the *Airports Act 1996* (Cth) (Airports Act). The Airports Act provides for the preparation of an Airport Plan, which will serve as the authorisation for the development of the proposed airport.

The Australian Government Department of Infrastructure and Regional Development (DIRD) is undertaking detailed planning and investigations for the proposed airport, including the development of an Airport Plan. A draft Airport Plan was exhibited for public comment with the draft EIS late in 2015. Following receipt of public comments, a revised draft Airport Plan has been developed. The revised draft Airport Plan identifies a staged development of the proposed airport. It provides details of the initial development being authorised, as well as a long-term vision of the airport's development over a number of stages. This enables preliminary consideration of the implications of longer term airport operations. Any airport development beyond Stage 1, including the construction of additional terminal areas or supporting infrastructure to expand the capacity of the airport using the first runway or construction of a second runway, would be managed in accordance with the existing process in the Airports Act. This includes a requirement that, for major airport developments (defined in the Airports Act), a major development plan be approved by the Australian Government Infrastructure Minister following a referral under the EPBC Act.

The Airport Plan will be required to include any conditions notified by the Environment Minister following this EIS. Any subsequent approvals for future stages of the development will form part of the airport lessee company's responsibilities in accordance with the relevant legislation.

### **1.2** Overview of the offset proposal

The EIS guidelines state that the EIS must include details of an offset package to be implemented to compensate for residual significant impacts associated with the project, as well as an analysis of how the offset meets the requirements of the *Environment Protection and Biodiversity Conservation Act* 1999 Environmental Offsets Policy October 2012 (EPBC Act Offsets policy) (DSEWPaC 2012a). The key considerations included in the policy are that:

- offsets are described as measures that compensate for significant residual adverse impacts on the environment and the policy applies to all matters that are protected under the EPBC Act;
- the 'offsets assessment guide' spreadsheet is a tool that has been developed to help assess the suitability of offset proposals. The offsets assessment guide uses a balance sheet approach to measure impacts and offsets;
- at least 90 per cent of a project's impacts should be directly offset (subject to exceptions outlined in the EPBC Act Offsets Policy) and any offsets should be implemented prior to or at the time of the impact occurring; and
- up to 10 per cent (or more if an appropriate exception applies) of a project's impacts may be indirectly offset through compensatory measures such as contributions to a research fund or an educational programme.

Further to this, consultation with the Commonwealth Department of the Environment and Energy (DoEE) has revealed that the estimate of offsets for significant residual impacts on plants, animals and their habitat, including threatened biota listed under the New South Wales (NSW) *Threatened Species Conservation Act 1995* (TSC Act) should be calculated with reference to the NSW Framework for Biodiversity Assessment (FBA) methodology. The FBA is based on the NSW Biodiversity Banking and Offsets Scheme (BioBanking) credit calculator and assessment methodology and is used to calculate offsets for major projects in NSW.

The EPBC Act Offsets Policy recognises that there are various options available for delivery of direct offsets, including market-based tools such as BioBanking (see section 1.4 below). DoEE requires biodiversity offset sites to be securely titled under a legally binding conservation covenant (or other appropriate property title mechanisms) and actively managed under a fully funded plan. There are a variety of mechanisms for achieving this, including BioBanking, Voluntary Conservation Agreements or dedication of land to the National Parks estate.

At this stage of the planning and assessment for the proposed airport, the intent is to deliver most biodiversity offsets through conservation of suitable offset sites. The offset sites will be secured by registration of a BioBanking agreement on the title of the relevant sites. A BioBanking agreement is recognised as a practical and secure way of delivering biodiversity offsets and is endorsed by DoEE as well as the NSW Office of Environment and Heritage (OEH) and Department of Planning and Environment (DPE) for this purpose. This approach would require the purchase of the number and type of biodiversity credits that match the required offset area calculated in accordance with the EPBC Act Offsets Policy.

Due to a variety of factors, most notably the scale and nature of the biodiversity offsets required for the proposed airport, it will not be possible to identify and secure all of the proposed biodiversity offsets as part of this final EIS. The Department of Infrastructure and Regional Development has also identified strategic offsetting opportunities which involve working with the NSW Government and local stakeholders to source and manage suitable biodiversity offsets, but some of these opportunities cannot be realised immediately.

Therefore, the process of identifying and securing suitable biodiversity offsets will continue after the Infrastructure Minister's determination of the Airport Plan for the proposed airport.

This biodiversity offset package sets out the preferred approach and framework for the staged delivery of offsets. A staged approach will assist in resolving the challenges and realising the opportunities described above.

Biodiversity offsets will be delivered as follows:

- 1. Development of this biodiversity offset package as an appendix to the EIS, comprising:
  - a summary of the biodiversity impact assessment for the Stage 1 development;
  - an estimate of the quantum of biodiversity offsets required;
  - an outline of the preferred approach for delivering biodiversity offsets, including a description of the process that will be undertaken to identify potential offset sites and other compensatory measures (as environmental contributions);
  - an estimate of the cost to deliver the biodiversity offset package; and
  - concluding statements referring to the assessment requirements for the EIS and how the offsets proposed for the proposed airport, when implemented, would improve or maintain the viability of the protected matters.
- 2. Preparation of a biodiversity offset delivery plan which sets out the final offsets proposal, based on the biodiversity offset package and in accordance with the conditions for the proposal in the Airport Plan (if determined), comprising:
  - confirmation of the actual biodiversity offsets that would be delivered such as a detailed description of specific offset sites or other compensatory measures (as environmental contributions);
  - the results of targeted surveys at offset sites to confirm the presence of relevant threatened biota and the quality of habitat,
  - confirmation of the quantum of impacts and biodiversity offsets required based on offsets assessment guide calculations in accordance with the EPBC Act Offsets Policy and credit calculations with reference to the FBA for impacts on plants, animals and their habitat;
  - description of the funding and management arrangements for delivering the biodiversity offset and the timing of delivery; and
  - concluding statements demonstrating compliance with the Airport Plan conditions.

The biodiversity offset delivery plan will be submitted and require approval from the Environment Minister or an SES Officer in DoEE prior to the commencement of Main Construction Works for the Stage 1 development of the proposed airport, ensuring that biodiversity offsets have been identified (and secured where possible) prior to the substantial impacts occurring.

Main Construction Works means substantial physical works on the airport site (including large scale vegetation clearance, bulk earthworks and the carrying out of other physical works, and the erection of buildings and structures) described in Part 3 of the Airport Plan, other than Preparatory Activities.

Preparatory Activities mean the following:

(a) day to day site and property management activities;

(b) site investigations, surveys (including dilapidation surveys), monitoring, and related works (e.g. geotechnical or other investigative drilling, excavation, or salvage);

(c) establishing construction work sites, site offices, plant and equipment, and related site mobilisation activities (including access points, access tracks and other minor access works, and safety and security measures such as fencing); and

(d) enabling preparatory activities such as:

i. demolition or relocation of existing structures (including buildings, services, utilities and roads) provided they are demolished or relocated in accordance with applicable environmental impact mitigation measures specifically referable to demolition or relocation of the relevant structures;

ii. the relocation of cemeteries in accordance with an approved cemeteries relocation management plan; and

iii. application of environmental impact mitigation measures.

This biodiversity offset package report has been prepared using the EPBC Act Offsets Policy, the offsets assessment guide and with reference to the FBA methodology and comprises the first stage in the delivery of biodiversity offsets for the proposed airport. It has been prepared in consultation with DoEE, the NSW Government and other stakeholders, and having regard to an extensive review of submissions received on the draft EIS.

### **1.3 Purpose and structure of this report**

This biodiversity offset package report (offset package) has been prepared to support the EIS for the proposed airport (GHD 2016b). The information presented in this report has been compiled from the *Western Sydney Airport Biodiversity Assessment* (Appendix K1 to the EIS, GHD 2016a) (Biodiversity Assessment), a desktop assessment of offset site assessments completed by GHD and other specialists in the region and consultation with the Department and other agencies. The offset package should be read in conjunction with the Biodiversity Assessment and the *Western Sydney Airport Environmental Impact Statement* (EIS) (GHD 2016b).

This report outlines the approach to the delivery of biodiversity offsets for the proposed airport and comprises:

- a description of the proposed airport's impacts and measures to avoid or mitigate impacts;
- identification of the threatened species and communities listed under the EPBC Act that require biodiversity offsets under the EPBC Act Offsets Policy;
- an estimate of the quantum of biodiversity offsets required for affected threatened biota listed under the EPBC Act as calculated with the offsets assessment guide;

- an estimate of the quantum of biodiversity offsets required for residual impacts on plants, animals and their habitat, including threatened biota listed under the TSC Act, as calculated with reference to the FBA and using the BioBanking credit calculator for a major project;
- a description of how conservation of offset sites using BioBanking would be the preferred approach to delivering biodiversity offsets;
- identification of potential offset contributions, including biobank sites with biodiversity credits that are available for sale, existing or potential biobank sites that would generate suitable biodiversity credits in the future, or other compensatory measures (as environmental contributions);
- an estimate of the cost of delivering the biodiversity offset package; and
- concluding statements demonstrating compliance with the assessment requirements of the EPBC Act and that the offset package for the airport, when implemented would improve or maintain the viability of the protected matters.

The final quantum of biodiversity offsets required for the proposed airport would be determined on the basis of the information presented in this offset package and the conditions in the Airport Plan.

As described above, it will not be possible to identify and secure all required biodiversity offsets in the EIS. The biodiversity offset delivery plan will be submitted and require approval prior to the commencement of Main Construction Works for the Stage 1 development and will include further information, such as:

- location details and fine scale mapping of individual offset sites;
- current tenure arrangements, land uses, risk of loss of offsets and legal mechanisms proposed to avert the risk of loss at individual offset sites;
- confirmed presence of threatened biota and assessment of the extent and quality of habitat at individual offset sites and details of studies and surveys used to inform offset calculations;
- a detailed description of the specific management actions that will be undertaken to improve the quality of the offset sites; and
- the overall cost of the proposed offset package.

The offset package has been developed with reference to, and is intended to build upon, the Cumberland Plain Recovery Plan (DECCW 2010) and the strategic assessment for the North West and South West growth centres, which include the conservation of a minimum of 998 hectares of Cumberland Plain Woodland within the growth centres (DoP 2010). The offset package will complement regional conservation strategies, in particular by securing offset sites within identified priority conservation lands that are intended to maintain the biodiversity values of the Cumberland Plain (DECCW 2010).

## 1.4 BioBanking

#### 1.4.1 Overview

BioBanking was established by the former NSW Department of Environment, Climate Change and Water (DECCW) (now the OEH) as a method to address the loss of biodiversity and threatened species. The scheme attempts to create a market-based framework for the conservation of biodiversity values and the offsetting of development impacts. This is achieved through the generation of biodiversity credits for undertaking biodiversity conservation actions at biobank sites, the trading of those credits, and the retirement of credits to offset impacts at a development site. Once credits have been retired they cannot then be used to offset the impacts of another development and funds become available to perform management actions at the biobank site.

BioBanking is established under Part 7A of the *NSW Threatened Species Conservation Act 1995* (TSC Act), which was enabled by the *Threatened Species Conservation Amendment (Biodiversity Banking) Act 2006*. The *Threatened Species Conservation (Biodiversity Banking) Regulation 2008* provides additional rules for specific aspects of the scheme that are important for its operation.

Landowners can generate biodiversity credits by entering into a BioBanking agreement with the NSW Environment Minister and carrying out biodiversity conservation actions on that site which are required under that agreement. An assessment of the biodiversity values of the site which presently exist and which can be produced through conservation actions is undertaken, and this assessment will determine the conservation actions which are to be taken on the site and the number and class of biodiversity credits which will be generated if those actions are undertaken.

The BioBanking agreement is registered on the title to the site in accordance with the TSC Act, as a means of protecting the biodiversity values on the site in perpetuity.

In the context of a NSW approval process, developers can undertake an assessment of the biodiversity impacts which their development will have and express that impact in terms of a number of biodiversity credits of specified classes. They can then offset that impact by purchasing and then retiring the specified number of credits in the specified classes (by delivering them to OEH).

The BioBanking Assessment Methodology 2014 (BBAM) sets out how biodiversity values will be assessed, establishes rules for calculating the number and class of biodiversity credits, and determines the trading rules that will apply (OEH 2014a). The BBAM includes a software package known as the BioBanking Credit Calculator (the credit calculator) which processes site survey and assessment data. Data is entered into the credit calculator based on information collected in a desktop assessment, site surveys and from using geographic information system (GIS) mapping software.

The credit calculator is used to determine:

- the type and extent of surveys required for a BioBanking assessment;
- the number and type of biodiversity credits that are required for a development site to offset impacts on biodiversity either as part of a major project biodiversity assessment or an application for a BioBanking statement; and
- the number and type of biodiversity credits generated through the conservation and management of a biobank site.

The BioBanking credit calculator can be used to complete three types of assessments: 'biobank' (for a proposed BioBanking agreement), 'development' (for a determination of offset requirements for a development proposal) or 'major project' (for a determination of offset requirements for a major project'

development proposal). BioBanking assessments are to be completed by a person accredited in accordance with section 142B(1)(c) of the TSC Act.

#### **1.4.2** Application to this offset package

Not all aspects of the Biobanking process described above are relevant to this offset package. BioBanking has been used in the following ways in order to develop this offset package.

#### Securing offsets for affected EPBC Act-listed biota

The EPBC Act Offsets Policy provides that offset sites should be securely titled for conservation and that arrangements are made to ensure funding of appropriate management actions. BioBanking agreements would be used to secure some of the biodiversity offsets for significant residual impacts on EPBC Act-listed biota. The offsets would be secured by the site owner registering a BioBanking agreement on title to the offset site.

The quantum of offset required for the affected EPBC Act-listed biota has been calculated using the offsets assessment guide in accordance with the EPBC Act offsets policy as summarised in Section 5. The quantum of offset is expressed as an area of habitat for the affected threatened biota at offset sites. The offset area would be converted to biodiversity credits based on the rate of generation of credits per hectare in the appropriate vegetation zone. The number and type of biodiversity credits that are linked to the offset areas for the affected threatened biota would then be purchased and retired. This would ensure that each offset area would be securely titled and managed for conservation as a biobank in perpetuity, as outlined in the overview above.

Sites containing suitable biodiversity offset areas would be located and:

- each relevant site would be surveyed to confirm the extent and quality of habitat for the affected threatened biota (i.e. the offset area). Where appropriate this assessment would rely upon the results of BioBanking assessments or other ecological surveys already conducted at the site;
- if a site is already subject to a BioBanking agreement, then the biodiversity credits linked to the offset area would be purchased and retired; and
- if a site is not yet subject to a BioBanking agreement, the site would be assessed using BBAM, the site owner would enter into a BioBanking agreement, and the biodiversity credits linked to the offset area would be purchased and retired.

The biodiversity credits that are purchased and retired for affected threatened biota will also be used to provide offsets for impacts on plants, animals and their habitat as calculated in Section 3. Additional biodiversity credits will be required for residual significant impacts on plants, animals and their habitat because a substantial area of poor condition vegetation at the airport site, that does not comprise habitat for any EPBC Act-listed biota, will also be required to be offset.

It should be noted that, in some cases, offset sites may be secured by other suitable means, such as conservation covenants under other NSW laws (for example, the *Nature Conservation Trust Act 2001*, the *National Parks and Wildlife Act 1974*, or suitable covenants under other legislation.

#### Calculating and securing offsets for plants and animals

The offsets assessment guide can only be used to calculate offsets for EPBC Act listed biota and so an alternative approach is required for significant residual impacts on other protected matters, namely plants, animals and their habitat. The EPBC Act offsets policy provides that the approach to calculating offsets must be in proportion to the level of statutory protection that applies to the protected matter, be of a size and scale proportionate to the residual impacts on the protected matter and be scientifically robust and reasonable (DSEWPaC 2013a). The impacts of the proposal on plants, animals and their habitat were assessed with reference to the *Framework for Biodiversity Assessment* – *NSW Biodiversity Offsets Policy for Major Projects* (the FBA) (OEH 2014b) and the *Credit Calculator for Major Projects and BioBanking Operational Manual.* (OEH 2016a). The FBA / BioBanking assessment methodology meets each of the assessment criteria in the EPBC Act Offsets Policy and is supported by DoEE for this purpose.

The number and type of biodiversity credits required to offset the impacts of the proposal on plants, animals and their habitat was calculated with reference to the FBA using 'Major project' type credit calculations (see Section 3). In general, the FBA as it is applied to a major project in NSW does not apply to the proposed airport because it is located on Commonwealth land and is the subject of an assessment process under the EPBC Act. The FBA methodology has only been used to calculate the required biodiversity offsets through credit calculations. The data and assumptions used to perform the credit calculations are summarised in Section 3.2. The biodiversity credit report is included as Appendix B.

### **1.5 Relationship with other reports**

This offset package should be read in conjunction with the *Western Sydney Airport Biodiversity Assessment* (GHD 2016a). The Biodiversity Assessment report:

- provides a detailed description of the existing environment of the airport site;
- identifies threatened biota and other protected matters that may be affected by the proposed airport;
- assesses the potential impacts arising from the construction and operation of the proposed airport;
- recommends measures to avoid or mitigate impacts; and assesses the significance of residual impacts on threatened biota and other protected matters (GHD 2016a).

This offset package relies on the Stage 1 development impact assessment and mitigation measures presented in the Biodiversity Assessment to calculate the quantum of significant residual impacts that require biodiversity offsets.

This offset package is a specialist appendix to the EIS. The EIS provides:

- a detailed description of the proposed construction and operation of the proposed Stage 1 development, as well as providing an overview of a potential longer term development;
- assesses the potential impacts of the Stage 1 development on environmental, social and economic receptors, while also providing a strategic-level assessment of impacts from a potential longer term development; and
- identifies measures to manage impacts.

This offset package relies on the environmental assessment and mitigation measures presented in the EIS to inform assessment of potential impacts on biodiversity values. This includes inputs from specialist areas such as hydrology or noise that are beyond the scope of the Biodiversity Assessment.

The final quantum of biodiversity offsets required for the proposed airport would be determined on the basis of information presented in this offset package and the conditions in the Airport Plan.



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# 2. Offset Requirements for affected EPBC Act-listed Biota

## 2.1 Identification of affected threatened biota

According to the EPBC Act Offsets Policy, biodiversity offsets are required for significant residual impacts on threatened species and communities listed under the EPBC Act (i.e. those significant impacts that cannot otherwise be avoided or mitigated through other measures). A desktop assessment, targeted field surveys and habitat assessments were used to identify the suite of EPBC Act listed biota that could occur at the airport site or be affected by the construction or operation of the proposed airport. Assessments of the likely significance of impact on EPBC Act listed biota with the potential to be affected by the proposed airport have been prepared in accordance with the 'Matters of National Environmental Significance Significant impact guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999' (Department of Environment [DoE] 2013a) (see Appendix D of GHD 2016a).

The outcome of these assessments is that the proposed Stage 1 development is likely to have a significant impact on:

- Cumberland Shale Plains Woodland and Shale-Gravel Transition Forest (Cumberland Plain Woodland) which is listed as a critically endangered ecological community (CEEC) under the EPBC Act and occurs at the airport site. Construction of Stage 1 of the proposed airport would require the permanent removal of 104.9 hectares of vegetation within the local occurrence of Cumberland Plain Woodland as shown on Figure 2. A permanent reduction in extent of this magnitude would threaten the viability and persistence of Cumberland Plain Woodland within the locality. Stage 1 of the proposed airport is likely to have a significant impact on the local and regional occurrence of Cumberland Plain Woodland Plain Woodland through a substantial reduction in the extent of the community, an increase in the degree of fragmentation and a substantial negative effect on the potential for recovery of the community; and
- The Grey-headed Flying-fox, which is listed as a vulnerable species under the EPBC Act and which has been observed at the airport site. Construction of Stage 1 of the proposed airport would remove 141.8 hectares of potential foraging habitat for the Grey-headed Flying-fox, including foraging resources for local roost camps when resources are scarce and at critical lifecycle stages. The proposed airport will further fragment foraging habitat for this species within an already highly fragmented landscape.

The quantum of impacts on these affected threatened biota that requires biodiversity offsets is described below.

## 2.2 Impacts on affected threatened biota

#### 2.2.1 Cumberland Plain Woodland CEEC

#### Area of community in impact zone

Larger and better condition patches of Grey Box - Forest Red Gum grassy woodland on flats, Grey Box - Forest Red Gum grassy woodland on hills and Broad-leaved Ironbark - Grey Box - *Melaleuca decora* grassy open forest at the airport site comprise occurrences of Cumberland Plain Woodland CEEC, as defined under the EPBC Act and associated guidelines. Patches of woodland at the airport site that comprise an occurrence of EPBC Act Cumberland Plain Woodland are shown on Figure 2. There are 158 hectares of Cumberland Plain Woodland as defined under the EPBC Act at the airport site.

Derived native grassland and moderate/good–poor condition vegetation at the airport site does not meet the condition criteria for a local occurrence of the CEEC Cumberland Plain Woodland as defined under the EPBC Act and associated guidelines. This vegetation does not qualify because native tree species are not present with a minimum projected foliage cover of greater than 10% (DEWHA 2010). Some patches of woodland have native tree cover greater than 10%, but are isolated from other native vegetation and are less than 0.5 hectares in area and so have also been excluded in accordance with the guidelines (DEWHA 2010).

Construction of Stage 1 of the proposed airport would require the permanent removal of 104.9 hectares of vegetation within the local occurrence of Cumberland Plain Woodland that is commensurate with the form of the community listed under the EPBC Act as shown in Figure 2. Therefore an impact area of '104.9 hectares' has been entered in the 'area of community' field in the 'impact calculator' section of the offsets assessment guide for Cumberland Plain Woodland (see Section 5.3).

Specific measures are proposed to manage weeds at the airport site, to mitigate biosecurity risks and to reduce the risk of off-site impacts. The Land Use Plan for the airport site, which is contained in the revised draft Airport Plan, includes around 117 hectares of land that is zoned 'EC 1 Environmental conservation' and that would be managed for biodiversity conservation (see Figure 1). The proposed environmental conservation zone would provide a buffer between edge effects arising from the proposed airport and adjoining areas of native vegetation along its eastern, southern and western boundaries, including the riparian corridors of Badgerys Creek, Oaky Creek and Duncans Creek. There is no Cumberland Plain Woodland or other sensitive environments to the north of the airport site. The extent of native vegetation cover would be increased through exclusion of grazing in the environmental conservation zone and weeds would be managed. This reduces the chance that weeds would spread or that other edge effects would penetrate into habitat outside the airport site.

The proposed airport would have a minor effect on the extent or seriousness of edge effects in the locality and would be unlikely to introduce any new weed species or increase the significance of weed infestations. The environmental conservation zone would help to maintain a vegetated link around the developed portions of the airport site and provide connectivity between aquatic, riparian and floodplain environments. The environmental conservation zone also increases the distance between potential sources of contamination such as runways, storage areas and parking areas and sensitive receptors outside the airport site. The indicative airport concept design and land use plan in the revised draft Airport Plan show proposed measures to manage surface water that have been purposefully designed to capture water on-site and to avoid negative impacts on surface water quality or drainage patterns outside of the airport site. These measures would help to mitigate the risk of any impacts on the ecological community outside of the airport site.

There would be minor residual impacts on areas of Cumberland Plain Woodland outside the airport site through factors such as noise, light spill, risk of fauna mortality through plane strike or other vehicle collisions and contribution to the degree of habitat fragmentation in the locality (GHD 2016a). Cumberland Plain Woodland in the vicinity of the airport site is already in moderate to poor condition and affected by clearing for agriculture, grazing, weed infestation and the noise, light and traffic associated with human activities. Given this context and the mitigation measures outlined above and in the Biodiversity Assessment (GHD 2016a), the proposed airport is unlikely to tangibly decrease the extent or quality of Cumberland Plain Woodland outside of the airport site. Therefore, no additional areas of the community outside of the airport site have been included in the offset calculations.

#### Quality of community in impact zone

Cumberland Plain Woodland at the airport site comprises remnant or regrowth native vegetation in moderate condition. The quality of a community is scored out of ten for offsets assessment guide calculations. DoEE's instructions for the offsets assessment guide identify three site characteristics that may contribute to quality: 'site condition', 'site context' and 'species stocking rate'. These three attributes must be weighted according to their relative importance to the offset calculations based on the ecology of the relevant species or community (DSEWPaC 2012b) (i.e. their relative contribution to the total score out of ten). The weighting of these three attributes for Cumberland Plain Woodland at the airport site was defined as follows:

- site condition 50 per cent comprising an assessment of the condition of the airport site in relation to the ecological requirements of the community and based on vegetation structure, native plant cover, species richness and presence of habitat resources;
- site context 50 per cent comprising an assessment of the relative importance of the airport site in terms of its position in the landscape based on patch size, connectivity and proximity to threats; and
- species stocking rate 0 per cent because this attribute is not directly relevant to threatened communities.

Each characteristic was then scored based on the results of the Biodiversity Assessment (GHD 2016a). Site condition was scored as 6/10 based on consideration of the condition thresholds in the listing advice for the community (TSSC 2008), the BioBanking plot/transects and other field survey data collected within the vegetation zones that comprise Cumberland Plain Woodland at the airport site as outlined below.

Good condition Grey Box - Forest Red Gum grassy woodland on flats (HN528, around 78.5 hectares out of the 104.9 hectares of Cumberland Plain Woodland to be removed) - Remnant or regrowth woodland with near-intact over storey. This vegetation meets the condition thresholds in the listing advice for the community, specifically it has a woodland structure and is part of a patch at least 0.5 hectares in area with 50% native perennial groundcover (TSSC 2008). Species richness was above benchmark in eight of the 12 plot/transects sampled in this vegetation zone and most native vegetation cover attributes were at benchmark values for this plant community type in the majority of plot/transects sampled. There were regenerating specimens of all canopy species observed. Few hollow-bearing trees were recorded, including only one in the 14 plots sampled. There were generally low quantities of fallen woody debris, including none in five of the 12 plots sampled. There is frequently high exotic plant cover (10-70 per cent in plot/transects sampled) mainly consisting of grasses and herbs in the under storey.

- Good condition Grey Box Forest Red Gum grassy woodland on hills (HN529, around 22 hectares out of the 104.9 hectares of Cumberland Plain Woodland to be removed) -Remnant or regrowth woodland with near-intact over storey that was within or slightly below benchmark values in all five plot/transects sampled. Native mid storey cover was well below benchmark values in four out of the five plot/transects. Species richness, shrub, grass and forb cover attributes and woody debris were at or above benchmark values for this plant community type in the majority of plot/transects sampled. There were regenerating specimens of all canopy species observed. There are few hollow-bearing trees, including only one in the five plots sampled. There is frequently high exotic plant cover (26-44 per cent in plot/transects sampled) mainly consisting of woody weeds in the mid storey.
- Good condition Broad-leaved Ironbark –*Melaleuca decora* grassy open forest (HN512, around 4.4 hectares out of the 104.9 hectares of Cumberland Plain Woodland to be removed) Near-intact, remnant or regrowth open forest. Species richness and most native vegetation cover attributes were at benchmark values for this plant community type. There were regenerating specimens of all canopy species observed. There were good quantities of hollow-bearing trees, including one in the plot/transect that was sampled and large quantities of fallen woody debris. This vegetation zone contains very little exotic plant cover compared to most of the airport site and included 0 per cent exotic plant cover along the transect sampled. Some exotic plants were observed at low cover/abundances in the surrounding plot (GHD 2016a).

Site context was scored as 6/10, reflecting the position of the local occurrence of the community in a highly fragmented, rural landscape. Fragmentation of native vegetation and associated fauna habitats in the locality has previously occurred through clearing for agriculture, residences and farm buildings and construction of transmission lines and roads. These land uses have created barriers to movement for many fauna species, particularly those that are limited by dispersal abilities and habitat preferences. The patches of Cumberland Plain Woodland that remain at the airport site have high edge to area ratios and are frequently dissected by tracks and fence lines. The suite of fauna species recorded in field surveys is dominated by generalist species of open country such as birds and bats, reflecting the fragmented nature of vegetation at the airport site (see Section 4.3.1 of GHD 2016a). Adjoining areas are dominated by exotic vegetation, including many noxious and environmental weeds that pose a threat to remnant patches. In this context, the species within Cumberland Plain Woodland at the airport site have limited opportunities for dispersal or recruitment and are subject to ongoing threats from exotic plants and pest fauna.

Based on the inputs described above, 'Impact calculator - quantum of impact – quality' (i.e. the quality of habitat in the airport disturbance footprint) was scored as 6/10 overall.

The above values have been entered in the offsets assessment guide calculations that are presented in Section 5.3.

#### Estimated offset requirement

A preliminary offsets assessment guide calculation was performed as a guide to the size and type of offset that would be required to meet the EPBC Act offset requirements for the Stage 1 development's impacts on EPBC Act Cumberland Plain Woodland. Based on the preliminary offsets assessment guide calculation included in Section 5.3, the proposed airport would require an offset of around 355 hectares of Cumberland Plain Woodland. Potential offset sites have been identified that contain the majority of the required area of the community and are described in Section 4.2.2 below. Final offset calculations and requirements will be finalised through the processes expected to be set out in the Airport Plan conditions. Based on these preliminary calculations, the potential offset areas identified in

this report that contain around 207.9 hectares of EPBC Act Cumberland Plain Woodland could provide around 60% of the offsets required for the proposed airport's impacts on Cumberland Plain Woodland. There are a further 135 hectares of poorer quality Cumberland Plain Woodland in the potential offset areas that could be regenerated to meet the condition of EPBC Act Cumberland Plain Woodland and that could provide a further 20% of the offsets required for the proposed airport's impacts on Cumberland Plain Woodland.

Further work will be undertaken in an effort to identify additional offset sites, according to the criteria and the process described in Section 6, to address the shortfall and to provide alternatives for offset sites which have been identified but which may not be secured for the proposed airport. For example, an identified site may be secured by others for other projects before they can be secured for the proposed airport.

#### 2.2.2 Grey-headed Flying-fox

#### Area of habitat in the impact zone

The Grey-headed Flying-fox (*Pteropus poliocephalus*) was recorded foraging at the site during the previous surveys (Biosis Research 1999) and flying over the site in 2015 (GHD 2016a). There are no Grey-headed Flying-fox camps located at the airport site, although there are at least seven known camps within 20 kilometres. All native woodland and forest in the airport site provides potential foraging habitat for this species.

The proposed airport would remove 141.8 hectares of foraging habitat associated with the native woodland and forest shown in Figure 3, all of which comprises critical foraging habitat as defined in the Recovery Plan for the Grey-headed Flying-fox (DECCW 2009).

The proposal would not result in a notable increase in the risk of mortality or fragmentation of habitat for this highly mobile species. There is a risk of plane strike or electrocution of power lines during the operation of the airport; however, this is unlikely to harm large numbers of individuals of the species (Avisure 2015, GHD 2016a).

The removal of habitat would be the most notable impact on the Grey-headed Flying-fox arising from the proposed airport. Therefore an area of habitat of 141.8 hectares has been entered in the 'Impact calculator' section of the offsets assessment guide for the Grey-headed Flying-fox (see Section 5.3).

As described above for Cumberland Plain Woodland, there would be minor residual impacts on areas of foraging habitat outside the airport site. Habitat for the Grey-headed Flying-fox in the vicinity of the airport site is already in moderate to poor condition and affected by clearing for agriculture, grazing, weed infestation and the noise, light and traffic associated with human activities. Given this context and the mitigation measures outlined in the Biodiversity Assessment (GHD 2016a), the proposed airport is unlikely tangibly to decrease the extent or quality of habitat outside of the airport site. Therefore, no additional areas of habitat for the Grey-headed Flying-fox outside of the airport site have been included in the offset calculations.

#### Quality of habitat in the impact zone

As described above, all native woodland and forest in the airport site provides foraging habitat for this species. Dominant canopy species include Forest Red Gum (*Eucalyptus tereticornis*), Grey Box (*Eucalyptus molluccana*) and Broad-leaved Ironbark (*Eucalyptus fibrosa*). Forest Red Gum and Grey Box are recognised as 'significant species' in the blossom diet of the Grey-headed Flying-fox (Eby and Law 2008). Forest Red Gum scores in the upper quartile of all diet plants for the region for productivity and reliability of flowering. This species flowers in late winter and spring, partly during the 'food bottleneck' for the Grey-headed Flying-fox. Grey Box has low productivity and reliability. It flowers in

late summer and early autumn. Broad-leaved Ironbark has high productivity but is an unreliable flowerer. This species flowers in summer and early autumn, providing foraging habitat during the breeding period for the Grey-headed Flying-fox (Eby and Law 2008). Habitat in the airport site is thus somewhat productive during food bottlenecks, and qualifies as habitat critical to the survival of the species, as defined in the draft recovery plan (DECCW 2009).

The Department's instructions for the offsets assessment guide state that the contribution of the three habitat attributes 'site condition', 'site context' and 'species stocking rate' to habitat quality must be weighted according to the ecology of the relevant species or community (DSEWPaC 2012b). The weighting of these three attributes for the Grey-headed Flying-fox population with respect to the airport site was defined as follows:

- site condition 60 per cent comprising an assessment of the condition of the airport site in relation to the ecological requirements of the species and based on vegetation condition and presence of food trees and other habitat resources;
- site context 20 per cent comprising an assessment of the relative importance of the airport site in terms of its position in the landscape based on patch size, connectivity, presence of roost camps and/or proximity to off-site roost camps and proximity to threats. This factor was given less weighting because the species is highly mobile and is known to forage in small or isolated patches of vegetation; and
- species stocking rate 20 per cent comprising an assessment of the usage or density of the species at the site. This factor was given less weighting because the species is highly mobile and all individuals in NSW are considered part of one regional population that undertakes nomadic movements to exploit seasonal resources (DECCW 2009). The Grey-headed Flying-fox is a highly mobile species which regularly travels up to 50 kilometres in a night to forage, and has been shown to make migratory movements of almost 1000 kilometres within a year (Churchill 2008, Webb and Tidemann 1996). Given this mobility and population fluctuations in any given area, the local species stocking rate is a relatively minor component of habitat quality.

Each characteristic was then scored based on the results of the Biodiversity Assessment (GHD 2016a).

Site condition was scored as 7/10 based on the following:

- the health and condition of the vegetation zones that comprise Grey-headed Flying-fox habitat based on BioBanking plot/transects, the health and abundance of food tree species and other field survey data. The majority of the habitat in the stage one construction impact zone is Cumberland Plain Woodland (around 107.7 out of 141.8 hectares) which is in moderate condition as described above. Forest Red Gum Rough-barked Apple grassy woodland (the remaining 34.2 out of 141.8 hectares) is also in moderate condition comprising remnant or regrowth native vegetation with near-intact over storey that was within or slightly below benchmark values in all five plot/transects (GHD 2016a); and
- the presence of Forest Red Gum and Grey Box as dominant canopy species across the airport site. As described above these two tree species are recognised as 'significant species' in the blossom diet of the Grey-headed Flying-fox, are somewhat productive during food bottlenecks (Eby and Law 2008) and qualify as habitat critical to the survival of the species, as defined in the draft recovery plan (DECCW 2009) (GHD 2016a).

Site context was scored as 6/10 based on the following:

- the airport site does not contain a roost camp and as such does not play an especially important role in relation to the overall population of the species. There are several known roost camps within 20 km of the site and so it is appropriately located to provide foraging resources for individuals from these camps; and
- habitat at the airport site is in a highly fragmented, rural landscape. The Grey-headed Flying-fox is a highly mobile species and so this would not limit opportunities for dispersal or recruitment or substantially increase the risk or energy cost of travelling to exploit foraging resources. However adjoining areas are dominated by exotic vegetation, including many noxious and environmental weeds that pose a threat to remnant patches of native vegetation and the productivity of food species.

Species stocking rate was scored as 7/10 comprising an area of productive foraging habitat within the broad range of this highly mobile species. Only a single individual was observed flying over the airport site during a total of 13 nights of survey effort between February and May 2015 (GHD 2016a). Larger numbers of individuals may be present at other times of year such as during the late Winter-Spring flowering period of Forest Red Gum or in other seasons when food trees are more productive at the site and/or less productive in surrounding areas. The survey period coincided with the late Summer – early Autumn flowering period of the other two main canopy species at the site.

Based on the inputs described above 'Impact calculator - quantum of impact – quality' (i.e. the quality of habitat in the airport disturbance footprint) was scored as 7/10 overall (rounded to the nearest whole number).

These values have been entered in the offsets assessment guide calculations that are presented in Section 5.3.

#### Estimated offset requirement

As described for Cumberland Plain Woodland above, a preliminary offsets assessment guide calculation was performed as a guide to the size and type of offset that would be required to meet the EPBC Act offset requirements for the Stage 1 development. Based on the notional offsets assessment guide calculation the proposed airport would require an offset, including around 410 hectares of habitat for the Grey-headed Flying-fox.

Offsets assessment guide calculations based on the available area of Grey-headed Flying-fox habitat in the offset sites that have been identified to date are included in Section 5.3. The offset calculations and requirements will be finalised through the processes expected to be set out in the Airport Plan conditions. Based on these preliminary calculations the potential offset sites could provide all of the offsets required for the proposed airport's impacts on the Grey-headed Flying-fox.



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# 3. Offset Requirements for Plants, Animals and their Habitat

# 3.1 Overview

The Biodiversity Assessment assessed impacts on biodiversity components of the environment (GHD 2016a) as required by the EPBC Act significant impact guidelines 1.2 (DoE 2013b) for actions being undertaken by the Commonwealth. The Biodiversity Assessment concluded that the proposed airport would result in significant residual impacts on 'plants' and 'animals', including threatened species, populations and communities listed under NSW legislation (GHD 2016a). Therefore biodiversity offsets are required for significant residual impacts on plants, animals and their habitat arising from the Stage 1 development.

The offsets assessment guide can only be used to calculate offsets for threatened biota listed under the EPBC Act and so an alternative approach is required for impacts on other protected matters. The EPBC Act Offsets Policy requires that the approach to calculating offsets must be in proportion to the level of statutory protection that applies to the protected matter, be of a size and scale proportionate to the residual impacts on the protected matter and be scientifically robust and reasonable (DSEWPaC 2013a). The FBA is the assessment methodology for a major project in NSW, meets each of these criteria and is supported by DoEE for this purpose.

Credit calculations with reference to the FBA (i.e. 'Major Project' BioBanking credit calculations) have been used to estimate offsets for significant residual impacts on plants, animals and their habitat, including species, populations and communities listed under NSW legislation. The credit calculations were performed by Ben Harrington (assessor accreditation number 0073) using credit calculator Version 4.0. The biodiversity credit report is included in Appendix B.

The data and assumptions used to perform the credit calculations are summarised below.

# 3.2 Credit calculations

# 3.2.1 Landscape features

The FBA requires the assessment of landscape features to help describe the biodiversity values of the study area and assess the impacts of the project. The proposed airport is a site-based development (rather than linear infrastructure) and so the landscape value has been assessed according to the methodology for site-based major projects (OEH 2014b). Landscape features relevant to the credit calculations are shown on Figure 4 and are summarised in Table 1.

## **Table 1 Summary of landscape features**

Landscape feature	Stage 1 construction impact zone
Major Catchment	The Stage 1 construction impact zone is located entirely within the Hawkesbury/Nepean major catchment.
Interim Biogeographic regionalisation of Australia (IBRA) bioregion and IBRA subregions	The Stage 1 construction impact zone is located entirely within the 'Sydney Basin' IBRA bioregion and Cumberland – Hawkesbury/Nepean IBRA subregion (DSEWPaC 2011).
Mitchell landscape	The Stage 1 construction impact zone contains the Cumberland Plain Mitchell landscape (DECC 2008).
% Native vegetation cover	The outer assessment circle is 4000 hectares in area and the inner assessment circle is 400 hectares.
	The current native vegetation cover in the outer assessment circle is 16-20% (around 800 hectares out of the 4000 hectare circle).
	The future native vegetation cover in the outer assessment circle is 11-15% (around 480 hectares out of the 4000 hectare circle, given the removal of around 318.4 hectares of native vegetation for the proposed airport).
	The current native vegetation cover in the inner assessment circle is 26-30% (around 110 hectares out of the 400 hectare circle).
	The future native vegetation cover in the inner assessment circle is <5% (around 17 hectares out of the 400 hectare circle, given the removal of 93 hectares of native vegetation for the proposed airport).
Connectivity value - class	The Stage 1 development would affect the 20 metre wide riparian corridor of a 4 <sup>th</sup> order stream where the stage one construction impact zone intersects the riparian corridor of Badgerys Creek (see Figure 1).
	A patch size polygon of around 670 hectares is shown on Figure 4 however the actual patch of connected native vegetation continues outside this area in the riparian corridors of Badgerys Creek to the north and Duncans Creek to the west. This is well above the patch size required to achieve the maximum patch size score for major projects (OEH, 2014b) (>100 ha, as the airport site is in the Cumberland Mitchell landscape, which is 89 % cleared (OEH 2015d).

## 3.2.2 Native vegetation

One vegetation zone was created for each NSW vegetation type and broad condition state in the Stage 1 construction impact zone. The area of each zone was calculated using GIS. Vegetation zones within the Stage 1 construction impact zone are summarised in Table 2.

Development impacts are expected to be restricted to the Stage 1 construction impact zone. Given the mitigation measures specified in the Biodiversity Assessment (GHD 2016a) and EIS (GHD 2016b), adjoining land uses, and the extent of existing weed infestation and disturbance in the study area, the development would not result in any tangible secondary impacts. Therefore, no additional, secondary impacts have been included in the credit calculations.

#### **Table 2 Vegetation zones**

Veg Zone ID	Vegetation Zone	Condition	TSC Act Status <sup>1</sup>	EPBC Act Status <sup>1</sup>	Area	Plot/transects required	Plot/transects completed
1	Good condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)	Moderate/good	CEEC	CEEC	79.8	5	Plot/transects 2, 5, 6, 7, 10, 11, 12, 16, 22, 23, 25, 31, 32, 35
2	Poor condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)	Moderate/good - poor	CEEC		112.5	6	Plot/transects 8, 19, 24, 28, 30, 37, 42
3	Good condition Grey Box - Forest Red Gum grassy woodland on hills (HN529)	Moderate/good	CEEC	CEEC	22.9	4	Plot/transects 20, 21, 36, 38, 40
4	Poor condition Grey Box - Forest Red Gum grassy woodland on hills (HN529)	Moderate/good - poor	CEEC		27.6	4	Plot/transects 39, 41 <sup>2</sup>
5	Good condition Forest Red Gum - Rough- barked Apple grassy woodland (HN526)	Moderate/good	EEC		34.2	4	Plot/transects 9, 13, 15, 17, 18, 26, 29, 33
6	Poor condition Forest Red Gum - Rough- barked Apple grassy woodland (HN526)	Moderate/good - poor	EEC		7.9	3	Plot/transects 14, 27, 34
7	Good condition Broad- leaved Ironbark - Grey Box - <i>Melaleuca decora</i> grassy open forest (HN512)	Moderate/good	EEC	CEEC	4.4	3	Plot/transect 1 <sup>2</sup>
8	Poor condition Broad- leaved Ironbark - Grey Box - Melaleuca decora grassy open forest (HN512)	Moderate/good - poor	EEC		0.6	1	Plot/transect 43
9	Good condition artificial freshwater wetland on floodplain (HN630)	Moderate/good			28.6	4	Wetland assessment at targeted frog survey sites 2, 4, 5, 8, 9, 10, 11 <sup>3</sup>

Notes: 1) CEEC - critically endangered ecological community; EEC - endangered ecological community.

- 2) Less than the required number of plot/transects were sampled in the biodiversity assessment (GHD 2016a) and so available plot/transects were duplicated.
- 3) Wetland assessment data was used to extrapolate equivalent plot/transect data.

Site value data was collected using the BioBanking plot/transect methodology and was entered for each plot/transect field in each vegetation zone.

Changes in site biodiversity values through the development of a site is the basis for calculation of biodiversity 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

(APZs) where only partial vegetation removal may be required. In such cases, vegetation zones should be split into separate management zones to allow separate calculation of impacts of full vegetation removal versus partial vegetation removal. All native vegetation and habitat within the Stage 1 construction impact zone would be removed. The default decrease in site value was entered in the credit calculator for all management zones (i.e. the site values for all vegetation and habitat attributes were reduced to zero). Management zones in the Stage 1 construction impact zone are summarised in Table 3.

Management Zone	Veg Zone ID	Vegetation Zone	Condition	Area (ha)	Management / Site Attribute Scores
MZ1	1	Good condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)	Moderate/good	79.8	Full removal / Default decrease in site value.
MZ2	2	Poor condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)	Moderate/good - poor	112.5	Full removal / Default decrease in site value.
MZ3	3	Good condition Grey Box - Forest Red Gum grassy woodland on hills (HN529)	Moderate/good	22.9	Full removal / Default decrease in site value.
MZ4	4	Poor condition Grey Box - Forest Red Gum grassy woodland on hills (HN529)	Moderate/good - poor	27.6	Full removal / Default decrease in site value.
MZ5	5	Good condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526)	Moderate/good	34.2	Full removal / Default decrease in site value.
MZ6	6	Poor condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526)	Moderate/good - poor	7.9	Full removal / Default decrease in site value.
MZ7	7	Good condition Broad-leaved Ironbark - Grey Box - <i>Melaleuca decora</i> grassy open forest (HN512)	Moderate/good	4.4	Full removal / Default decrease in site value.
MZ8	8	Poor condition Broad-leaved Ironbark - Grey Box - <i>Melaleuca decora</i> grassy open forest (HN512)	Moderate/good - poor	0.6	Full removal / Default decrease in site value.
MZ9	9	Good condition artificial freshwater wetland on floodplain (HN630)	Moderate/good	28.6	Full removal / Default decrease in site value.

#### **Table 3 Management zones**

#### 3.2.3 Threatened Species

#### Predicted threatened species

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 airport site. Each of these species has a

'threatened species multiplier' that feeds into the ecosystem credit calculations. The species with the highest threatened species multiplier drives the credit calculations. If that fauna species or specific habitat resources for that species are not present at the airport site, then the threatened species multiplier score may be adjusted.

The suite of threatened species associated with ecosystem credits for the development is shown in Table 4. There is known or potential habit for each of these threatened species in the stage 1 construction impact zone and so the threatened species multipliers have not been adjusted.

Common name	Scientific name	Threatened species multiplier	On site <sup>1</sup>
Australian Painted Snipe	Rostratula australis	1.3	Yes
Barking Owl	Ninox connivens	3.0	Yes
Black-chinned Honeyeater (eastern subspecies)	Melithreptus gularis subsp. gularis	1.3	Yes
Black-tailed Godwit	Limosa limosa	2.6	Yes
Brown Treecreeper (eastern subspecies)	Climacteris picumnus subsp. victoriae	2.0	Yes
Bush Stone-curlew	Burhinus grallarius	2.6	Yes
Diamond Firetail	Stagonopleura guttata	1.3	Yes
Eastern False Pipistrelle	Falsistrellus tasmaniensis	2.2	Yes
Eastern Freetail-bat	Mormopterus norfolkensis	2.2	Yes
Flame Robin	Petroica phoenicea	1.3	Yes
Freckled Duck	Stictonetta naevosa	1.3	Yes
Gang-gang Cockatoo	Callocephalon fimbriatum	2.0	Yes
Glossy Black-Cockatoo	Calyptorhynchus lathami	1.8	Yes
Greater Broad-nosed Bat	Scoteanax rueppellii	2.2	Yes
Hooded Robin (south-eastern form)	Melanodryas cucullata subsp. cucullata	1.7	Yes
Little Eagle	Hieraaetus morphnoides	1.4	Yes
Little Lorikeet	Glossopsitta pusilla	1.8	Yes
Masked Owl	Tyto novaehollandiae	3.0	Yes
Painted Honeyeater	Grantiella picta	1.3	Yes
Powerful Owl	Ninox strenua	3.0	Yes
Scarlet Robin	Petroica boodang	1.3	Yes
Speckled Warbler	Chthonicola sagittata	2.6	Yes
Spotted Harrier	Circus assimilis	1.4	Yes
Spotted-tailed Quoll	Dasyurus maculatus	2.6	No
Square-tailed Kite	Lophoictinia isura	1.4	Yes
Swift Parrot	Lathamus discolor	1.3	Yes
Turquoise Parrot	Neophema pulchella	1.8	Yes
Varied Sittella	Daphoenositta chrysoptera	1.3	Yes
White-fronted Chat	Epthianura albifrons	0.8	Yes
Yellow-bellied Sheathtail-bat	Saccolaimus flaviventris	2.2	Yes

#### Table 4 Predicted threatened species (ecosystem credit species)

Notes: 1) There are habitat resources for the species at the site that would be removed by the proposed development.

#### **Species credits**

The credit calculator references geographic, vegetation and habitat data for the project site to generate a list of the species credit-type threatened species predicted to occur and requiring targeted survey. These threatened species cannot be reliably predicted to use an area of land based on habitat surrogates according to the BBAM. These species require targeted survey, with the impacts and offset requirements expressed in terms of individual species credits rather than being linked to ecosystem credits.

A table of 'Threatened species survey / time matrix and survey effort' in accordance with the BBAM is included in Appendix B. The majority of the species credit-type species predicted to occur has been reliably excluded from occurring at the airport site or being impacted by the proposed airport based on the field survey effort undertaken for the biodiversity assessment (GHD 2016a). A total of four species were not targeted by surveys at appropriate times of year according to the survey / time matrix. Nonetheless, these species can be reliably excluded from occurring at the airport site or being impacted by the proposed airport based on the desktop assessment and on-site habitat assessments undertaken for the biodiversity assessment (GHD 2016a) as summarised in Appendix B.

The species credit-type threatened species that are present at the airport site are summarised in Table 5 along with the extent of impacts. For plants, impacts were calculated based on the number of individuals in the Stage 1 construction impact zone. For animals, impacts were calculated based on the extent of habitat for the species in the Stage 1 construction impact zone as presented in the biodiversity assessment (GHD 2016a).

Common name	Scientific name	TSC Act Status	Likelihood of occurrence	Quantum of impact
Pultenaea parviflora	Pultenaea parviflora	Endangered	Present. Four individuals were recorded at the airport site.	4 individuals
Marsdenia viridiflora subsp. viridiflora	Marsdenia viridiflora subsp. viridiflora	Endangered population	Present. 145 stems were recorded at the airport site.	145 stems
Southern Myotis roosting habitat	<i>Myotis macropus</i> roosting habitat	Vulnerable	Probably recorded (based on echo-location call analysis). Likely to forage along creeks and above dams. May roost under bridges and in tree- hollows at the airport site.	34.2 hectares
Cumberland Plain Land Snail	Meriodolum corneovirens	Endangered	Present. Generally occurs in larger remnant patches of Cumberland Plain Woodland with deep leaf litter.	141.8 hectares
Black Bittern	Ixobrychus flavicollis	Vulnerable	Present. Recorded in riparian vegetation along Badgerys Creek.	62.7 hectares

# Table 5 Impacts on species credit-type threatened species

# **3.3 Biodiversity credits**

The data summarised above was entered into Version 4.0 of the credit calculator to determine the number of biodiversity credits that would be required to offset the removal of vegetation and habitat in the Stage 1 construction impact zone. The Biodiversity credit report is included in Appendix B and is summarised below.

3.3.1 Ecosystem credits

The ecosystem credits that would be required to offset the impacts of the proposed airport on plants, animals and their habitat are shown in Table 6 along with potential offset options (i.e. the plant community types which can be used to offset these impacts according to the FBA/BioBanking credit trading rules).

Plant community type name	Condition	TSC Act Status	EPBC Act Status	Management zone area	Ecosystem credit requirement	Offset options – Plant community types
Good condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)	Moderate/ Good	CEEC	CEEC	79.8	4,220	HN528, HH526 <sup>1</sup>
Poor condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)	Moderate/ Good_Poor	CEEC		112.5	3,686	HN528, HH526
Good condition Grey Box - Forest Red Gum grassy woodland on hills (HN529)	Moderate/ Good	CEEC	CEEC	22.9	1,062	HN529, HN528, HN526 <sup>1</sup>
Poor condition Grey Box - Forest Red Gum grassy woodland on hills (HN529)	Moderate/ Good_Poor	CEEC		27.6	884	HN529, HN528, HN526
Good condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526)	Moderate/ Good	EEC		34.2	1,878	HN526, HN528
Poor condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526)	Moderate/ Good_Poor	EEC		7.9	262	HN526, HN528
Good condition Broad-leaved Ironbark - Grey Box - <i>Melaleuca decora</i> grassy open forest (HN512)	Moderate/ Good	EEC	CEEC	4.4	337	HN512, HN513, HN604, HN556 <sup>1</sup>
Poor condition Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest (HN512)	Moderate/ Good_Poor	EEC		9.0	21	HN512, HN513, HN604, HN556
Good condition artificial freshwater wetland on floodplain (HN630)	Moderate/ Good			28.6	873	HN630, HN520

# Table 6 Ecosystem credits required to offset impacts of the proposed airport

Notes: 1) Ecosystem credits that are used to offset impacts on EPBC Act Cumberland Plain Woodland would need to be plant community types HN528, HN529 or HN512 and associated with better quality vegetation in order to comply with the EPBC Act Offsets Policy (DSEWPaC 2012).

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# 3.3.2 Species credits

The species credits that would be required to offset the impacts of the proposed airport on plants, animals and their habitat are shown in Table 7. The intent of this offset package is to offset impacts with matching species credits.

Common name	Scientific name	Threatened species multiplier	Species credits required
Black Bittern	Ixobrychus flavicollis	1.3	815
Cumberland Plain Land Snail	Meridolum corneovirens	1.3	1,843
Marsdenia viridiflora subsp. viridiflora in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	<i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i> - endangered population	4.0	5,800
Pultenaea parviflora	Pultenaea parviflora	1.5	60
Southern Myotis roosting habitat	Myotis macropus roosting habitat	2.2	752

## Table 7 Species credits required to offset impacts of the proposed airport

# **3.4** Assumptions and amendments to the FBA methodology

The biodiversity offsets for impacts on plants, animals and their habitat have been determined with reference to the FBA and using the BioBanking credit calculator as it is applied to major projects as described above. Some data has been estimated or modified to enable credit calculations based on the biodiversity assessment results (GHD 2016a). The assumptions and amendments to the BioBanking assessment methodology for major projects are listed below.

- Credit calculations have not been completed for proposed biobank sites (see Table 8). A rate of seven ecosystem credits per hectare has been used to estimate the number of credits that would be generated at these sites, which is based on the results of BioBanking calculations from similar biobank sites;
- Wetlands were not sampled with plot/transects because of the inherent safety risk. Wetland vegetation was sampled by walking the margins of waterbodies and noting dominant plant species and percentage cover in each vegetation strata present (i.e. trees, shrubs, emergent, aquatic and fringing plants). These 'wetland survey' results were then used as surrogates for plot/transect data in credit calculations;
- Less than the minimum number of plot/transects required by the BioBanking assessment methodology for major projects were sampled in two out of the nine native vegetation zones at the airport site. In these instances, the available plot/transect data for each vegetation zone were duplicated; and
- It is assumed that all vegetation within the Stage 1 construction impact zone would be completely removed during construction of the proposed airport. One management zone was created for each vegetation zone in the Stage 1 construction impact zone and all site value scores were reduced to zero after the development.



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# 4. Potential Direct Offsets

# 4.1 Approach for identifying potential offsets

As outlined in further detail in Section 6 of this report, due to a variety of factors the identification and delivery of biodiversity offsets will be staged.

This biodiversity offset package sets out the overarching framework and strategy for how biodiversity offsets will be identified and secured for the proposed airport. Offsets for the proposed airport would mainly comprise the conservation of habitat for the affected protected matters in suitable offset sites. This section of the report outlines potential offset sites that the Department of Infrastructure and Regional Development intends to secure and has been used to estimate the quantum and cost of biodiversity offsets for the Stage 1 development of the proposed airport. Most of the offset sites would be secured by registration of a BioBanking agreement on title that will ensure that they are securely conserved and managed in perpetuity.

If the Stage 1 development is approved, a biodiversity offset delivery plan will be developed to set out the specific actions to be taken to meet the offset conditions set out in the Airport Plan and will be guided by the framework established in this biodiversity offset package. The biodiversity offset delivery plan will include additional information required to support EPBC Act offset calculations and will include additional site specific information such as the proposed management, current risk of development and the security of title proposed for individual offset sites. The biodiversity offset delivery plan will also specify any additional offset sites, or actions necessary to meet overall offset requirements. The process for identifying additional offset sites is specified in Section 4.2.1 of this report.

The quantum of offsets for affected EPBC Act-listed biota is expressed as an area of habitat. The offset delivery plan will include maps that clearly show the offset area and areas of habitat for the affected threatened biota that will be protected and managed in perpetuity. Where the form of protection involves the generation of biodiversity credits, the number and type of biodiversity credits that are linked to the offset areas for the affected threatened biota would then be purchased and retired. As described in Section 1.4.2, this outcome will be achieved either through identification of suitable offset areas and completion of a BioBanking assessment with a view to establishing a new biobank site, or purchase of biodiversity credits from existing biobank sites that are linked to appropriate offset areas.

The biodiversity credits that are purchased and retired for affected threatened biota will also be used to provide offsets for impacts on plants, animals and their habitat as calculated in Section 3. Additional biodiversity credits will be required to provide offsets for impacts on species and communities not listed under the EPBC Act and to fully offset significant impacts on plants, animals and their habitat.

Offsets for impacts on plants, animals and their habitat have been calculated with reference to the FBA and using the BioBanking credit calculator.

The offset package only identifies potential offset sites that are expected to be appropriate for the proposed airport. The assessment of potential offset areas for affected EPBC Act listed biota included in Section 4.2.3 and potential biodiversity credits for plants, animals and their habitat included in Section 4.2.4 include specific consideration of the suitability of habitat and current availability of credits. Only suitable habitat and available credits have been included in the preliminary offset calculations. Discussions with landowners and the formal securing of offset sites will continue after the determination of the Airport Plan for the proposed airport. The actual offset sites that will be

secured will be specified in the biodiversity offset delivery plan. If some biodiversity credits at an existing biobank site identified in this offset package have already been purchased and retired to offset the impacts of another development, then the area of land linked to those credits will not be included in the biodiversity offset delivery plan. Similarly, where a biobank site includes vegetation and habitat that is not suitable to offset the impacts of the proposed airport then the biodiversity credits associated with these unsuitable areas would not be purchased and retired.

Consultation with NSW and Commonwealth agencies, conservation groups and private landowners is being undertaken to identify suitable offset contributions. This is being undertaken to ensure that the offsets delivered from the proposed airport complement existing programmes such as the Commonwealth Cumberland Conservation Corridor programme, which includes the Australian Government's 20 Million Trees programme, to achieve the best possible environmental improvements for biodiversity in Western Sydney.

The EPBC Act Offsets Policy requires that a minimum of 90 per cent of the proposed airport's impacts must be directly offset as calculated with the offsets assessment guide for EPBC Act-listed threatened species and communities or as calculated through an alternative metric for other matters subject to exceptions, including where it can be demonstrated that a greater benefit to the protected matter is likely to be achieved through increasing the proportion of other compensatory measures in an offset package. As indicated earlier in this report, it is expected that most offsets will be provided through the conservation of land directly, by means of BioBanking agreements (with relevant credits to be purchased and retired) or other conservation covenants. The remaining offset requirement is able to be met by alternative environmental contributions such as a financial contribution to conservation programmes, research or education. These other compensatory measures, and consideration of the EPBC Act offsets policy requirements for direct offsets, are presented in Sections 6 and 7 of this report.

The specific components of this approach to the biodiversity offset package are described below.

# 4.2 Potential offset sites

## 4.2.1 Identification of offset sites

A desktop assessment was performed to identify and describe potential offset sites for the proposed airport. Candidate sites would be secured under a BioBanking agreement, or an alternative covenant that would ensure that the offset sites would be securely titled for conservation in perpetuity. This desktop assessment process will continue after submission of the final EIS up until the full quantum of biodiversity offsets are specified in the biodiversity offset delivery plan.

The sources considered in the desktop assessment include:

- the 'biodiversity credits register' (OEH 2015b) which was used to identify existing biobank sites with biodiversity credits that would offset impacts on the affected threatened biota and that are available for sale;
- the BioBanking 'Expression of interest register' (OEH 2015c) which was used to identify potential biobank sites that could generate suitable biodiversity credits in the future;
- available BioBanking assessment reports for existing and potential biobank sites, which were used to describe the biodiversity values of the sites and especially to confirm the extent and quality of habitat for the affected threatened biota;

- consultation with private landowners, ecological consultants and agencies such as OEH, the NSW Department of Planning and Environment (DPE) and the Western Sydney Parklands Trust to identify or to describe potential offset sites; and
- consultation with private landowners and conservation organisations such as the Nature Conservation Trust and Cumberland Conservation Network.

The following criteria were used to identify potential offset sites:

- presence of Cumberland Plain Woodland, comprising the NSW vegetation types HN528, HN529 and HN512 (OEH 2014):
  - that meets the condition criteria required to comprise the community as defined under the EPBC Act and associated policy (DEWHA 2010); or
  - is poorer quality Cumberland Plain Woodland that could be managed to achieve that condition and is connected to EPBC Act Cumberland Plain Woodland.
- presence of habitat for the Grey-headed Flying-fox based on the presence of known food tree species (Eby and Law 2008) and the critical habitat criteria listed in the Draft National Recovery Plan for the Grey-headed Flying-fox (DECCW 2009);
- presence of other biodiversity values appropriate to offset the proposed airport's impacts on plants, animals and their habitats;
- land that is relatively close to the airport site, in order to more directly benefit the populations and communities affected by the proposed airport, and which as a minimum is located in the Cumberland IBRA sub-region;
- land that is within identified priority conservation lands or wildlife corridors or that could connect fragmented patches of habitat (see Figure 5); and
- land that is already set aside as a biobank and that has suitable biodiversity credits for sale, that
  is likely to be set aside as a biobank or otherwise protected under a conservation covenant, or
  that may be available for sale and would be suitable for the purposes of establishing a new
  biobank site.

The offset package includes the conservation of core areas of Cumberland Plain Woodland in offset sites that already meet the condition criteria required to comprise the community as defined under the EPBC Act and associated policy (DEWHA 2010). The offset package will also include the conservation and management of poorer quality Cumberland Plain Woodland that could be managed to achieve that condition.

The guide to identifying and protecting EPBC Act Cumberland Plain Woodland notes that appropriate management of patches that do not meet the condition thresholds may still play an important ecological role, especially where they are linking native vegetation remnants in the landscape and contributing to the future viability of listed patches of the ecological community. Both patches that meet the condition thresholds and those that do not should be considered in recovery and other management actions (DEWHA 2010). This approach is consistent with the Commonwealth listing advice for Cumberland Plain Woodland which notes that if a patch does not meet the condition criteria, suitable recovery and management actions may improve it to the point that it can be regarded as part of the ecological community listed under the EPBC Act (TSSC 2008). The listing advice also notes that

"derived grasslands and shrublands can be quite easily recovered to meet the Description and Condition Thresholds for the listed ecological community through planting of key canopy tree species and ongoing management actions" (TSSC 2008, p.5). In line with the listing advice, only derived native grassland and scrub with predominantly native groundcover and the capacity for natural regeneration have been included as poorer quality Cumberland Plain Woodland in the offset package. Specific detail about the condition, landscape context and proposed management of poorer quality Cumberland Plain Woodland at individual offset sites will be included in the biodiversity offset delivery plan.

# 4.2.2 Description of potential offset sites

The desktop assessment has revealed suitable offset sites that contain Cumberland Plain Woodland and/or Grey-headed Flying-fox habitat. The potential offset sites include established biobank sites with suitable biodiversity credits for sale and proposed biobank sites that are at various stages of the assessment and approval process for obtaining a BioBanking agreement.

Potential offset sites that contain habitat for the affected threatened biota and that could be included in this offset package are listed in Table 8. The locations of the potential offset sites relative to the airport site are shown in Figure 5. Of these potential sites, the 'Hampden Vale biobank' has been identified and included in this biodiversity offset package since the Draft EIS was placed on public exhibition. Supplementary surveys have also been conducted at the Ropes and South Creeks group of offset sites to confirm the presence of threatened biota affected by the airport and to help describe the extent and quality of habitat. This is in accordance with the ongoing process of identifying, assessing and securing suitable offsets that will continue through the planning and assessment phase for the proposed airport. The biodiversity offset delivery plan will be submitted and require approval from the Environment Minister or an SES Officer in DoEE prior to Main Construction Works for the Stage 1 development, ensuring that biodiversity offsets are identified (and secured where possible) prior to the substantial impacts occurring.

The potential offset sites are appropriately sited to make a contribution to the conservation of regional populations of Cumberland Plain Woodland, the Grey-headed Flying-fox and other biodiversity values. Portions of the Williamswood, Montpelier Stages 1 and 2, Hampden Vale and Durham biobanks are located in mapped Cumberland Plain Priority Conservation Lands that are identified in the recovery plan for Cumberland Plain Woodland (DECCW 2010, 2011). The Ropes and South Creek biobank sites and the Menangle Road and Dunheved biobank sites are connected to Cumberland Plain Priority Conservation Lands by remnant native vegetation (DECCW 2011). As shown in Figure 5, all but two of the sites are located in regional wildlife corridors and priority biodiversity investment areas identified in the *Biodiversity Investment Opportunities Map - Mapping Priority Investment Areas for the Cumberland Subregion* (OEH 2015d). Conservation of the potential offset sites would ensure the protection and management of core areas of habitat within recognised regional wildlife corridors and increase the width of corridors through regeneration of vegetation on adjoining land.

A detailed description of each of the potential offset sites is provided in Appendix A, including their location, tenure, land uses, the vegetation types present, the extent and quality of habitat for the affected threatened biota, existing threats and recommended management actions. An overview of these sites is provided below.

The 'Williamswood biobank' and 'The Oaks biobank' offset sites have been subject to detailed field survey and BioBanking assessment and have already been set aside for conservation under a BioBanking agreement. Offsets are available for the airport because biodiversity credits linked to Cumberland Plain Woodland and/or Grey-headed Flying-fox habitat have not yet been purchased and retired. They are located within the Wollondilly Local Government Area (LGA) around 20 kilometres to

the south of the airport site and feature a variety of grassy woodland vegetation types on shale and alluvial substrate. Both sites are currently zoned RU2 Rural Landscape under the *Wollondilly Local Environment Plan 2011* (LEP) and were grazed by cattle prior to being set aside as a biobank. Both sites contain Cumberland Plain Woodland that also comprises Grey-headed Flying-fox habitat as well as additional habitat associated with other vegetation types on shale or alluvium.

The 'Durham biobank', 'Mare biobank', Forrester biobank', 'Luddenham biobank', 'Caddens biobank' and 'Dunheved biobank' offset sites are proposed biobanks on land owned by the NSW DPE in the Ropes Creek and South Creek riparian corridors around 10-20 kilometres to the north of the airport site. These sites have been subject to a detailed field survey and a preliminary BioBanking assessment but have not yet been set aside for conservation under a BioBanking agreement. These offset sites each feature a variety of grassy woodland vegetation types on shale and alluvial substrate. These sites contain Cumberland Plain Woodland that also comprises Grey-headed Flying-fox habitat as well as additional habitat associated with other vegetation types.

The 'Stage 1 Montpelier Biobank', 'Stage 2 Montpelier biobank', 'Menangle Road biobank', 'Bruelle biobank' and 'Hampden Vale biobank' offset sites are each proposed biobanks that have been subject to field surveys and BioBanking assessments prior to applications for BioBanking agreements from OEH. Each of these biobanks is located within 20 kilometres of the airport site in the Wollondilly or Penrith LGAs. They are currently zoned RU2 Rural Landscape under applicable LEPs and are subject to grazing and other land uses. These sites each feature a variety of grassy woodland vegetation types on shale and alluvial substrate, including Cumberland Plain Woodland and Grey-headed Flyingfox habitat.

The 'Western Sydney Parklands biobank ID 120' and 'Western Sydney Parklands biobank ID 70' offset sites have already been set aside for conservation under BioBanking agreements. Offsets could be available for the proposed airport because biodiversity credits linked to Cumberland Plain Woodland and/or Grey-headed Flying-fox habitat have not yet been purchased and retired. They are located around 10 kilometres to the north-east of the airport site and feature a variety of grassy woodland vegetation types on shale and alluvial substrate. These sites contain Cumberland Plain Woodland that also comprises Grey-headed Flying-fox habitat.

Potential Offset Site	Location	Total area (ha)	Status and ownership	Source
Williamswood biobank	Mount Hunter	104.4	Established biobank, private owner.	Williamswood Biobank BioBanking Assessment (GHD 2014a).
Durham biobank	Oxley Park (Ropes Creek riparian corridor)	46.85	Potential biobank, DPE.	Ropes and South Creek Preliminary BioBanking Assessment Report (GHD 2016c).
Mamre biobank	Mamre Park (South Creek riparian corridor)	98.1	Potential biobank, DPE.	Ropes and South Creek Preliminary BioBanking Assessment Report (GHD 2016c).
Luddenham biobank	Mamre Park (South Creek riparian corridor)	42	Potential biobank, DPE.	Ropes and South Creek Preliminary BioBanking Assessment Report (GHD 2016c).
Roper biobank	Minchinbury (Ropes Creek riparian corridor)	14.05	Potential biobank, DPE.	Ropes and South Creek Preliminary BioBanking Assessment Report (GHD 2016c).

## **Table 8 Potential offset sites**

Potential Offset Site	Location	Total area (ha)	Status and ownership	Source
Caddens biobank	Claremont Meadows (South Creek riparian corridor)	36.08	Potential biobank, DPE.	Ropes and South Creek Preliminary BioBanking Assessment Report (GHD 2016c)
Dunheved biobank	Werrington County (South Creek riparian corridor)	90.17	Potential biobank, DPE.	Ropes and South Creek Preliminary BioBanking Assessment Report (GHD 2016c).
Forrester biobank	Tregear (Ropes Creek riparian corridor)	30.43	Potential biobank, DPE.	Ropes and South Creek Preliminary BioBanking Assessment Report (GHD 2016c).
Stage 1 Montpelier biobank	The Oaks	76.24	Potential biobank, private owner.	Stage 1 Montpelier Biobank BioBanking Assessment (GHD 2015a).
Stage 2 Montpelier biobank	The Oaks	79.5	Potential biobank, private owner	Stage 2 Montpelier Biobank BioBanking Assessment (GHD in prep. a).
Menangle Road biobank	The Oaks	57.07	Potential biobank, private owner	Menangle Road Biobank BioBanking Assessment (GHD 2015b).
Bruelle biobank	Mulgoa	27.5	Potential biobank, private owner	Bruelle biobank site Draft Biobank agreement assessment (GHD 2015c).
The Oaks	Mowbray Park	40	Established biobank, private owner	The Oaks Biobank BioBanking Assessment (GHD 2015d).
Western Sydney Parklands ID 120	Cecil Park	19.4	Established biobank, Western Sydney Parklands Trust	The biodiversity credits register (OEH 2015b).
Western Sydney Parklands ID 70	Cecil Park and Chandos West	40.5	Established biobank, Western Sydney Parklands Trust	The biodiversity credits register (OEH 2015b).
Hampden Vale biobank	Razorback	101	Potential biobank, private owner	Hampden Vale Biobank BioBanking Assessment (GHD in prep. a).

There are local occurrences of each of the TECs that would be removed for construction of the airport and known or potential habitat for many of the threatened species that would be affected at the offset sites (see Appendix A and Table 9).

Common name	Scientific name	TSC Act Status	EPBC Act Status	Sites recorded
Black Bittern	Ixobrychus flavicollis	V		Mamre <sup>5</sup>
Brown Treecreeper (eastern subspecies)	Climacteris picumnus subsp. victoriae	V		Dunheved <sup>1</sup>
Eastern Freetail-bat	Mormopterus norfolkensis	V		Mamre <sup>2</sup>
Little Eagle	Hieraaetus morphnoides	V		Roper, Luddenham, Montpelier Stage 1, Montpelier Stage 2, Williamswood <sup>3</sup>
Powerful Owl	Ninox strenua	V		Mamre <sup>2</sup>
Swift Parrot	Lathamus discolor	E	CE	Dunheved <sup>1</sup>
Turquoise Parrot	Neophema pulchella	V		Luddenham <sup>1</sup>
Varied Sittella	Daphoenositta chrysoptera	V		Dunheved <sup>1,</sup> Mamre <sup>2</sup>
Cumberland Plain Land Snail	Meridolum corneovirens	Ε		Forrester <sup>1</sup> , Caddens <sup>2</sup> , Durham, Roper, Mamre, Dunheved, Forrester, Caddens, Luddenham <sup>5</sup>
Juniper-leaved Grevillea	Grevillea juniperina subsp. juniperina	V		Durham <sup>3</sup> , Roper <sup>3</sup>
Dillwynia tenuifolia	Dillwynia tenuifolia	V		Roper <sup>4</sup>
Grey-headed Flying-fox	Pteropus poliocephalus	V	V	Caddens <sup>2</sup> and roost camp within 500 metres <sup>4</sup> . Dunheved, Forrester, Caddens <sup>5</sup> .
Large-footed Myotis	Myotis macropus	V		Mamre <sup>2</sup>
Marsdenia viridflora subsp. viridiflora				Hampden Vale⁵
Pultenaea parviflora	Pultenaea parviflora	V	V	Dunheved <sup>3</sup>
Spiked Rice-flower	Pimelea spicata	E	E	Williamswood <sup>3</sup>

# Table 9 Threatened species recorded at the potential offset sites

1 = Toolijooa (various dates); 2 = OEH (2015a); 3 = GHD (2014a,b; 2015a,b,c,d,e; in prep.); 4 = PB (2013) 5 – GHD (in prep. b.) 5 = targeted surveys undertaken by GHD as part of the preparation of this offst package.



Ci21/24265/GISIMaps\Deliverables\21-24265-Z161\_AirportSiteAndOffsetSites.mxd Level 15, 133 Castlereagth Street Sydney NSW 2000 T61 2 9239 7100 F61 2 9239 7109 Esydmail@ghd.com.au Www.ghd.com.au Generations or warrantes about its accuracy, reliability, completeness or suitability for any particular protocal castle and a complete or unsuitable in any way and for any reason. Data source: Aerial Imagery: ESRI, 2015. Offset sites: GHD, 2015. Cumberland Plain Conservator: DECCW, 2011 Created by:mweerakoon

## 4.2.3 Potential offset areas for affected EPBC Act-listed threatened biota

The potential offset sites described above contain some areas of native vegetation and habitat that is not an appropriate 'like for like' match for impacts on the affected EPBC Act-listed threatened biota or is associated with biodiversity credits that have already been sold. A subset of the habitat available at the potential offset sites has been selected on the basis that it would directly offset impacts on the affected threatened biota, and the biobanking credits which are generated to represent the offsets for that area are available for purchase. These specific areas would be documented and mapped in the biodiversity offset delivery plan.

The criteria for selecting the proposed offset areas are:

- areas that are linked to biodiversity credits that are available for sale at established biobanks or that would be available for sale at proposed biobanks;
- presence of EPBC Act Cumberland Plain Woodland; and
- presence of habitat for the Grey-headed Flying-fox.

The 'proposed offset areas' (i.e. the specific areas of habitat at potential offset sites that could be included in the biodiversity offset delivery plan to offset impacts on the affected threatened biota) are summarised in Table 10. Table 10 presents the potential offset areas that are available at the time of publication (i.e. August 2016). Biodiversity credits linked to these areas may be sold to other parties prior to the finalisation of the biodiversity offset delivery plan. Additional or alternative offset areas will also be identified, including areas at the potential additional offset sites listed in Section 4.3.

The area of Grey-headed Flying-fox habitat available in the proposed offset areas (at least 451 hectares) is greater than the estimated area required to meet this species' offset requirement (410 hectares). This area would also contribute offsets for impacts on plants, animals and their habitat as estimated in Section 3.

Table 10 Habitat for the affected threatened biota at potential offset sites (at August 2016)

Notes	EPBC Act Cumberland Plain Woodland linked to credits that are available for sale, which also comprises Grey-headed Flying-fox habitat. Additional poorer quality Cumberland Plain Woodland linked to credits that are available for sale.	EPBC Act Cumberland Plain Woodland linked to credits that are available for sale, which also comprises Grey-headed Flying-fox habitat. Additional poorer quality Cumberland Plain Woodland linked to credits that are available for sale.	EPBC Act Cumberland Plain Woodland linked to credits that are available for sale, which also comprises Grey-headed Flying-fox habitat. Additional Grey-headed Flying-fox habitat associated with River Flat Eucalypt Forest and close to a known roost camp linked to credits that are available for sale.	Grey-headed Flying-fox habitat associated with River Flat Eucalypt Forest and linked to biodiversity credits that are available for sale.	EPBC Act Cumberland Plain Woodland linked to credits that are available for sale, which also comprises Grey-headed Flying-fox habitat. Additional Grey-headed Flying-fox habitat associated with River Flat Eucalypt Forest. Additional poorer quality Cumberland Plain Woodland is available.	EPBC Act Cumberland Plain Woodland and poorer quality Cumberland Plain Woodland linked to credits that are available for sale.	EPBC Act Cumberland Plain Woodland linked to credits that are available for sale, which also comprises Grey-headed Flying-fox habitat. Additional poorer quality Cumberland Plain Woodland. Biodiversity credits for other impacts on plants, animals and their habitat are available.
Grey-headed Flying fox habitat (ha) <sup>3</sup>	50.4	10.4	24.1	52.5	34.6	6.7	17.3
Extent of available poorer quality Cumberland Plain Woodland (ha) <sup>2</sup>	28.0	3.0	0.0	0.0	0.7	1.7	1.2
Extent of available EPBC Act Cumberland Plain Woodland (ha) <sup>1</sup>	31.9	10.0	2.9	0.0	4.1	3.0	4.8
Total area (ha)	104.5	40.0	42.7	98.1	40.0	13.3	33.3
Potential Offset Site	Williamswood biobank	The Oaks	Durham biobank	Mamre Biobank	Luddenham biobank	Roper biobank	Caddens biobank

Notes	EPBC Act Cumberland Plain Woodland linked to credits that are available for sale, which also comprises Grey-headed Flying-fox habitat. Additional poorer quality Cumberland Plain Woodland. Biodiversity credits for other impacts on plants, animals and their habitat.	EPBC Act Cumberland Plain Woodland linked to credits that are available for sale, which also comprises Grey-headed Flying-fox habitat. Grey-headed Flying-fox habitat associated with River Flat Eucalypt Forest and linked to biodiversity credits that are available for sale.	EPBC Act Cumberland Plain Woodland linked to credits that are available for sale, which also comprises Grey-headed Flying-fox habitat. Additional poorer quality Cumberland Plain Woodland. Biodiversity credits for other impacts on plants, animals and their habitat.	EPBC Act Cumberland Plain Woodland linked to credits that are available for sale, which also comprises Grey-headed Flying-fox habitat. Additional poorer quality Cumberland Plain Woodland. Biodiversity credits for other impacts on plants, animals and their habitat.	EPBC Act Cumberland Plain Woodland linked to credits that are available for sale, which also comprises Grey-headed Flying-fox habitat. Additional poorer quality Cumberland Plain Woodland. Biodiversity credits for other impacts on plants, animals and their habitat.	EPBC Act Cumberland Plain Woodland linked to credits that are available for sale, which also comprises Grey-headed Flying-fox habitat. Biodiversity credits for other impacts on plants, animals and their habitat.	EPBC Act Cumberland Plain Woodland linked to credits that are available for sale, which also comprises Grey-headed Flying-fox habitat. Biodiversity credits for other impacts on plants, animals and their habitat are available for sale.
Grey-headed Flying fox habitat (ha) <sup>3</sup>	23.0	26.7	40.9	48.5	36.0	27.5	18.2
Extent of available poorer quality Cumberland Plain Woodland (ha) <sup>2</sup>	8.7	0.0	11.4	9.2	21.1	0.0	0.0
Extent of available EPBC Act Cumberland Plain Woodland (ha) <sup>1</sup>	8 r	1.6	34.1	20.9	27.0	14.4	18.2
Total area (ha)	65.0	30.4	76.2	79.5	57.1	26.8	19.4
Potential Offset Site	Dunheved biobank	Forrester biobank	Stage 1 Montpelier biobank	Stage 2 Montpelier biobank	Menangle Road biobank	Bruelle biobank	Western Sydney Parklands ID 120

ed Notes	EPBC Act Cumberland Plain Woodland linked to credits that are available for sale, which also comprises Grey-headed Flying-fox habitat. Biodiversity credits for other impacts on plants, animals and their habitat are available for sale.	EPBC Act Cumberland Plain Woodland linked to credits that are available for sale, which also comprises Grey-headed Flying-fox habitat. Biodiversity credits for other impacts on plants, animals and their habitat are available for sale.		
Grey-heade Flying fox habitat (ha)	5.2	28.7	450.6	410
Extent of available poorer quality Cumberland Plain Woodland (ha) <sup>2</sup>	0.0	50.1	135.0	
Extent of available EPBC Act Cumberland Plain Woodland (ha) <sup>1</sup>	5.2	16.0	207.9	355
Total area (ha)	40.5	101.0	867.8	
Potential Offset Site	Western Sydney Parklands ID 70	Hampden Vale biobank	Total	Estimated offset requirement (see Section 5.3)

Notes:

- 2010) and which are linked to biodiversity credits associated with an established biobank site that are currently available for sale and/or which are in a parcel of land that is likely to be set aside as 1- Vegetation types HN528, HN529 and HN512 that meet the condition criteria required to comprise Cumberland Plain Woodland as defined under the EPBC Act and associated policy (DEWHA a biobank.
- Poorer condition patches of vegetation types HN528, HN529 and HN512 that do not meet the condition criteria required to comprise Cumberland Plain Woodland as listed under the EPBC Act (DEWHA 2010) but which comprises an occurrence of the form of the community that is listed under the TSC Act. Comprises derived native scrub or grassland with <10 per cent canopy cover. 'n
- Based on vegetation type descriptions in offset site assessment reports compared with the critical habitat criteria listed in the Draft National Recovery Plan for the Grey-headed Flying-fox (DECCW 2009). ဗု

The quality of habitat in the proposed offset areas is described further in Section 5.2. These data have been used to perform the preliminary offsets assessment guide calculations included in Section 5. Based on these preliminary offset calculations the proposed offset areas could deliver 100 per cent of the required offsets for the Grey-headed Flying-fox as direct offsets but only around 74 per cent of the estimated requirement for Cumberland Plain Woodland. The process of identification of potential offset sites will continue until the required quantum of offsets can be delivered. As additional offset sites are identified, the proposed offset areas would be reconsidered to ensure that the most suitable offset areas are included in the biodiversity offset delivery plan. Similarly, if some of the proposed areas are set aside as offsets for another project or otherwise become unavailable then alternative offset sites or other offset options would be identified.

# 4.2.4 Potential biodiversity credits for impacts on plants, animals and their habitat

Biodiversity credits would be purchased to offset the proposal's impacts on plants, animals and their habitat, including for threatened biota that are listed under the NSW TSC Act but not the EPBC Act. The number and type of biodiversity credits that would be required to offset the proposed airport's impacts on plants, animals and their habitat are specified in the Biodiversity credit report (see Appendix B).

The FBA allows trading of ecosystem credits for closely related vegetation types if they are in the same vegetation class and are at least as extensively cleared (i.e. have the same or greater conservation significance). The suite of matching biodiversity credits that are available at the potential offset sites to offset impacts on plants, animals and their habitat are summarised in Table 11. Many of the offset sites included in Table 11 are proposed biobanks that have not yet been subject to detailed BioBanking credit calculations and so a rate of seven credits per hectare has been used to estimate the number of biodiversity credits available.

Table 11 includes a comparison of the credits available at the potential offset sites and the ecosystem credit requirement to offset the proposed airport's impacts on plants, animals and their habitat as estimated in Section 3. There would be sufficient ecosystem credits available to offset impacts on Grey Box - Forest Red Gum grassy woodland on shale (HN529) and Forest Red Gum - Rough-barked Apple grassy woodland (HN526). The 'Credit balance' in Table 11 shows that additional ecosystem credits would be required to offset impacts on other vegetation types and associated predicted threatened species. The credit shortfall for Grey Box - Forest Red Gum grassy woodland on flats (HN528) can be partially met by trading surplus HN526 credits, which is permitted by the FBA credit trading rules.

The credit shortfall for HN528 could also be partially met by up to 1,818 ecosystem credits associated with HN529 and Grey Box - Forest Red Gum shrubby woodland (HN524). These are not matching credits according to the FBA credit trading rules but are associated with very closely related ecological communities with similarly high conservation significance. Both vegetation types are associated with EPBC Act-listed critically endangered ecological communities and HN528 and HN529 are both consistent with Cumberland Plain Woodland.

Potential Offset Site	Total area (hectares)	Available HN528 credits	Available HN529 credits	Available HN526 credits	Available HN512 credits	Available HN630 credits	Available HN524 credits
Williamswood biobank	104.5	0	694	280	0	0	38
Durham biobank	42.7	31	0	246	0	0	0
Mamre biobank	98.1	0	0	680	0	7	0
Luddenham biobank	40.0	34	0	246	0	0	0
Roper biobank	13.3	48	0	20	25	0	0
Caddens biobank	33.3	47	0	181	0	5	0
Dunheved biobank	65.0	93	0	362	0	0	0
Forrester biobank	30.4	81	0	127	0	0	0
Stage 1 Montpelier biobank	76.2	119	442	0	0	0	153
Stage 2 Montpelier biobank	79.5	0	363	0	0	0	118
Menangle Road biobank	57.1	0	454	36	0	0	29
Bruelle biobank	26.8	0	141	0	0	0	0
The Oaks	40.0	0	261	11	0	0	69
Western Sydney Parklands ID 120	19.4	120	0	61	0	0	0
Western Sydney Parklands ID 70	40.5	49	0	10	0	0	0
Hampden Vale biobank	101	185	417	52			36
Total	867.8	807	2772	2312	25	12	443
Ecosystem credit requirement		2062	1946	2140	358	873	0
Credit balance		-7099	826	172	-333	-861	443
Total, including trading of matching credits <sup>1</sup>		679					
Credit balance, including trading of matching credits		-6927	826	0	-333	-861	443

Table 11 Ecosystem credits for impacts on plants, animals and their habitats

Notes: 1) includes 172 HN526 credits which may be traded with HN528.

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No species credits have been calculated at any of the existing or proposed biobank sites included in this offset package. Species credits may be generated once targeted surveys have been undertaken to confirm the presence of threatened species and the number of plant individuals and the area of fauna habitat. Based on the assessments undertaken to date, the potential offset sites contain known or potential habitat for each of the species credit-type threatened species affected by the proposed airport. Table 12 summarises the species credits required to offset the impacts of the proposed airport as calculated in Section 3.3.2, the equivalent area of fauna habitat or number of plants required to generate these credits at an offset site and a summary of the potential habitat available at offset sites.

Sufficient *Pultenaea parviflora* has already been recorded at the Dunheved biobank site to generate the required number of species credits to offset the impacts of the proposed airport (GHD 2014a). The Black Bittern has been recorded at the Mamre biobank site and the Cumberland Plain Land Snail has been recorded at the Mamre, Forrester, Dunheved, Roper, Luddenham, Durham and Caddens biobank sites during recent surveys conducted by GHD as part of the preparation of the offset package. These records will be used to calculate species credits that would be available to help offset the proposed airport's impacts on these species.

The Hampden Vale biobank contains at least 75 stems of *Marsdenia viridiflora* subsp. *viridiflora* within around 80 hectares of potential habitat (see Section 4.2.3 and Appendix A). A potential offset site at Ninth Ave, Penrith contains at least 200 stems within up to 50 hectares of habitat that may be available as an offset, subject to agreement from multiple landowners (Harrold, L. Cumberland Conservation Network) (see Section 4.3).

Based on the site surveys and habitat assessments undertaken it is likely that supplementary surveys would confirm the presence of the relevant affected threatened fauna species at the identified offset sites and allow the calculation of species credits which may be available for purchase.

Common name	Scientific name	Species credits required	Individuals / area (ha) required in offset site	Individuals / area available in offset site(s
Black Bittern	lxobrychus flavicollis	815	115 ha	Up to around 314 hectares of potential habitat in Forest Red Gum - Rough-barked Apple grassy woodland (HN526) and Coastal freshwater wetland (HN630) at proposed offset sites. The species has been recorded at the Mamre biobank site.
Cumberland Plain Land Snail	Meridolum corneovirens	1,843	260 ha	Up to around 414 hectares of potential habitat in Grey Box - Forest Red Gum grassy woodland on shale (HN529) and Grey Box - Forest Red Gum grassy woodland on plains (HN528). The species has been recorded at the Mamre, Forrester, Dunheved, Roper, Luddenham, Durham and Caddens biobank sites.
Marsdenia viridiflora subsp. viridiflora in the Bankstown, Blacktown, Camden, Cambelltown, Fairfield, Holroyd,	Marsdenia viridiflora subsp. viridiflora - endangered population	5,800	817 stems	Up to around 476 hectares of potential habitat in Grey Box - Forest Red Gum grassy woodland on shale (HN529), Grey Box - Forest Red Gum grassy woodland on plains (HN528) and Grey Box - Forest Red Gum shrubby woodland (HN524). Around 75 stems of the species have been recorded as a result of partial survey of around 80 hectares of habitat at the Hampden Vale biobank site.

# Table 12 Species credits potentially available at potential offset sites

Common name	Scientific name	Species credits required	Individuals / area (ha) required in offset site	Individuals / area available in offset site(s
Liverpool and Penrith local government areas				The species has been recorded at the 'Ninth Ave. Penrith' potential offset site (see Section 4.3).
Pultenaea parviflora	Pultenaea parviflora	60	8 individuals	100 individuals have been recorded at the Dunheved biobank site.
Southern Myotis	Myotis macropus	752	106 ha	Over 330 hectares of potential habitat in Forest Red Gum - Rough-barked Apple grassy woodland (HN526) at proposed offset sites. The species has been recorded at the Mamre biobank site.

# 4.3 Potential additional offset sites

Based on the preliminary calculations included in Section 5, the potential offset sites described above would not be sufficient to offset all the biodiversity impacts of the Stage 1 development. Additional offset sites or other compensatory measures (as environmental contributions) will be identified and included in the biodiversity offset delivery plan to address this shortfall.

A number of additional potential offset sites have already been considered in the preparation of this offset package but could not be formally included at this stage because insufficient information was available about their biodiversity values and/or future ownership and management. These sites are outlined below.

- Additional land in the Western Sydney Parklands that has not yet been set aside as a biobank (Kirkland, D., Western Sydney Parklands Trust, pers. comm.).
- The 'Picton Farm biobank' on land managed by Sydney Water Corporation at Picton. This site is a 121 hectare proposed biobank that was assessed by GHD and contains around 20 hectares of Cumberland Plain Woodland (HN528 credits) as well as around 90 hectares of Shale Sandstone Transition Forest (HN556 credits) and 10 hectares of Western Sydney Dry Rainforest and Moist Woodland on Shale (HN538 credits) that could provide offsets for impacts on plants, animals and their habitat. Large-footed Myotis (*Myotis macropus*) breeding habitat and Cumberland Plain Land Snails (*Meridolum corneovirens*) have been recorded at the site and so species credits could be purchased and retired to offset impacts on these threatened species (GHD 2016d). Additional land managed by Sydney Water Corporation is also likely to be set aside as biobank sites in the future and may be appropriate to offset the impacts of the Stage 1 development.
- The 'Hardwicke property' which is a 200 hectare site located in the Wollondilly LGA that was identified via consultation. There would be four separate biobank agreements across the site, each of which may contribute offsets for the proposed airport as follows:
  - Biobank 1 (56 hectares), issue of the BioBanking agreement is imminent and up to 87 HN529 ecosystem credits equating to around 12 hectares of habitat would be available to offset impacts on Cumberland Plain Woodland.

- Biobank 2 (57 hectares), BioBanking assessment has been completed and up to 550 HN529 ecosystem credits equating to around 79 hectares of habitat would potentially be available to offset impacts on Cumberland Plain Woodland.
- Biobanks 3 and 4 (87 hectares), BioBanking assessment has not yet commenced but around 1,000-1,300 HN529 and HN528 ecosystem credits equating to around 160 hectares of habitat would potentially be available to offset impacts on Cumberland Plain Woodland (Humphreys, R. EcoLogical Australia, pers. comm.).
- The 'Sunnyside biobank' at The Oaks which is a 52 hectare potential biobank with a private owner who is a GHD client. Up to 81 HN529 credits associated with 5.9 hectares of habitat would be available to offset impacts on Cumberland Plain Woodland as well as around 600 additional biodiversity credits that would be appropriate to offset impacts on plants, animals and their habitats (GHD 2014b).
- The Moorebank 'Boot land' offset site, which is a 100 hectare site identified via consultation on Commonwealth-owned land at Moorebank and includes species and communities that are likely to be surplus to the offsetting requirements of the project that it is intended to offset (Cockerill, A. PB, pers. comm.). HN512 credits may be available to offset impacts on Cumberland Plain Woodland as well as up to 35 hectares of other threatened ecological communities and threatened plant populations that may be appropriate to offset impacts on plants, animals and their habitats (GHD 2015).
- The 'Ninth Avenue, Penrith' offset site which is a potential offset site located on three parcels of undeveloped land identified by conservation groups in their submissions on the draft EIS. Between seven and 50 hectares of land may be available, subject to agreement from separate land owners. Based on preliminary surveys undertaken at the site it contains up to 50 hectares of Cumberland Plain Woodland and related communities and a local population of at least 200 stems of *Marsdenia viridiflora* subsp. *viridflora*.
- 75-90 Fairlight Road Mulgoa, which is a private property identified by conservation groups in their submissions on the draft EIS and which may be available for purchase as an offset site. It contains up to 26 hectares of Cumberland Plain Woodland and is well positioned adjacent to the existing Fernhill East biobank site and as such would contribute to a network of conservation land.
- Private biobank 1 (83 hectares), which is a privately owned biobank located near Picton NSW that was identified via consultation. A BioBanking agreement application has been lodged with OEH. Around 10 HN528 ecosystem credits, equating to around one hectare of habitat, may be available to offset impacts on Cumberland Plain Woodland. Cumberland Plain Land Snail species credits and other biodiversity credits may be available to offset impacts on plants, animals and their habitats (Richardson, M. Niche EH, pers. comm.).
- Private biobank 2 (approx. 150 hectares), which is a privately owned biobank located near Picton NSW that was identified via consultation. A BioBanking assessment has been completed and a BioBanking agreement application is expected to be lodged with OEH in late 2016. Around 50 HN528 ecosystem credits equating to around five hectares of habitat may be available to offset impacts on Cumberland Plain Woodland. Cumberland Plain Land Snail species credits and other biodiversity credits may be available to offset impacts on plants, animals and their habitats (Richardson, M. Niche EH, pers. comm.).

- Private biobank 3 (approx. 50 hectares), which is a privately owned biobank located near Picton NSW that was identified via consultation. A BioBanking assessment has been completed and a BioBanking agreement application is expected to be lodged with OEH in late 2016. Around 200 HN528 ecosystem credits equating to around 20 hectares of habitat may be available to offset impacts on Cumberland Plain Woodland. Cumberland Plain Land Snail species credits and other biodiversity credits may be available to offset impacts on plants, animals and their habitats (Richardson, M. Niche EH, pers. comm.).
- Biobank site 217, which is a 57 hectare established biobank located in Camden Council LGA that is listed on the BioBanking credits available register. Up to 212 HN528 and 12 HN529 ecosystem credits may be available to offset impacts on Cumberland Plain Woodland. The potential offset area containing EPBC Act-listed Cumberland Plain Woodland, or poorer condition vegetation that could be rehabilitated to this standard, would need to be confirmed. All of these ecosystem credits and a further 341 HN526 ecosystem credits would be suitable for offsetting impacts on plants, animals and their habitats (OEH 2015b).

Additional consultation, survey and assessment would be required to confirm the availability of biodiversity credits and that these additional potential offset sites would be suitable for inclusion in the biodiversity offset delivery plan for the proposed airport. A particular focus would be to confirm that they contain EPBC Act-listed Cumberland Plain Woodland, poorer quality Cumberland Plain Woodland and/or habitat suitable for offsetting impacts on plants, animals and their habitat.

# 5. EPBC Act Offsets Assessment Guide Calculations

# 5.1 Overview

The EPBC Act policy requires a formal assessment of impacts and offset contributions for EPBC Act-listed species and communities using the 'offsets assessment guide'. The offsets assessment guide utilises a balance sheet approach to measure impacts and offsets. According to the EPBC Act Offsets Policy, controlled actions requiring offsets must achieve a minimum 90 per cent 'direct offset'. Direct offsets are defined as 'those actions that provide a measurable conservation gain for an impacted protected matter'. A conservation gain for the protected matter may be achieved by measures such as:

- improving existing habitat;
- creating new habitat;
- reducing threats; and/or
- averting the loss of a protected matter or its habitat that is under threat.

The majority of the direct offsets for the proposed airport would comprise the conservation and management of the affected threatened biota and their habitat in offset sites. These measures would achieve improvement in the condition of habitat, creation of new habitat and resources, mitigation of threats and averted risk of loss through development or agricultural activities. The quality of habitat in the proposed offset areas and the change in site quality with management is assessed in Section 5.2 below.

A single offset area can compensate for impacts on multiple threatened biota if they have common habitat requirements (DSEWPaC 2012b). EPBC Act Cumberland Plain Woodland at the airport site and in the potential offset sites also comprises Grey-headed Flying-fox habitat. Therefore, some offset areas at potential offset sites would contribute to meeting both EPBC Act Cumberland Plain Woodland and Grey-headed Flying-fox offset requirements.

Preliminary offsets assessment guide calculations have been performed based on the significant residual impacts which are documented in the EIS (GHD 2016a, 2015b) and the likely conservation and management of the potential offset sites identified in Section 4.2 of this report. The attributes of the potential offset sites described in Section 4.2.2 and Appendix A have been used as a guide to the likely quantum of offset required for the proposed airport and to demonstrate to the DoEE that offset areas are currently available that would substantially meet this requirement. The quality of habitat for the affected threatened biota at the potential offset areas' at each offset site have been defined which include only vegetation and habitat that is appropriate to offset impacts on the affected threatened biota which is linked to biodiversity credits that are currently available for sale (see Section 5.2). The data and assumptions that were used to perform the offset calculations are described in Table 13 and Table 14. The 'area of offset' has been treated as a variable, to estimate the total area of habitat at offset sites that would be required to directly offset 100% of the proposed airport's impacts. The

calculator inputs associated with the other attributes of the offset areas is an aggregate based on the assessment of all potential offset sites identified in Section 4.2.

BioBanking would be used to obtain a secure conservation covenant over offset sites. The biodiversity offset delivery plan will include maps that clearly show the offset area and areas of habitat for the affected threatened biota. The number and type of biodiversity credits that are linked to the offset areas for the affected threatened biota would be purchased and retired. As described in Section 1.4.2, this outcome will be achieved either through identification of suitable offset areas and completion of a BioBanking assessment with a view to establishing a new biobank site, or purchase of biodiversity credits from existing biobank sites that are linked to appropriate offset areas. The biodiversity credits that are purchased and retired for affected threatened biota will also be used to provide offsets for impacts on the plants, animals and their habitat as calculated in Section 3.

The offsets assessment guide calculations will be updated and finalised in the biodiversity offset delivery plan based on specific data for individual offset sites or appropriate alternative environmental contributions (as other compensatory measures).

In addition to conservation of land, offsets can be delivered through 'other compensatory measures', which are 'those actions that ... are anticipated to lead to benefits for the impacted protected matter, for example funding for research or educational programmes'. The intent of the offset package is to secure 100 per cent direct offsets, through conservation of appropriate vegetation and habitat in offset sites if possible. Any indirect offsets required to make up a shortfall would be developed in consultation with DoEE and documented in the biodiversity offset delivery plan. Options for other compensatory measures that could provide appropriate indirect offsets are presented in Section 6.

# 5.2 Quality of potential offset sites

## 5.2.1 EPBC Act Cumberland Plain Woodland

The quality of habitat for the affected threatened biota at the potential offset sites has been determined through detailed field surveys of the sites using the BioBanking assessment methodology and consideration of the listing advice for Cumberland Plain Woodland (TSSC 2008).

Cumberland Plain Woodland in the proposed offset areas that already meets the condition criteria for the EPBC Act listed form of the community (hereafter referred to as 'EPBC Act Cumberland Plain Woodland') comprises remnant or regrowth native vegetation in moderate condition. As described for each offset site in Appendix A, EPBC Act Cumberland Plain Woodland specifically comprises vegetation zones at offset sites that are part of a patch >0.5 hectares in area, with >10 per cent over storey cover of characteristic canopy species, shale-influenced soils and >50 per cent perennial native plants in the groundcover as defined in the listing advice for the community (TSSC 2008).

The quality of a community is scored out of ten for offsets assessment guide calculations. As described above, for the airport site there are three site characteristics that may contribute to quality: 'site condition', 'site context' and 'species stocking rate' that must be weighted according to their relative importance to the offset calculations (DSEWPaC 2012b). The weighting of these three attributes for EPBC Act Cumberland Plain Woodland in the potential offset areas was defined in the same way as for the airport site, namely: site condition – 50 per cent, site context – 50 per cent and species stocking rate – 0 per cent.

Each characteristic was scored based on the results of the BioBanking assessments for the various potential offset sites, weighted according to the size of the area at each site that would be included in the offset package.

Site condition was scored as 5/10 based on the BioBanking plot/transects and other field survey data collected within the vegetation zones that comprise EPBC Act Cumberland Plain Woodland in the potential offset areas. This score is based on the characteristics outlined below.

- Moderate/good medium condition Grey Box Forest Red Gum grassy woodland on hills (HN529). Remnant or regrowth native woodland at the Williamswood, The Oaks, Bruelle, Menangle Road, Hampden Vale and Stage 1 and 2 Montpelier biobanks. Vegetation zones at these biobanks have relatively similar characteristics comprising partially cleared grazing country on undulating shale hills. These vegetation zones feature near-intact over storey, moderate scores for native species richness and most vegetation cover attributes occasional hollow-bearing trees and relatively little woody debris. There is frequently high exotic plant cover mainly consisting of woody weeds such as African Olive (*Olea europa* subsp. *cuspidata*) in the mid storey.
- Moderate/good medium condition Grey Box Forest Red Gum grassy woodland on flats (HN528) or Broad-leaved Ironbark -*Melaleuca decora* grassy open forest (HN512). Remnant or regrowth woodland at the Ropes and South Creek and Western Sydney Parklands biobanks. Vegetation zones at these biobanks have relatively similar characteristics comprising partially cleared grazing country or open space on lower slopes and flats near to major drainage lines. These vegetation zones feature near-intact over storey, moderate scores for native species richness and most vegetation cover attributes, occasional hollow-bearing trees and relatively little woody debris. There is frequently high exotic plant cover mainly consisting of perennial grasses such as Kikuyu (*Pennisetum clandestinum*) and herbs in the under storey or woody weeds such as Privet (*Ligustrum* species) in the mid storey.

A more detailed description of site condition in each of the potential offset areas is provided in Appendix A.

Site context was scored as 5/10, reflecting the position of each of the local occurrences of the community in highly fragmented, rural landscapes (the Wollondilly and Penrith LGA biobanks) or narrow bushland remnants surrounded by suburban development (the Ropes and South Creeks and Western Sydney Parklands biobanks). Fragmentation of native vegetation and associated fauna habitats in the locality of these offset sites has previously occurred through clearing for agriculture, residences and industry and construction of transmission lines, railways and roads. These land uses have created barriers to movement for many fauna species, particularly those that are less mobile or have specific habitat preferences. The patches of Cumberland Plain Woodland that remain at the potential offset sites have high edge to area ratios and are frequently dissected by tracks and fence lines. In this context, many of the species within Cumberland Plain Woodland at the potential offset sites have limited opportunities for dispersal or recruitment and are subject to ongoing threats from human activities, grazing, exotic plants and pest fauna.

Based on the inputs described above, 'offset calculator – start area and quality – quality' (i.e. the current quality of the community in the potential offset areas) was scored as 5/10 overall. This is a slightly lower site quality score than the airport site, reflecting generally more severe weed infestation and generally smaller patches of vegetation, surrounded by more intensive land use and development.

The EPBC Act Cumberland Plain Woodland in the potential offset areas could be managed and improved to the same condition as the community at the airport site in the short to medium term, particularly through the intensive treatment of weed infestations. The 'time until ecological benefit', (i.e. the period required to achieve the probable increase in site quality score and/or decline in site quality

without management) was set as ten years. Ten years is the expected time it takes to establish a biobank, complete primary activities such as fencing and erosion control, complete the initial intensive weed control activities and achieve natural regeneration. The proposed management actions and the likely benefits to the community are described in greater detail in Section 7.4.2.

The 'offset calculator - future quality without offset' component for EPBC Act Cumberland Plain Woodland in the potential offset areas (i.e. the likely decline in site condition if the site was not managed as a biodiversity offset) was scored as 4/10 reflecting a decline in the condition and possibly also extent of the community in the potential offset areas through an additional ten years of impacts arising from grazing, weed infestation, erosion, human activities and other threats.

The 'offset calculator - future quality with offset' component (i.e. the likely increase in site condition if the site is managed as a biodiversity offset) was scored as 8/10 reflecting a substantial improvement in the condition of the community through measures such as exclusion of grazing and unauthorised access, removal of rubbish, an ecological burn, treatment of erosion and especially treatment of weed infestations. After ten years the severe infestations of woody weeds through the mid storey in much of the proposed offset area would be substantially controlled and a natural vegetation structure would be restored. The management of additional poorer quality Cumberland Plain Woodland in the potential offset areas would improve the 'site context' component of the site quality score by increasing the extent of the community, removing threats associated with adjoining areas of exotic vegetation and connecting fragmented remnants.

The potential offset areas would be managed in perpetuity and additional gains in site quality would be achieved over the longer term through bush regeneration activities, continued development of species richness and vegetation structure, increased patch sizes, improved habitat connectivity and development of habitat resources such as woody debris and hollow-bearing trees.

These values have been entered in the offsets assessment guide calculations that are presented in Section 5.3. As described above, these preliminary calculations have been presented to help estimate the quantum of offsets required and to demonstrate progress in securing suitable offset sites. The offsets assessment guide calculations will be updated in the biodiversity offsets delivery plan based on specific data for individual offset sites.

The biodiversity offsets delivery plan is likely to also include poorer quality Cumberland Plain Woodland in offset sites that comprise derived native scrub or grassland. These patches of the community do not currently meet the condition criteria for the EPBC Act listed form of the community because the native over storey cover is less than 10 per cent, however they meet the other condition attributes for the community including >50 per cent perennial native groundcover and connectivity to at least a patch of at least 0.5 hectares of EPBC Act Cumberland Plain Woodland (see DEWHA 2010). When purposefully managed for conservation in a biobank site, suitable recovery and management actions may improve these patches to the point that they can be regarded as part of the ecological community listed under the EPBC Act (TSSC 2008). The set of preliminary offsets assessment guide calculations included in Section 5.4 do not include any areas of poorer condition Cumberland Plain Woodland because it is not possible to know the proportion that would be included in the biodiversity offsets delivery plan. The starting site quality and increase achievable with management would need to be determined on a site by site basis.

The poorer quality Cumberland Plain Woodland in the potential offset areas could be managed and improved to at least the same condition as the community at the airport site in the medium to long term, through the intensive treatment of weed infestations and exclusion of grazing to permit regeneration of over storey vegetation. The aims of this management would be to achieve restoration

of vegetation that comprises EPBC Act Cumberland Plain Woodland, specifically vegetation with >10 per cent canopy cover and >50 per cent native groundcover in accordance with the condition criteria specified in the conservation and listing advice for the community (TSSC 2008, DEWHA 2010). The 'time until ecological benefit' in the final offsets assessment guide calculations (i.e. the time period required to achieve the probable increase in site quality score and/or decline in site quality without management) will be set at 20 years; a considerably longer period than for EPBC Act Cumberland Plain Woodland. Twenty years is the expected time it takes to establish a biobank, complete primary weed control and other management activities, complete supplementary planting where appropriate, achieve natural regeneration and for regenerating *Eucalyptus* to mature into over storey vegetation.

Monitoring of regeneration of poorer condition Cumberland Plain Woodland without a canopy in the Royal Botanic Gardens at Mount Annan revealed:

- recovery of mid-storey plants (mainly Native Blackthorn) after 5-7 years in areas where they had been suppressed by grazing;
- significant declines in exotic groundcover after 15 years; and
- regeneration of canopy species and growth up to 8 metres after 17 years in areas of adequate water supply (Royal Botanic Gardens & Domain Trust undated). The Commonwealth listing advice notes that the canopy in regrowth stands of EPBC Act Cumberland Plain Woodland may be shorter than 10 metres tall (TSSC 2008). Based on the results at Mount Annan, twenty years is likely to be sufficient to achieve natural regeneration over broad areas and for regenerating *Eucalyptus* to mature into over storey vegetation.

The management of poorer quality Cumberland Plain Woodland in potential offset areas would also connect fragmented patches of vegetation. Further information about the specific management actions to be performed at individual offset sites would be included in the biodiversity offsets delivery plan. This detail will be used to support the offset calculations and demonstrate that poorer quality Cumberland Plain Woodland at offset sites could be regenerated to the same site quality as the EPBC Act Cumberland Plain Woodland at the airport site in accordance with the EPBC Act Offsets Policy. The potential offset areas would not be of the same quality as the current condition of the airport site with regards to all condition attributes after 20 years. For instance, the canopy height is likely to be lower and there would still be fewer hollow-bearing trees. However, the potential offset areas would be in better condition with respect to some attributes such as patch size, species richness, native vegetation cover and especially the extent of weed infestation. For these reasons, an overall site quality at least equal to that at the airport site could be achieved.

The potential offset areas would be managed in perpetuity and additional gains in site quality would be achieved over the longer term through bush regeneration activities, continued development of species richness and vegetation structure and development of habitat resources such as woody debris and hollow-bearing trees.

# 5.2.2 Grey-headed Flying-fox

The quality of habitat for the Grey-headed Flying-fox at the potential offset sites has been determined through detailed field surveys of the sites using the BioBanking assessment methodology and consideration of the ecological requirements of the species and the draft recovery plan (DECCW 2009). The ecological survey effort conducted at these sites to date has focussed on vegetation and habitat resources and has not included nocturnal fauna surveys. Based on the presence of woodland and forest containing 'significant species' in the blossom diet of the Grey-headed Flying-fox (Eby and

Law 2008), the species would be likely to occur at each of the potential offset sites. A Grey-headed Flying-fox roost camp has been recorded in the Ropes Creek riparian corridor less than 500 metres to the south of the Durham biobank (PB 2013). Grey-headed Flying Foxes were recorded foraging in Forest Red Gums at the Dunheved, Forrester and Caddens biobank sites during targeted surveys conducted in June 2016 for this offset package.

The DoEE's instructions for the offsets assessment guide state that the contribution of the three habitat attributes 'site condition', 'site context' and 'species stocking rate' to habitat quality must be weighted according to the ecology of the relevant species or community (DSEWPaC 2012b). The weighting of these three attributes for the Grey-headed Flying-fox population at the potential offset sites was scored the same as for the airport site: site condition – 60 per cent; site context – 20 per cent; species stocking rate – 20 per cent.

Each characteristic was then scored based on the results of the ecological survey and assessments undertaken at each of the potential offset sites (see Appendix A).

Site condition was scored as 7/10 based on the characteristics outlined below.

- The health and condition of the vegetation zones that comprise Grey-headed Flying-fox habitat based on BioBanking plot/transects and other field survey data. The habitat in the potential offset areas is Cumberland Plain Woodland and River Flat Eucalypt Forest which is in moderate condition comprising remnant or regrowth native vegetation with near-intact over storey.
- The presence of Forest Red Gum and Grey Box as dominant canopy species within Cumberland Plain Woodland and River Flat Eucalypt Forest in the potential offset areas. As described above, these two tree species are recognised as 'significant species' in the blossom diet of the Grey-headed Flying-fox, are productive during food bottlenecks (Eby and Law 2008) and qualify as habitat critical to the survival of the species, as defined in the draft recovery plan (DECCW 2009) (GHD 2016a).

Site context was scored as 8/10 based on the characteristics outlined below.

- There are no camps located at the potential offset sites, although there are multiple roost camps within 20 kilometres of each site and so they are appropriately located to provide foraging resources for individuals from those camps. A Grey-headed Flying-fox roost camp has been recorded in the Ropes Creek riparian corridor less than 500 metres to the south of the Durham biobank. Flying-foxes were recorded suckling young at this roost camp (PB 2013). This roost camp is around 500 metres north of the Roper biobank and less than four kilometres south of the Forrester biobank which collectively form part of the same patch of connected riparian vegetation in the Ropes Creek corridor. The Dunheved, Caddens, Mamre and Luddenham biobanks are each within five kilometres of the roost camp in the South Creek Corridor. Collectively the Ropes and South Creek biobank sites would conserve 164 hectares of foraging habitat critical to the survival of the species in the close vicinity of this occupied roost camp.
- Habitat at many of the potential offset sites is in highly fragmented, rural landscapes or narrow bushland remnants surrounded by suburban development, as described above for the Cumberland Plain Woodland at the same potential offset sites.

Species stocking rate was scored as 8/10 due to the potential offset sites providing an area of productive foraging and sheltering habitat within the broad range of this highly mobile species and in the immediate vicinity of a roost camp in the Ropes and South Creek group of offset sites.

Based on the inputs described above, the 'offset calculator – start area and quality – quality' (i.e. the current quality of the habitat in the proposed offset area) component was scored as 7/10 overall. This is the same site quality score as the airport site, reflecting the fact that the majority of the habitat in the potential offset areas is of a similar quality to the airport site. The potential offset areas also include habitat in the immediate vicinity of a roost camp but this difference in quality is not sufficient to result in an entire point increase.

The Grey-headed Flying-fox habitat in the potential offset areas would be managed to improve the health and productivity of food tree species and to reduce threats. The 'time until ecological benefit', (i.e. the period required to achieve the probable increase in site quality score and/or decline in site quality without management) was set as ten years. Ten years is the expected time it takes to establish a biobank, complete primary activities such as fencing and erosion control, complete the initial more intensive weed control activities and achieve natural regeneration. The proposed management actions and the likely benefits to Grey-headed Flying-fox habitat are described in greater detail in Section 7.4.2.

The 'offset calculator - future quality without offset' component for Grey-headed Flying-fox habitat in the potential offset areas (i.e. the likely decline in site condition if the sites were not managed as biodiversity offsets) was scored as 6/10 reflecting a decline in the condition and possibly also extent of habitat in the potential offset areas through an additional ten years of impacts arising from grazing, weed infestation, human activities and other threats.

The 'offset calculator - future quality with offset' component (i.e. the likely increase in site condition if the site is managed as a biodiversity offset) was scored as 8/10 reflecting an improvement in the quality of habitat through exclusion of grazing and unauthorised access, treatment of weed infestations, regeneration and maturation of food tree species and development of habitat resources. After ten years the severe infestations of woody weeds through the mid storey in much of the proposed offset area would be substantially controlled and a natural vegetation structure and composition would be restored. This is likely to increase the health and productivity of food tree species. Given that some potential offset areas for EPBC Act Cumberland Plain Woodland would also be used to offset for the Grey-headed Flying-fox habitat, the management of additional poorer quality Cumberland Plain Woodland in potential offset sites, as outlined in Section 5.2.1, would also improve the 'site context' component of the site quality score for the Grey-headed Flying-fox by increasing the extent of potential habitat, removing threats associated with adjoining areas of exotic vegetation and connecting fragmented remnants.

The potential offset areas would be managed in perpetuity and additional gains in site quality would be achieved over the longer term through continued development of vegetation structure and habitat resources and maturation of poorer quality Cumberland Plain Woodland to the extent that it would also comprise Grey-headed Flying-fox habitat.

These values have been entered in the offsets assessment guide calculations that are presented in Section 5.3.

# **5.3 Preliminary EPBC Act offsets assessment guide calculations**

It is intended that the majority of the direct offsets for the proposed airport would comprise the conservation and management of the potential offset areas listed in Table 10 and so the preliminary calculations included below are based on the extent and quality of habitat for the affected threatened biota described in Section 5.2.

Preliminary offsets assessment guide calculations were performed for the affected threatened biota based on the following:

- removal of 104.9 hectares of EPBC Act Cumberland Plain Woodland with a site quality score of 6/10 (as described in Section 2.2.1);
- removal of 141.8 hectares of habitat for the Grey-headed Flying-fox with a site quality score of 7/10 (as described in Section 2.2.2); and
- the conservation and management of offset sites to achieve increased site quality, containing:
  - EPBC Act Cumberland Plain Woodland (as described in Section 5.2.1); and
  - Grey-headed Flying-fox habitat (as described in Section 5.2.2).

The 'area of offset' has been treated as a variable, to estimate the total area of habitat at offset sites that would be required to directly offset 100 per cent of the Stage 1 development impacts. The calculator inputs associated with the other attributes of the offset areas is an aggregate based on the assessment of all potential offset sites identified in Section 4.2. This approach has been used to demonstrate that suitable offset areas are available having regard to the EPBC Act Offset Policy and that these potential offset areas would substantially meet the offset requirements for the proposed airport as direct offsets.

The outcome of these preliminary offsets assessment guide calculations is that:

- Removal of 141.8 hectares of EPBC Act Cumberland Plain Woodland at the airport site during Stage 1 would require an offset area of around 355 hectares in order to offset 100 per cent of the impacts on the community. At present, there are 207.9 hectares of EPBC Act Cumberland Plain Woodland in the potential offset sites. There are a further 135 hectares of poorer quality Cumberland Plain Woodland that would be actively managed so that it would reach the same site quality as the airport site and comprise a functioning occurrence of the EPBC Act-listed form of the community over the medium-term (see Table 10).
- Removal of 141.8 hectares of habitat for the Grey-headed Flying-fox at the airport site during Stage 1 would require an offset area of around 410 hectares to offset 100 per cent of the impacts on this vulnerable species. There are up to 451 hectares of Grey-headed Flying-fox habitat in the proposed offset areas (see Table 10).

The data that were entered in the preliminary offset assessment guide calculations are summarised in Table 13 and Table 14 along with the justification for the attribute values that were entered.

Specific offset requirements for residual impacts arising from the Stage 1 development are expected to be set as conditions in the Airport Plan (if determined). Offset site identification and assessment would be finalised in the biodiversity offset delivery plan which will also include additional site specific information such as proposed management, current risk of development and the security of title proposed for individual offset sites.
Based on the preliminary calculations included in this offset package, the potential offset areas identified to date could not meet all of the proposed airport's EPBC Act offsetting requirements as direct offsets. Additional offset sites containing Cumberland Plain Woodland will be identified throughout the environmental assessment and approval process for the proposed airport and will be included in the biodiversity offset delivery plan.

Offsets assessment guide attribute	Value	Justification
Impact Calculator – Quantum of impact – Area	104.9 hectares	A direct reduction in extent of an occurrence of EPBC Act Cumberland Plain Woodland as documented in the Biodiversity Assessment (GHD 2016a) and Section 2.2.1 above.
Impact Calculator – Quantum of impact – Quality	6/10	Removal of moderate quality patches of the community as documented in the Biodiversity Assessment (GHD 2016a) and Section 2.2.1 above.
Offset calculator – Time horizon – Risk related time horizon	20 years	The offset sites would be protected and managed in perpetuity under a BioBanking agreement. Twenty years is the maximum timeframe for averting loss in the guide.
Offset calculator – Time horizon – Time until ecological benefit	10 years	The offset sites contain EPBC Act Cumberland Plain Woodland that would be managed through measures such as exclusion of stock, weed control and treatment of pest fauna. Ecological benefits in moderate condition vegetation can be achieved in the short to medium term. A tangible increase in site quality score with management or decrease because of ongoing threats would be expected after 10 years.
Offset calculator - Future area and quality without offset – Risk of loss without offset	15 per cent	The offset sites are located in partially cleared and developed parcels of land in western Sydney. The majority of the offset area is agricultural land that is zoned RU2 Rural Landscape. This zoning enables a range of industries and developments to occur while preserving the rural nature of a landscape. Should the site not be secured under a BioBanking agreement, the impacts of existing agricultural use would continue and/or the land would be used for another purpose or development as long as it can be shown the rural nature of the site can be maintained. The locality surrounding the offset sites is moderately populated and is subject to potential impacts from housing development, agriculture and infrastructure construction. Western Sydney is, in general, experiencing some of the greatest development pressure and especially demand for housing of any region in Australia.

# Table 13 Attribute values entered in the preliminary offsets assessment guide calculations for EPBC Act Cumberland Plain Woodland

Offsets assessment guide attribute	Value	Justification
Offset calculator – Future area and quality with offset – Risk of loss with offset	1 per cent	The offset sites would be protected and managed in perpetuity under a BioBanking agreement. This is the strongest conservation mechanism available on privately owned land in NSW. DSEWPaC (2013) guidance and recent determinations by DoEE suggest that one per cent is a reasonable residual risk of loss for land protected under a BioBanking agreement.
Confidence in result – averted loss of offset	95 per cent	DSEWPaC (2013) guidance and recent determinations by DoEE suggest that 95 per cent is a reasonable estimate of the confidence in the strength and effectiveness of a BioBanking agreement.
Offset calculator – Start area and quality – Area	355 hectares	Area of offset was treated as a variable in order to estimate the quantum of offset required to offset 100 per cent of the impacts of the proposed airport.
Offset calculator – Start area and quality – Start quality	5/10	The proposed offset areas contain EPBC Act Cumberland Plain Woodland in moderate condition as described in Section 5.2.1.
Offset calculator – Future area and quality without offset – Future quality without offset (1- 10)	4/10	EPBC Act Cumberland Plain Woodland would continue to deteriorate through impacts from grazing, weed infestation etc. in the proposed offset areas if they were not set aside for conservation as described in Section 5.2.1.
Offset calculator – Future area and quality with offset – Future quality with offset (1-10)	8/10	EPBC Act Cumberland Plain Woodland at the offset sites would be managed as described in Section 5.2.1 and would improve in quality and would exceed the condition of habitat at the airport site. The improvement in site quality of poorer condition Cumberland Plain Woodland would contribute to this increase in site quality by connecting remnant patches of EPBC Act Cumberland Plain Woodland. The DSEWPaC (2012a) Offsets Policy requires that an offset site must reach the quality of vegetation in the impact footprint as a minimum.
Confidence in result – change in quality	85 per cent	DSEWPaC (2013) guidance and recent determinations by DoEE suggest that 85 per cent is a reasonable estimate of the effectiveness of standard environmental management and bush regeneration techniques.
Percentage of impact offset	100.53 per cent	This indicates that 100.53 per cent of the offset requirements for the proposed airport would be met with direct offsets if 355 hectares of Cumberland Plain Woodland with similar attributes to the potential offset areas are secured.

# Table 14 Attribute values entered in the preliminary offsets assessment guide calculations for the Grey-headed Flying-fox

Offset assessment guide attribute	Value	Justification
Impact Calculator - Quantum of impact - Area	141.8 hectares	Direct removal of 141.8 hectares of Grey-headed Flying-fox habitat as documented in the Biodiversity Assessment (GHD 2016a) and Section 2.2.2 above.
Impact Calculator - Quantum of impact – Quality	7/10	Removal of moderate quality Grey-headed Flying-fox habitat as documented in the Biodiversity Assessment (GHD 2016a) and Section 2.2.2 above.
Offset calculator – Time horizon –Risk related time horizon	20 years	The offset sites would be protected and managed in perpetuity under a BioBanking agreement. Twenty years is the maximum timeframe for averting loss in the guide.
Offset calculator – Time horizon – Time until ecological benefit	10 years	The offset sites contain occupied Grey-headed Flying-fox habitat that would be managed through measures such as exclusion of stock, weed control and treatment of pest fauna. Ecological benefits in moderate condition habitat can be achieved in the short to medium term. A tangible increase in site quality score with management or decrease because of ongoing threats would be expected after 10 years.
Offset calculator - Future area and quality without offset – Risk of loss without offset	15 per cent	The offset sites are located in partially cleared and developed parcels of land in western Sydney. The majority of the offset area is agricultural land that is zoned RU2 Rural Landscape. This zoning enables a range of industries and developments to occur while preserving the rural nature of a landscape. Should the site not be secured under a BioBanking agreement the impacts of existing agricultural use would continue and/or the land would be used for another purpose or development as long as it can be shown the rural nature of the site can be maintained. The locality surrounding the offset sites is moderately populated and is subject to potential impacts from housing development, agriculture and infrastructure construction. Western Sydney is, in general, experiencing some of the greatest development pressure and especially demand for
		housing of any region in Australia. Under this scenario a risk of loss without offset of 15 per cent was considered appropriate.
Offset calculator - Future area and quality with offset – Risk of loss with offset	1 per cent	The offset sites would be protected and managed in perpetuity under a BioBanking agreement. This is the strongest conservation mechanism available on privately owned land in NSW. DSEWPaC (2013) guidance and recent determinations by DoEE suggest that one per cent is a reasonable residual risk of loss for land protected under a BioBanking agreement.

Offset assessment guide attribute	Value	Justification
Confidence in result – averted loss of offset	95 per cent	DSEWPaC (2013) guidance and recent determinations by DoEE suggest that 95% is a reasonable estimate of the confidence in the strength and effectiveness of a BioBanking agreement.
Offset calculator – Start area and quality – Area	410 hectares	Area of offset was treated as a variable in order to estimate the quantum of offset required to offset 100 per cent of the impacts of the proposed airport.
Offset calculator – Start area and quality – Start quality	7/10	The proposed offset areas contain Grey-headed Flying-fox habitat in good condition as described in Section 5.2.2.
Offset calculator - Future area and quality without offset – Future quality without offset (1- 10)	6/10	Grey-headed Flying-fox habitat would deteriorate through impacts from grazing, weed infestation etc. in the proposed offset areas if they were not set aside for conservation as described in Section 5.2.2.
Offset calculator - Future area and quality with offset – Future quality with offset (1-10)	8/10	Grey-headed Flying-fox habitat at the offset sites would be managed as described in Section 5.2.2 and would improve in quality and exceed the condition of habitat at the airport site. The improvement in site quality of poorer condition Cumberland Plain Woodland would contribute to this increase in site quality by connecting remnant patches and eventually also providing foraging resources. The DSEWPaC (2012a) offset policy requires that an offset site must reach the quality of vegetation in the impact footprint as a minimum.
Confidence in result – change in quality	85 per cent	DSEWPaC (2013) guidance and recent determinations by DoEE suggest that 85 per cent is a reasonable estimate of the effectiveness of standard environmental management and bush regeneration techniques.
Percentage of impact offset	100.73 per cent	This indicates that 100.73 per cent of the offset requirements for the proposed airport would be met with direct offsets if 410 hectares of Greyheaded Flying-fox habitat with similar attributes to the potential offset areas are secured.

## 6. Other compensatory measures

## 6.1 Overview

As described above the EPBC Act Offsets Policy requires that a minimum of 90 per cent of a project's impacts must be directly offset and the remainder may be met by alternative contributions such as a financial contribution to research or conservation. The intent of the offset package for the Stage 1 development is to secure 100 per cent of the offset requirement as direct offsets by securing appropriate offset sites (via purchase and retirement of biodiversity credits or via other arrangements involving conservation covenants). 'Other compensatory measures' will be considered in the development of a biodiversity offset delivery plan, if there is a shortfall in securing direct offsets or if an appropriate alternative contribution is revealed through this work that will continue after the determination of the Airport Plan for the proposed airport. A deviation from the 90 per cent direct offset requirement may be considered where it can be demonstrated that a greater benefit to the protected matter is likely to be achieved through increasing the proportion of other compensatory measures.

Conservation of offset sites through the NSW BioBanking Scheme is expected to form the primary component of the biodiversity offsets for the proposed airport. However, there are a variety of other conservation actions which may also be included in the biodiversity offset delivery plan that would meet offset requirements. These may include additional funding to a variety of existing and future programmes, projects, and policies and where such alternative options are more practical, or achieve greater strategic benefits for biodiversity conservation in the region.

Alternative conservation mechanisms which could be used to deliver offsets for the proposed airport may include:

- Contribution to the Cumberland Conservation Corridor programme to enhance efforts to acquire and protect priority conservation lands within the Cumberland Conservation Corridor;
- Contribution to Cumberland Plain restoration projects such as funding of revegetation programmes in the Western Sydney Parklands or expanding the 20 Million Trees programme;
- Contribution to landholders such as local councils to fund bush regeneration or revegetation programmes;
- Funding a seed collection and propagation programme to support bush regeneration or revegetation programmes;
- Translocation of threatened flora from within the Stage 1 construction impact zone and monitoring of translocated populations in a way that will contribute to the long term conservation of the species; and
- Payment into the NSW Biodiversity Conservation Fund, noting that it has not yet been established but could be before offsets need to be implemented.

Consultation with agencies and bodies such as the DoEE Biodiversity Conservation Division, NSW OEH, NSW Department of Planning and the Environment, Penrith City Council, Greater Sydney Local Land Services, the Western Sydney Parklands Trust, and members of the Cumberland Conservation Corridor Reference Group will continue and may identify options that are more suitable.

As a coordinated approach to consulting on the development of alternative conservation mechanisms, the Department of Infrastructure and Regional Development will establish an Experts Group including DoEE, other relevant NSW authorities, organisations and stakeholder groups as determined by the Department. Key considerations, with reference to the EPBC Act Offsets Policy, will include that any offsets must directly benefit the protected matter to be affected, must be based on sound ecological survey and assessment, and must be additional to any existing funding for conservation programmes.

Any funding of existing programmes will be additional to any current or proposed government funding. This additionally will be demonstrated through robust accounting mechanisms.

# 6.2 Contribution to the Cumberland Conservation Corridor programme

The Cumberland Conservation Corridor (CCC) programme, managed through the Biodiversity Conservation Division in DoEE, is focussed on protecting and regenerating threatened bushland on the Cumberland Plain in Western Sydney. The aim of the corridor is to connect patches of remnant Cumberland Plain Woodland to improve the resilience of this critically endangered ecological community and to support the movement of species through the landscape. The CCC programme focusses on acquiring land containing Cumberland Plain Woodland and other native ecological communities which are located within a corridor along a north-south axis across Western Sydney.

As part of the CCC, the DoEE chairs a Reference Group which advises the Commonwealth on suitable lands for acquisition. Members of the Reference Group include NSW OEH, Penrith City Council, the University of Western Sydney, non-government organisations (NGOs) working in environmental management and bush regeneration, local Indigenous stakeholders, and the Greater Sydney Local Land Services. A number of Reference Group members are now working together on conservation projects both on public and private land in the Penrith region. The Reference Group has been established by DoEE to support the delivery of the current Australian Government's Election commitment funding.

The typical process of identifying conservation sites for the CCC programme is:

- Members of the Reference Group identify potential conservation land, typically through liaising with real estate agents on land for sale, reviewing development applications, and consulting with local landowners and stakeholders;
- DoEE, through a funding agreement, directs the Nature Conservation Trust (NCT) to undertake preliminary investigations of the land. If it is found to be suitable for land acquisition for conservation, then the NCT begins a process of formal land evaluation and negotiations with the vendor; and
- If the acquisition is successful, then the Commonwealth provides the required funding to the NCT which acquires the land. The NCT places a conservation covenant over the land and sells the land to a third party. The third party, often a local NGO, is required to manage the land in perpetuity, consistent with the covenant, to achieve conservation outcomes.

The CCC programme is supported by the current Australian Government's 2013 Election commitment funding for the protection and management of Cumberland Plain Woodland in Western Sydney. It includes funding for land acquisition/conservation covenants, 20 Million Trees and Green Army projects. It is currently funded to June 2017 with options for continued support under the current Australian Government's 2016 election commitments to 2020.

The allocation of funds would include clear criteria to ensure that any sites that are acquired for this purpose contain species, communities and habitats that are an appropriate 'like for like' match for the protected matters affected by the proposed airport.

## 6.3 **Contribution to Cumberland Plain restoration projects**

The DoEE Biodiversity Conservation Division, NSW Local Land Services, Western Sydney Parklands Trust, other Government organisations and NGOs such as Greening Australia are involved in a variety of ecological restoration programmes on the Cumberland Plain. These include the 20 Million Trees Programme, which aims to plant 20 million trees by 2020 to re-establish green corridors and urban vegetation. In general, these programmes involve planting or restoration of vegetation in areas of previously cleared or degraded land rather than the conservation of intact ecological communities. This approach recognises that because it is not economically possible to retain all of the remnant ecological communities of the Cumberland Plain in conservation reserves, the long term viability of these remnants is dependent on the restoration of some areas of currently cleared land and the provision of linkages that enable the remnants to be managed as a bushland network across the landscape (DEC 2005).

The Department of Infrastructure and Regional Development could contribute a portion of the funds allocated to securing offsets for the proposed airport to appropriate restoration projects, expanding the overall scale of restoration projects. Restoration of degraded land would be included in the biodiversity offset delivery plan in order to supplement the conservation of core offset areas containing extant examples of the affected protected matters relevant to the proposed airport. Appropriate restoration projects would need to be:

- Focussed on restoring species, communities and their habitats that are equivalent to the affected protected matters relevant to the proposed airport;
- Located in areas of confirmed habitat for the affected protected matters relevant to the proposed airport with appropriate soil type and landscape position supported by evidence such as adjoining stands of native vegetation in better condition;
- Located in a strategic position that would join fragmented patches of Cumberland Plain Woodland or other native vegetation and contribute to a vegetated habitat corridor, preferably located within or adjoining mapped Cumberland Plain Priority Conservation Lands (DECCW 2010, 2011);
- Fully funded, including allowance for ongoing management and monitoring; and
- Located on a site that would be protected under a secure conservation covenant and that preferably has not already been set aside for conservation.

In certain circumstances, it may be appropriate to provide additional funding to local councils or other large landholders to extend existing bush regeneration or revegetation programmes. This approach recognises that although land may already be set aside for conservation, funds may not be available to effectively manage threats or achieve biodiversity gains. Any supplementary funding that permits additional management at a site would achieve additional biodiversity gains and help to offset the impacts of the proposed airport.

Funding may also be provided to achieve biodiversity gains at a regional scale rather than individual projects. For instance, investment in the development and implementation of regional management plans that target control of weeds that threaten the species and communities affected by the airport.

Revegetation programmes may be limited by the availability of suitable seedling stock and so funding a seed collection and propagation programme would help achieve conservation outcomes (see below).

### 6.4 Seed collection and propagation programme

Revegetation programmes rely upon stock of indigenous native plant species that are preferably of local provenance. Programmes on the Cumberland Plain have, in general, been limited by seedling supply and it is likely that there will be insufficient stock for Commonwealth revegetation projects in the next five years. Beyond that, there is not a dedicated programme for the establishment of seedlings. To ensure that there is sufficient stock for revegetation then financial support is required for seed collection and propagation operations such as those currently being operated by Greening Australia and various commercial operators.

The biodiversity offsets for the proposed airport could include dedicated funds for a seed collection and propagation programme to support bush regeneration or revegetation programmes on the Cumberland Plain. Such a fund would enhance conservation actions at biobank sites included in the biodiversity offset delivery plan as well as other programmes that would directly benefit the species and communities affected by the airport.

## 6.5 Payment into the NSW Biodiversity Conservation Fund

On 3 May 2016, the NSW Government released draft legislation for public comment which would, among other things, establish the Biodiversity Conservation Trust (the Trust). The Trust would be a not-for-profit statutory body which would manage government investment in conservation on private land and expand the BioBanking scheme. In relation to offsetting and the BioBanking scheme, the Trust would replace the NCT and would manage a newly established Biodiversity Conservation Fund (the Fund). This draft legislation follows the release of the final report of the Independent Biodiversity Legislation Review Panel which included recommendations to improve the legislative and policy framework for biodiversity conservation and native vegetation management in NSW.

The establishment of the Fund would allow project proponents to satisfy their offset requirement through a monetary contribution. Proponents would pay money into the Fund and the Trust would purchase offsets on their behalf. Once payment is made, the Trust would become responsible for finding the required offsets. The Trust must meet the offset obligations consistent with the rules of the proposed NSW Biodiversity Offsets Scheme. The Trust would be able to pool offset obligations and funds (including public investment in private land conservation and developer payments) to establish larger and more viable offset sites (NSW Government 2016).

An offsets payment calculator would determine how much a proponent must pay into the Fund to satisfy an offset obligation, reflecting all costs incurred by the Trust in meeting each offset obligation. The calculator will also include the value to an applicant of transferring the responsibility of finding biodiversity credits to the Trust (NSW Government 2016). According to the NSW Government (2016), the Trust would:

- Work with private landholders to invest in conservation in line with the NSW Government's Biodiversity Conservation Investment Strategy;
- Determine biodiversity offsets when a proponent chooses to pay into the Fund, which receives payments from applicants to meet their development offset obligations;
- Engage with private landholders to target biodiversity that is important to retain and enter into and manage private land conservation agreements with them; and

• Continue to exercise the functions of the existing NCT, such as buying and selling private rural land with a legally binding conservation agreement attached.

The Department of Infrastructure and Regional Development could contribute a portion of the funds allocated to securing offsets for the proposed airport to the Fund to make up any shortfall in biodiversity offsets at the time of submission of the biodiversity offset delivery plan (if the fund has been established at that time). The Trust would ensure that the funds are used to secure appropriate 'like for like' offsets with reference to the proposed NSW Biodiversity Offsets Scheme and this offset package.

#### 6.6 Threatened flora translocation

A threatened flora salvage and/or translocation plan, to be contained within the Biodiversity Plan for the proposed airport, will be prepared in consultation with relevant stakeholders, such as the Australian Botanic Gardens, Mount Annan and consideration of the Guidelines for the Translocation of Threatened Plants (Vallee et al 2004). It is recommended that this include consideration of the salvage and propagation or transplanting of the known local populations of *Pultenaea parviflora* and *Marsdenia viridiflora* subsp. *viridiflora* and any other threatened plants detected at the airport site. The plan should consider the suitability of sites within the environmental conservation zone and other sites within the vicinity of the airport site in order to maintain populations of these species as close to their original location as is possible. The proposed translocation may not guarantee the survival of threatened plants and so for the purposes of impact and impact calculations it is assumed that all threatened plants at the airport site would be removed.

Consultation with DoEE has confirmed that translocation may be considered as a proportion of the 'other compensatory measures' component of the biodiversity offset delivery plan. To qualify for this approach, the translocation programme must be undertaken as part of a sound scientific experimental framework, with adequate monitoring and reporting that genuinely increases the knowledge and understanding of the species.

## 7. Delivery of Offsets

#### 7.1 Governance framework

#### 7.1.1 The Airport Plan and the offset package

Due to a variety of factors, most notably the scale and nature of the biodiversity offsets required for the proposed airport, it will not be possible to identify and secure all of the proposed biodiversity offsets prior to finalisation of this EIS. The Department of Infrastructure and Regional Development has also identified strategic offsetting opportunities which involve working with the NSW Government and local stakeholders to source and manage suitable offsets, but some of these opportunities cannot be realised immediately.

This offset package sets out the preferred approach and framework for staged delivery of offsets. A staged approach will allow more efficient allocation of funding for offsets of the scale required for the proposed airport, by utilising NSW Government and local expertise in sourcing and managing offsets. It has also identified a number of potential offset sites and other compensatory measures (as environmental contributions) to assist in meeting overall offset requirements. The process of securing suitable offsets will continue after the Infrastructure Minister's determination of the Airport Plan for the proposed airport.

The Airport Plan would include conditions set by the Commonwealth Environment Minister, including conditions that would specify the final quantum of biodiversity offsets required for the proposed airport. Conditions related to biodiversity offsets would be based on the information presented in this offset package and technical review by DoEE.

#### 7.1.2 The biodiversity offset delivery plan

If the Stage 1 development is approved, a biodiversity offset delivery plan will be developed to set out the specific actions to be taken to meet the biodiversity offset conditions set out in the Airport Plan and will be guided by the framework established in this offset package. The biodiversity offset delivery plan will be submitted and require approval from the Environment Minister or an SES Officer in DoEE prior to the commencement of Main Construction Works for the Stage 1 development of the proposed airport, ensuring that biodiversity offsets have been identified (and secured where possible) prior to the substantial impacts occurring.

The biodiversity offset delivery plan will include additional information required to support EPBC Act offset calculations. This will include additional, specific information on each of the offset sites, such as the proposed management, current risk of development and the security of title. These additional data would be entered in the offsets assessment guide. The final calculations and details regarding data and assumptions underlying the results would be compiled for the biodiversity offset delivery plan for the Stage 1 development of the proposed airport.

The biodiversity offset delivery plan will also include additional information required to finalise offset calculations for impacts on plants, animals and their habitats and would include an approved FBA assessment and final credit calculations for each proposed biobank site. Unless alternative matching biodiversity credits become available on the open market this would include plot/transect surveys to accurately calculate ecosystem credits and targeted surveys to calculate species credits.

Based on the preliminary offsets assessment guide calculations and FBA calculations, the potential offset sites currently identified in this offset package could not meet all of the proposed airport's EPBC Act offsetting requirements as direct offsets for the Stage 1 development. Additional offset sites containing Cumberland Plain Woodland and other additional offset contributions (as other

compensatory measures) will be identified and considered as appropriate in the development of the biodiversity offset delivery plan, with this work to occur after the determination of the Airport Plan.

Any additional offset sites would be identified according to the approach specified in Section 4.2.1 and the following specific criteria:

- areas that are linked to biodiversity credits that are available for sale at established biobanks, that would be available for sale at proposed biobanks or are in parcels of land that are available for sale and suitable for BioBanking;
- presence of EPBC Act Cumberland Plain Woodland or poorer quality Cumberland Plain Woodland that is appropriately situated and has sufficient resilience to regenerate into EPBC Act Cumberland Plain Woodland;
- presence of habitat for the Grey-headed Flying-fox;
- presence of other biodiversity values appropriate to offset the proposed airport's impacts on plants, animals and their habitats;
- land that is within identified priority conservation lands or wildlife corridors or that could connect fragmented patches of habitat; and
- proximity to the airport site, in order to more directly benefit the populations and communities affected by the proposed airport.

These criteria will ensure that offset sites are an appropriate 'like for like' match for the proposed airport's impacts and meet the other requirements of the EPBC Act Offsets Policy.

A similar approach would be taken in the event that any credits which have been identified for purchase from biobank sites identified in this offset package are sold to third parties before they can be secured as offsets for the proposed airport.

As outlined in section 6, there are a variety of alternative conservation mechanisms (as other compensatory measures) to BioBanking which may also be utilised in the biodiversity offset delivery plan as mechanisms to meet offset requirements. Biodiversity offsets using these alternative mechanisms may be delivered through a variety of existing and future programmes, projects and policies and may be appropriate under certain circumstances. These alternative options may be more practical, or achieve greater strategic benefits for biodiversity conservation in the region.

Consultation with agencies and bodies such as the NSW Office of Environment and Heritage, NSW Department of Planning and the Environment, Penrith City Council, Greater Sydney Local Land Services, the Western Sydney Parklands Trust, and members of the Cumberland Conservation Corridor programme Reference Group will continue and may identify more suitable options.

As a coordinated approach to consulting on the development of alternative conservation mechanisms, the Department of Infrastructure and Regional Development will establish an Experts Group including DoEE, other relevant NSW authorities, organisations and stakeholder groups as determined by the Department. Key considerations, with reference to the EPBC Act Offsets Policy, will include that any offsets must directly benefit the protected matter to be affected, must be based on sound ecological survey and assessment, and must be additional to any existing funding for conservation programmes.

Any alternative options would be presented in the biodiversity offset delivery plan with an appropriate justification as to how and why they should be included as offsets of the proposed airport. Figure 6 presents the stages in the delivery of biodiversity offsets for the proposed airport. This process would ensure that biodiversity offsets are identified (and secured where possible) prior to the commencement of main Construction Works for the Stage 1 development.

## 7.2 Stages in the delivery of offsets

Based on the approach outlined in this offset package, the next steps involved in finalising the delivery of offsets for the proposed airport would be to:

- define the final quantum of impacts arising from the proposed airport, including refinements to impact calculations based on detailed design, pre-clearing surveys and any necessary modifications to vegetation and habitat mapping;
- identify additional offset areas to address the shortfall in the offset areas for EPBC Act Cumberland Plain Woodland, biodiversity credits for impacts on plants, animals and their habitat and any additional offsets required by the Airport Plan conditions;
- complete pre-clearing surveys of the Stage 1 construction impact zone as specified in the biodiversity assessment (GHD 2016a) and include any additional threatened plants or other relevant biodiversity values in impact and offset calculations;
- complete supplementary surveys as required at offset sites to confirm the extent and quality of habitat for Cumberland Plain Woodland, the Grey-headed Flying-fox and species credit-type species, which require biodiversity offsets. These surveys have been conducted at the Ropes and South Creeks group of offset sites and would be conducted as required at all other offset sites that are included in the biodiversity offsets delivery plan once the Department of Infrastructure and Regional Development has confirmed arrangements with individual landowners;
- compile information on the proposed management, current risk of development and the security of title proposed for individual offset sites;
- compile any additional information required to finalise offsets assessment guide and/or BioBanking credit calculations;
- finalise the number and type of biodiversity credits to be purchased, or other action to be taken in relation to alternative offset mechanism;
- finalise the biodiversity offset delivery plan consistent with conditions set out in the Airport Plan, taking into consideration the actions outlined above and taking into account the framework established in this offset package;
- purchase the number and type of biodiversity credits from the biobank site owners and take any other action, which is outlined in the biodiversity offset delivery plan;
- retire the biodiversity credits that are identified in the biodiversity offset delivery plan. The responsibility for ongoing monitoring and compliance at biobank sites would then rest with the NSW OEH according to the requirements of BioBanking; and

 deliver offsets through other compensatory measures (as alternative conservation mechanisms), where appropriate. Ongoing monitoring of the effectiveness of alternative mechanisms and compliance with the offset delivery plan would proceed according to the requirements set in the plan. An overview of this process is outlined in Figure 6.

#### Figure 6 Stages in the delivery of offsets for the proposed airport



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## 7.3 Purchase and retirement of biodiversity credits

Biodiversity credits would be purchased to secure the potential offset areas for affected EPBC Actlisted biota and impacts on plants, animals and their habitat.

The EPBC Act Offsets Policy and the FBA and BioBanking assessment methodology include different rules that govern the biodiversity offsets that can be delivered for a development's impacts. The EPBC Act Offsets Policy requires 'like for like' biodiversity offsets and the offset site must be able to reach the same site quality score as the development site. Therefore only EPBC Act Cumberland Plain Woodland, poorer quality Cumberland Plain Woodland that could reach this standard and Greyheaded Flying Fox habitat have been included in the proposed offset areas (see Section 5.2). The suite of biodiversity credits that are associated with the proposed offset areas would be purchased and retired in order to secure the offsets for affected EPBC Act-listed biota.

The FBA methodology includes greater flexibility with respect to some criteria. This flexibility allows trading of ecosystem credits for closely related vegetation types if they are in the same vegetation class and are at least as extensively cleared (i.e. have the same or greater conservation significance). The FBA also allows trading of ecosystem credits associated with low condition vegetation at a biobank site, including vegetation that could not meet the standard of EPBC Act Cumberland Plain Woodland. This flexibility should be considered along with the fact that the FBA requires the calculation of biodiversity offsets for poorer condition vegetation. A substantial area of poor condition vegetation at the airport site has contributed to the amount of offset required for residual significant impacts on plants, animals and their habitat. Species credits should normally be traded on a like for like basis though the FBA includes some flexibility in circumstances where direct trades are not available (OEH 2014b).

The number and type of biodiversity credits that would be required to offset the proposed airport's Stage 1 impacts on plants, animals and their habitat are specified in the Biodiversity credit report (see Appendix B). The suite of matching ecosystem credits that are available at the potential offset sites to offset impacts on plants, animals and their habitat are summarised in Table 11.

Table 12 summarises the species credits required to offset the impacts of the proposed airport as calculated in Section 3.3.2, the equivalent area of fauna habitat or number of plants required to generate these credits at an offset site and a summary of the potential habitat available at offset sites.

#### 7.4 Management of offset sites

#### 7.4.1 Legal protection of offset sites

The current focus of the offset package is on sites which already have, or will have, registered BioBanking agreements. Several of the potential offset sites described above have already been set aside as biobanks, however only offset areas within these biobanks that are linked to biodiversity credits that have not yet been sold and retired have been included in this offset package. The biodiversity offsets delivery plan will include maps that clearly show the offset area and areas of habitat for the affected threatened biota within the biobank sites.

A BioBanking agreement comprises a conservation covenant on the title of the lots within the biobank site. The covenant is the strongest condition available on private lands and restricts subsequent land uses other than conservation unless the BioBanking agreement is varied or terminated by the NSW Minister for the Environment to permit alternative uses. Certain mining rights may be granted over a biobank site, and certain development can be carried out by public authorities on a biobank site, but any impacts from these activities must be offset again as an addition to any offsetting activities required by a given project in its own right. Therefore the risk of loss of the offset sites with the

BioBanking agreement in place has been assessed as 1 per cent for the purposes of the offsets assessment guide calculations (see Section 5.3).

As described in Section 6, there are a variety of alternative conservation mechanisms to BioBanking that may be appropriate under certain circumstances. The final offsets assessment guide calculations in the biodiversity offset delivery plan will be based on the conservation mechanism proposed at each individual offset site and will include consideration of the appropriate values for risk of loss and confidence in the result.

#### 7.4.2 Management actions

A BioBanking agreement includes a binding requirement to perform management actions that will achieve improvements in biodiversity values at the biobank site (i.e. the offset sites). The following sections provide an outline of the actions that would be required for ongoing management of the offset sites and to achieve the proposed improvements in biodiversity values. A management action plan (MAP), detailing rehabilitation activities and a management programme would be prepared for inclusion in the BioBanking agreement application. The MAP would include the costs and timeline for each proposed management action.

Management actions that would be performed at the offset sites may include:

- exclusion of domestic grazing;
- fencing;
- weed control;
- management of fire for conservation;
- management of human disturbance;
- retention of regrowth and remnant native vegetation;
- retention of dead timber;
- erosion control; and
- retention of rocks.

Performing these management actions would increase the quality and condition of habitat for all of the native species linked to ecosystem credits and species credits at the site. These types of management actions would improve the condition and viability of Cumberland Plain Woodland. Management would also improve the quality of habitat for the Grey-headed Flying-fox and especially the quality of foraging resources by increasing the extent, health and productivity of native vegetation containing food tree species.

Management actions would be specified in greater detail in the BioBanking assessments and/or MAPs for the offset sites as part of arrangements for protection of the sites in perpetuity. Additional site specific management actions may be required under the BioBanking methodology to alleviate specific threats for other species. Both threats and actions would be identified during field surveys conducted as part of the BioBanking assessment. Site specific management actions may include feral herbivore control or feral cat and/or fox control, in line with existing control programmes in the locality, as required.

Based on an understanding of management measures which typically would be required for an offset site under a biobanking agreement, and observed conditions at the potential offset sites (see appendix A) an increase in habitat quality score with offset has been entered in the offsets assessment guide calculations (see Section 5.3). Table 15 provides the justification for the increase in habitat quality score with reference to conservation advice and recovery plans for the affected threatened biota as relevant.

The final offsets assessment guide calculations in the biodiversity offsets delivery plan will be based on the condition of habitat and specific management actions proposed at each individual offset site. The plan will include consideration of the appropriate site-specific values for the increase in site quality score and confidence in the result.

Management action	Effect on Cumberland Plain Woodland	Effect on Grey-headed Flying-fox habitat
Retention of regrowth and remnant native vegetation.	Maintenance and improvement of the condition of the community. Improved viability of the populations of component species. Continued development of vegetation structure and habitat resources. Contributes to the following recovery objective identified in the recovery plan for the community: Objective 1. To build a protected area network, comprising public and private lands, focused on the priority conservation lands (DECCW 2010). Five of the potential offset sites are located in mapped Cumberland Plain Priority Conservation Lands that are identified in the recovery plan for Cumberland Plain Woodland (DECCW 2010, 2011). BioBanking agreements are recognised as a preferred conservation mechanism (DECCW 2010).	Maintenance and improvement of shelter and foraging habitat. Regeneration and maturation of food tree species. Contributes to the following recovery objectives identified in the recovery plan for the species: Objective 1: To identify and protect foraging habitat critical to the survival of Grey-headed Flying-foxes throughout their range; and Objective 2: To protect and increase the extent of key winter and spring foraging habitat of Grey-headed Flying-foxes (DECCW 2009).
Regeneration of canopy vegetation in derived native grassland and scrub.	Increased extent of the EPBC Act community. Development of natural vegetation structure and microclimate and associated benefits for vegetation condition and species richness. Increased shelter and foraging habitat for component species. Improved connectivity of habitat. Improved quality and viability of the community through reduced edge effects.	Increased extent of shelter and foraging habitat. Improved connectivity of habitat resulting in reduced risk and energy costs of movement between patches of habitat. Improved quality and viability of retained habitat through reduced edge effects. Regeneration and maturation of food tree species. Contributes to the following recovery objective identified in the recovery plan for the species: Objective 2: To protect and increase the extent of key winter and spring foraging habitat of Grey-headed Flying-foxes (DECCW 2009).

Table 15 Effect of management actions on quality of habitat in the potential offset sites

Management action	Effect on Cumberland Plain Woodland	Effect on Grey-headed Flying-fox habitat
Weed control	Maintenance and improvement in the condition of the community by increasing the extent, health and productivity of native vegetation and restoring natural vegetation structure and microclimate. Reduced competition for component plant species. Consistent with one of the key principles presented in the recovery plan for the community, which is that active management to best practice standards is needed to prevent the degradation of the remaining bushland in the fragmented landscape of Western Sydney (DECCW 2010).	Maintenance and improvement in quality of foraging habitat by increasing the extent, health and productivity of native vegetation containing food tree species.
Exclusion of domestic grazing and management of human disturbance.	Improved health and productivity of native vegetation. Reduced risk of secondary impacts such as erosion and sedimentation and transmission of weeds or disease.	Likely increase in the extent and quality of foraging habitat by increasing the extent, health and productivity of native vegetation containing food tree species.
Fire management (ecological burning and reduced risk of wildfire)	Maintenance of natural vegetation structure and microclimate and associated benefits for vegetation condition and species richness. Reduced risk of wildfire and associated erosion having an impact on the quality of the community.	Improvement in the health of vegetation and quality of foraging resources. Reduced risk of wildfire and associated risk of harm to individual animals and of erosion having an impact on the quality of the habitat.
Control of pest fauna (deer, rabbits, pigs, feral cattle).	Improved health and productivity of native vegetation. Reduced risk of secondary impacts such as erosion and sedimentation and transmission of weeds or disease.	Likely increase in the extent and quality of foraging habitat by increasing the extent, health and productivity of native vegetation containing food tree species.
Property maintenance (perimeter fencing, rubbish and barbed wire fence strand removal, erosion control etc.).	Increased condition of vegetation. Reduced risk and energy costs of movement between patches of habitat for component species. Reduced risk of uncontrolled access, erosion, rubbish dumping etc. having an impact on the quality of habitat.	Increased quality of shelter and foraging habitat. Reduced risk and energy costs of movement between patches of habitat. Reduced risk of adverse impacts on the quality of habitat. Contributes to the following recovery objective identified in the recovery plan: Objective 9: To assess and reduce the impact on Grey-headed Flying-foxes of electrocution on power lines and entanglement in netting and on barbed- wire (DECCW 2009).

#### 7.4.3 Funding of offset sites

The management of the offset sites would be funded through the purchase and retirement of biodiversity credits through BioBanking. The credits would be purchased from the biobank site owner at an agreed market rate.

The cost of biodiversity credits includes a minimum value set by the BioBanking methodology known as the 'total fund deposit'. This value is the minimum required to be paid into the BioBanking trust fund to ensure that adequate funds are available to perform the management actions specified in the MAP on an ongoing, annual basis, in perpetuity. BioBanking includes provision for annual monitoring of biobank sites and scope for OEH to enforce expenditure on management actions or acquire the property if management has not been performed satisfactorily. OEH provides a work sheet as part of

the BBAM: the 'total fund deposit worksheet (Part A costs)'. This work sheet is used to determine the costs that are included in the MAP and is part of the BioBanking agreement application.

BioBanking provides certainty that the management of the offset site would be fully funded. The total cost of delivering the offset package will not be confirmed until agreements have been made to purchase enough biodiversity credits to secure the biodiversity offset delivery plan for the proposed airport. Any other conservation mechanisms that are included in the biodiversity offset delivery plan (see Section 6) would also be fully funded for the duration of the offset.

## 7.5 Cost of delivery of offsets

Attachment 4 to the EIS guidelines for the proposed airport specifies that the offset package must include an assessment of the overall cost of the proposed offset package; including costs associated with acquisition and transfer of land, implementation of all related management actions and monitoring, reporting and auditing of offset performance. A preliminary costing for the offset package has been undertaken using the assumption that all offsets would be secured through BioBanking as this provides a useful benchmark for overall pricing of offsets that would be included in the biodiversity offset delivery plan.

BioBanking includes rules for determining the price of biodiversity credits. Notably these rules specify that, on the first sale of the biodiversity credits, the biodiversity credit sale price must be at least equal to the 'Total Fund Deposit' as calculated with the Biodiversity Credits Pricing Spreadsheet (also known as the 'Part A costs'). The Total Fund Deposit proportion of the total credit sale price is held in the BioBanking Trust Fund administered by the NSW Government to cover the costs of managing the biobank site in perpetuity. Payments are made from the Trust Fund to the biobank site owner annually to cover the cost of management actions. The BioBanking rules ensure that the cost of delivering the offset package will include appropriate funds to cover the implementation of all related management actions and monitoring, reporting and auditing of offset performance in perpetuity in accordance with the EIS guidelines. The remainder of the biodiversity credit price is set in negotiation between the landowner and the credit purchaser and reflects the original cost of the land, opportunity costs and a profit margin for the landowner.

As stated in Section 7.1 above, the precise number and type of biodiversity credits that would be purchased and retired to offset the impacts of the proposed airport would not be confirmed until detailed BioBanking assessments have been conducted at each of the offset sites that will be included in the biodiversity offset delivery plan. The same assessment would also need to be applied for additional offset sites identified in accordance with Section 7.2.

Based on the FBA and BioBanking credit calculations included in Sections 3.3 and 4.2.4 and recent biodiversity credit sales for equivalent vegetation types and species in the Western Sydney region on the 'market' it is estimated that it would cost between \$123,000,000 and \$157,000,000 (ex GST) to deliver the biodiversity offset package for the Stage 1 development. A breakdown of how this estimate has been calculated is included in Table 16 below.

Credits required	Price range per credit	No. of credits required	Total cost (lower estimate)	Total cost (higher estimate)
EPBC Act Cumberland Plain Woodland (HN528, HN529, HN512)	\$12,000 to \$15,500	2,065	\$24,780,000	\$32,007,500
NSW TSC Act Cumberland Plain Woodland (low condition) (HN528, HN529, HN512)	\$12,000 to \$15,500	4,592	\$55,104,000	\$71,176,000
NSW TSC Act River Flat Eucalypt Forest (HN526)	\$12,000 to \$15,500	2,135	\$25,620,000	\$33,092,500
Freshwater Wetland (HN630)	\$12,000 to \$15,500	875	\$10,500,000	\$13,562,500
Black Bittern	\$1,500	815	\$1,222,500	\$1,222,500
Southern Myotis	\$1,500	752	\$1,128,000	\$1,128,000
Cumberland Plain Land Snail	\$800	1,843	\$1,474,400	\$1,474,400
Pultenaea parviflora	\$500	60	\$30,000	\$30,000
Marsdenia viridiflora subsp. viridiflora	\$500	5,800	\$2,900,000	\$2,900,000
		Total	\$122,758,900	\$156,593,400
		20% contingency <sup>*</sup>		\$31,400,000
		Total, including contingency		\$188,400,000.00

#### Table 16 Offset package cost estimate breakdown

Notes: All figures quoted are ex GST. \* Contingency calculated on total cost (higher estimate) rounded to \$157,000,000.

The overall cost of delivery of offsets for the Stage 1 development may vary depending on the final quantum of offsets required, the total biodiversity credit sale price (which would only be confirmed once sale terms have been finalised with individual offset site owners) and the mix of delivery mechanisms used. The total cost of delivering direct offsets would be confirmed once the biodiversity offset delivery plan is approved.

To account for these possible variations in cost, alternate options have been considered for estimating the potential budget required to secure the necessary offsets should land acquisition and/or conservation of existing Commonwealth land be used as part of the offsets required. This analysis shows that land acquisition and gazetting as a biobank can vary in costs considerably, largely dependent on land value. Land value can vary considerably in Western Sydney depending on such things as existing or potential zoning, future development potential, location and other factors. Due to the large variation in prices it was considered more appropriate to use the current value of credits to estimate the offsets budget and include a contingency to allow for potential credit price rises during the time it will take to secure all offsets. A 20% contingency has been applied based on the upper limit of the credit value range of \$157,000,000, which equates to \$31,400,000. Therefore, the 'upper limiting cost', which includes the contingency, would be approximately \$188,400,000 (ex GST).

It may not be possible to source all of the offsets required for the proposed airport as direct offsets in the biodiversity offset delivery plan. In this case, the total cost of delivering the direct biodiversity offsets that have been identified would be used to calculate the amount of financial contribution required to fund an appropriate quantum of other compensatory measures to address the shortfall.

## 7.6 Consistency with EPBC Act Offsets Policy

The EIS guidelines for the proposed airport require an analysis of how the offset package meets the requirements of the EPBC Act Offsets Policy. Table 17 provides a summary of how this offset package meets each of the overarching principles included in the EPBC Act Offsets Policy that are applied in determining the suitability of offsets.

#### Table 17 Consistency with the EPBC Act offset principles

Offset principles (DSEWPaC 2012a)	Western Sydney Airport offset package
Suitable offsets must:	
1. deliver an overall conservation outcome that improves or maintains the viability of the aspect of the environment that is protected by national environment law and affected by the proposed action	This offset package has been developed in accordance with biodiversity offset assessment methodologies that have been developed by Government agencies in order to ensure that appropriate biodiversity offsets would improve or maintain the viability of the affected protected matters. The conservation outcomes that would be delivered by this offset package are based on:
	<ul> <li>an estimate of the quantum of biodiversity offsets required for affected threatened biota listed under the EPBC Act as calculated with the offsets assessment guide; and</li> </ul>
	<ul> <li>an estimate of the quantum of biodiversity offsets required for impacts on plants, animals and their habitat as calculated with reference to the FBA and using the BioBanking credit calculator for a major project.</li> </ul>
2. be built around direct offsets but may include other compensatory measures	The offset package is based on direct offsets for each of the protected matters affected by the proposal. Direct biodiversity offsets would be delivered primarily through conservation of suitable offset sites. The offset sites will be secured by registration of a BioBanking agreement, or other covenant on title to the sites. The Biobanking approach would require the purchase of the number and type of biodiversity credits that match:
	<ul> <li>the offset area which is required to offset the proposal's impacts on specific EPBC Act-listed biota and deliver appropriate direct offsets as calculated in accordance with the EPBC Act offsets policy.</li> </ul>
	<ul> <li>the ecosystem and species credits which are required to offset the proposal's impacts on plants, animals and their habitat(including NSW-listed threatened biota) and deliver appropriate direct offsets as calculated with reference to the FBA and using the BioBanking credit calculator.</li> </ul>
3. be in proportion to the level of statutory protection that applies to the protected matter	Offsets for impacts on affected EPBC Act-listed biota have been calculated using the offsets assessment guide which includes International Union for Conservation of Nature data on the probability of annual extinction for different categories of threatened species as a multiplier in the offset calculations (DSEWPaC 2012). The higher the level of statutory protection and associated probability of annual extinction the greater the quantum of biodiversity offset required.
	Offsets for impacts on plants, animals and their habitat have been calculated with reference to the FBA which includes a 'threatened species offset multiplier' that feeds into the biodiversity credit calculations. The level of statutory protection of threatened biota as well as the expected response of threatened biota to management actions at a biobank site determine the multiplier that applies to credit calculations.

Offset principles (DSEWPaC 2012a)	Western Sydney Airport offset package
4. be of a size and scale proportionate to the residual impacts on the protected matter	This offset package has been developed in accordance with biodiversity offset assessment methodologies that have been developed by Government agencies in order to ensure that biodiversity offsets are of a size and scale proportionate to the residual impacts on the protected matter.
	The quantum of biodiversity offsets required for affected threatened biota listed under the EPBC Act has been calculated with the offsets assessment guide, which includes factors for the: area and quality of the impact area; area and improvement in quality of the offset site; averted risk of loss of the offset site; the time it will take for conservation gains to be achieved; and risk of the offset not succeeding (DSEWPaC 2012).
	The quantum of biodiversity offsets required for residual impacts on plants, animals and their habitat has been calculated with reference to the FBA, which takes into account the extent and condition of the impact area; landscape-scale impacts on habitat connectivity; extent and improvement in condition of the offset; and averted risk of loss of the offset (OEH 2014a).
5. effectively account for and manage the risks of the offset not succeeding	Most offset sites will be secured by registration of a BioBanking agreement on title to the sites. A BioBanking agreement is the strongest conservation covenant available on private land in NSW and restricts subsequent land uses other than conservation unless the BioBanking agreement is varied or terminated by the NSW Minister for the Environment to permit alternative uses. Certain mining rights may be granted over a biobank site, and certain development can be carried out by public authorities on a biobank site, but any impacts from these activities must be offset again as an addition to any offsetting activities required by a given project in its own right.
	A BioBanking agreement confers an obligation on the landowner to conserve and manage the biodiversity values of the biobank site in order to ensure that the offsets would improve or maintain the viability of the affected protected matters. The BioBanking Trust Fund ensures that sufficient funds are available to perform the required management actions in perpetuity. BioBanking requires preparation of an annual monitoring report to ensure compliance with the requirements of the agreement and the effectiveness of management actions. BioBanking also includes periodic inspections by OEH to ensure compliance and enforcement measures up to and including compulsory acquisition of the biobank by OEH.
	The security of titling and the management and monitoring framework afforded by BioBanking effectively account for, and substantially reduce the risks of, the offset not succeeding.
	Any offset contributions that are delivered through alternative mechanisms would be developed in consultation with an Experts Group, including DoEE, other relevant NSW authorities, organisations and stakeholder groups, to be established by the Department of Infrastructure and Regional Development. Any alternative offset contributions would include similar measures to mitigate the risks of the offset not succeeding. These would include measures such as alternative conservation covenants, monitoring and adaptive management frameworks and oversight by appropriate conservation bodies.
<ol> <li>be additional to what is already required, determined by law or planning regulations or agreed to under</li> </ol>	The biodiversity offsets presented in this offset package are the sole requirement of the EIS and are not the result of any other legal requirement that applies to the proposed airport.
other schemes or programs (this does not preclude the recognition of state or territory offsets that may be suitable as offsets under the EPBC Act for the same action)	The offset areas and associated biodiversity credits included in this offset package are not linked to any other conservation covenant or set aside as an offset for another development. Some of the biobank sites included in this offset package are associated with biodiversity credits that have been used to offset the impacts of another development. These credits and associated areas of land at the biobank sites have been excluded from this offset package.

Offset principles (DSEWPaC 2012a)	Western Sydney Airport offset package
7. be efficient, effective, timely, transparent, scientifically robust and reasonable	As stated above, this offset package has been developed in accordance with biodiversity offset assessment methodologies that have been developed by Government agencies in order to ensure that biodiversity offsets are efficient, effective, transparent, scientifically robust and reasonable.
	This offset package includes an approach to identifying the majority of the direct offset requirement for protected matters affected by the proposal at the time of public exhibition of the EIS. Direct biodiversity offsets would continue to be identified and secured according to the criteria and process outlined in this offset package.
	The biodiversity offset delivery plan will be submitted and require approval from the Environment Minister or an SES officer in DoEE prior to the commencement of Main Construction Works for the Stage 1 development of the proposed airport. This means that biodiversity offsets will have been identified (and secured where possible) prior to the substantial impacts occurring. This approach will ensure the timely delivery of offsets for the majority of the protected matters affected by the proposal.
8. have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced.	The current focus of the offset package is on sites which already have, or will have, a BioBanking agreement on registered title to the sites. A BioBanking agreement confers an obligation on the landowner to conserve and manage the biodiversity values of the biobank site in order to ensure that the offsets would improve or maintain the viability of the affected protected matters. BioBanking requires preparation of an annual monitoring report to ensure compliance with the requirements of the agreement and the effectiveness of management actions. BioBanking also includes periodic inspections by OEH to ensure compliance and enforcement measures up to and including compulsory acquisition of the biobank by OEH.
	These governance arrangements are transparent, in that they are specified in the BBAM and the individual BioBanking agreements which will be available on the biodiversity credits and BioBanking agreements register (OEH 2015b).
	Any offset contributions that are delivered through alternative mechanisms would be developed in consultation with an Experts Group, including DoEE, other relevant NSW authorities, organisations and stakeholder groups, to be established by the Department of Infrastructure and Regional Development. Any alternative offset contributions would include similar measures to mitigate the risks of the offset not succeeding. These would include measures such as alternative conservation covenants, monitoring and adaptive management frameworks and oversight by appropriate conservation bodies.

## 8. Conclusions

The Biodiversity Assessment for the proposed airport has concluded that biodiversity offsets would be required to compensate for significant residual impacts on Cumberland Plain Woodland, the Greyheaded Flying-fox and plants, animals and their habitat in accordance with the EPBC Act Offsets Policy (DSEWPaC 2012a). The EPBC Act Offsets Policy requires offsets for significant impacts on threatened species and communities listed under the EPBC Act, calculated using the 'offsets assessment guide' spreadsheet. Consultation with DoEE has confirmed that the FBA is their preferred approach for estimating offsets for the significant residual impacts on plants, animals and their habitat on Commonwealth Land, including threatened biota listed under the NSW TSC Act. The biodiversity offset package for the proposed airport has been prepared in accordance with the EPBC Act Offsets Policy and will conserve habitat for the affected matters in suitable offset sites.

Due to a variety of factors, most notably the scale and nature of the biodiversity offsets required for the proposed airport, it will not be possible to identify and secure all of the proposed biodiversity offsets as part of this final EIS. A staged approach will assist in resolving the challenges and realising the opportunities described above. The process of identifying and securing suitable biodiversity offsets will continue after the Infrastructure Minister's determination of the Airport Plan for the proposed airport and will comprise the following main stages:

- This biodiversity offset package report, which outlines the approach to the delivery of biodiversity offsets for the proposed airport, including an estimate of the quantum of offsets required, options to deliver these offsets, an estimate of the costs involved and the additional steps required to finalise their delivery.
- The biodiversity offset delivery plan which will set out the specific actions to be taken to meet the offset conditions for the airport as set out in the Airport Plan. Its development will be guided by the framework established in this biodiversity offset package.
- The biodiversity offset delivery plan will be submitted and require approval from the Environment Minister or an SES officer in DoEE prior to the commencement of Main Construction Works for the Stage 1 development, ensuring that biodiversity offsets have been identified (and secured where possible) prior to the substantial impacts occurring

At this stage of the planning and assessment for the proposed airport, the intent is to deliver most biodiversity offsets through conservation of suitable offset sites. The offset sites will be secured by registration of a BioBanking agreement on the title of the relevant sites that would ensure they would be securely titled and managed for conservation as a biobank in perpetuity. The number and type of biodiversity credits would be purchased and retired from offset sites to match the proposed airport's impacts on affected EPBC Act-listed biota as calculated by the offsets assessment guide. Additional biodiversity credits would be purchased to offset impacts on plants, animals and their habitat. This would secure the conservation covenant over the area of land that is linked to the biodiversity credits and provide funds for management in perpetuity.

Suitable offset sites have been identified that contain Cumberland Plain Woodland and/or Greyheaded Flying-fox habitat and biodiversity credits appropriate to match the proposed airport's impacts on plants, animals and their habitat on Commonwealth land. The potential offset sites include established biobank sites with suitable biodiversity credits for sale and proposed biobank sites that are at various stages of the assessment and approval process for obtaining a BioBanking agreement. Portions of four of these potential offset sites are located in Cumberland Plain Priority Conservation Lands identified in the recovery plan for Cumberland Plain Woodland (DECCW 2010, 2011). Twelve out of fourteen potential offset sites are located in regional wildlife corridors and priority biodiversity investment areas identified in the *Biodiversity Investment Opportunities Map - Mapping Priority Investment Areas for the Cumberland Subregion* (OEH 2015d). Conservation of the potential offset sites would ensure the protection and management of core areas of habitat within recognised regional wildlife corridors as well as increasing the extent and connectivity of habitat though the regeneration of poorer condition vegetation.

There are a variety of alternative offsetting conservation mechanisms to BioBanking which may also be utilised in the biodiversity offset delivery plan as other compensatory measures to meet offset requirements. Biodiversity offsets using these alternative mechanisms may be delivered through a variety of existing and future programmes, projects, and policies that may be appropriate under certain circumstances. This is particularly the case where such alternative options may be more practical, or achieve greater strategic benefits for biodiversity conservation in the region.

As a coordinated approach to consulting on the development of alternative conservation mechanisms, the Department of Infrastructure and Regional Development will establish an Experts Group including DoEE, other relevant NSW authorities, organisations and stakeholder groups as determined by the Department. Key considerations, with reference to the EPBC Act Offsets Policy, will include that any offsets must directly benefit the protected matter to be affected, must be based on sound ecological survey and assessment, and must be additional to any existing funding for conservation programmes.

Offset assessment guide calculations were performed for the affected protected matters listed under the EPBC Act based on the following:

- removal of 104.9 hectares of Cumberland Plain Woodland;
- removal of 141.8 hectares of habitat for the Grey-headed Flying-fox; and
- the conservation and management of offset sites to achieve increased site quality.

The 'area of offset' has been treated as a variable in these preliminary offset assessment guide calculations to estimate the total area of habitat at offset sites that would be required to directly offset 100% of the proposed airport's impacts. The calculator inputs associated with the other attributes of the offset areas is an aggregate based on the assessment of all potential offset sites identified in Section 4.2. This approach has been used to demonstrate that suitable offset areas are available having regard to the EPBC Act Offset Policy and that these potential offset areas would substantially meet the offset requirements for the proposed airport as direct offsets.

The outcome of these preliminary offsets assessment guide calculations is that:

• Removal of 104.9 hectares of EPBC Act Cumberland Plain Woodland at the airport site would require an offset area of around 355 hectares to offset 100 per cent of the proposed airport's impacts on the community. There are 207.9 hectares of EPBC Act Cumberland Plain Woodland in the proposed offset areas. There are a further 135 hectares of poorer quality Cumberland Plain Woodland that would be actively managed so that it would reach the same site quality as the airport site and comprise a functioning occurrence of the EPBC Act-listed form of the community over the medium-term.

• Removal of 141.8 hectares of habitat for the Grey-headed Flying-fox at the airport site would require an offset area of around 410 hectares to offset 100 per cent of the proposed airport's impacts on this vulnerable species. There are up to 451 hectares of Grey-headed Flying-fox habitat in the proposed offset areas.

The DoEE is expected to confirm the specific offset requirements for residual impacts arising from the Stage 1 development. Offset calculations would be finalised with additional site specific information such as proposed management, current risk of development and the security of title proposed for individual offset sites. This additional data would be entered in the offsets assessment guide by specialists within DoEE to confirm the quantum of offsets that would be delivered for threatened biota listed under the EPBC Act in the biodiversity offset delivery plan.

Based on preliminary calculations in this report, the currently identified potential offset sites could not meet all of the proposed airport's EPBC Act offsetting requirements as direct offsets. Additional offset sites containing Cumberland Plain Woodland will be identified and considered through the development of a biodiversity offset delivery plan, with this work to commence after the Infrastructure Minister's determination of the Airport Plan for the proposed airport.

BioBanking credit calculations using the FBA methodology have been used to estimate offsets for impacts on plants, animals and their habitat, including threatened species, populations and communities listed under NSW legislation. The estimated offset requirement for impacts on these other plants, animals and their habitat substantially overlaps with that required for affected EPBC Act-listed biota but involves a considerably greater quantum because of the inclusion of additional matters that are not protected under the EPBC Act. Notably, offsets would be required for poorer condition vegetation that does not comprise EPBC Act-listed Cumberland Plain Woodland. The quantum of offsets required for impacts on plants, animals and their habitat would be determined by DoEE based on the FBA calculations included in this offset package.

A preliminary costing for the offset package has been undertaken using the assumption that all offsets would be secured through BioBanking, as this provides a useful benchmark for overall pricing of offsets that would be included in the biodiversity offset delivery plan. Based on the FBA and BioBanking credit calculations included in this offset package and recent biodiversity credit sales for equivalent vegetation types and species in the Western Sydney region on the 'market', it is estimated that it would cost between \$123,000,000 and \$157,000,000 (ex GST) to deliver biodiversity offsets for the Stage 1 development. GHD recommends a 20% contingency to allow for potential credit price rises during the time it will take to secure all offsets. Based on the upper limit of the credit value range of \$157,000,000, this equates to \$31,400,000. The 'upper limiting cost', which includes the contingency, would be approximately \$188,400,000 (ex GST).

This offset package outlines the approach for the delivery of biodiversity offsets for the proposed airport, including:

- an estimate of the quantum of offsets that may be required for the significant residual impacts on Cumberland Plain Woodland, the Grey-headed Flying-fox and on plants, animals and their habitat that are likely to arise from the proposed airport;
- evidence that access is possible to offset sites that could substantially meet this offsetting requirement and that are aligned with conservation priorities for the affected protected matters;
- an approach to delivering the remaining offset requirement; and
- a commitment to deliver an approved biodiversity offset delivery plan prior to the commencement of Main Construction Works for the Stage 1 development, ensuring that biodiversity offsets have been identified (and secured where possible) prior to the substantial impacts occurring.

When implemented, the biodiversity offset delivery plan would improve or maintain the viability of the protected matters that would be affected by the proposed airport.

## 9. References

Avisure 2015, *Western Sydney Airport Bird and Bat Strike Risk Assessment*. Report prepared for Department of Infrastructure and Regional Development, Western Sydney Unit.

Biosis Research 1999, Proposal for a Second Sydney Airport at Badgerys Creek or Holsworthy Military Area Technical Paper 8: Flora and Fauna. Report prepared for PPK.

Churchill, S 2008, Australian Bats, Allen and Unwin, Australia.

Department of Environment and Conservation (DEC) (NSW). 2005. Recovering Bushland on the *Cumberland Plain: Best practice guidelines for the management and restoration of bushland*. Department of Environment and Conservation (NSW), Sydney.

DECC 2008, *NSW (Mitchell) Landscapes, Version 3.* Department of Environment and Climate Change.

DECCW 2009, *Draft National Recovery Plan for the Grey-headed Flying-fox* (Pteropus poliocephalus). Department of Environment, Climate Change and Water, NSW

http://www.environment.nsw.gov.au/resources/threatenedspecies/08214dnrpflyingfox.pdf

DECCW 2010, *Cumberland Plain Recovery* Plan. Department of Environment, Climate Change and Water (NSW), Sydney.

DECCW 2011, Cumberland Plain Priority Conservation Lands. GIS dataset.

DEWHA 2010, Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest A guide to identifying and protecting the nationally threatened ecological community Environment Protection and Biodiversity Conservation Act 1999 Policy Statement 3.31. Department of Environment, Water, Heritage and the Arts, Commonwealth of Australia, Canberra, ACT.

Department of Infrastructure and Transport 2012 *Joint Study on Aviation Capacity in the Sydney Region.* Department of Infrastructure and Transport, Commonwealth of Australia, Canberra, ACT.

Department of Infrastructure and Transport 2013 A Study of Wilton and RAAF Base Richmond for civil aviation operations. Department of Infrastructure and Transport, Commonwealth of Australia, Canberra, ACT.

DIRD 2014, *Western Sydney Airport referral of proposal action*. Department of Infrastructure and Regional Development.

DoE 2013a, Matters of National Environmental Significance Significant impact guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999. Department of the Environment, Commonwealth of Australia.

DoE 2013b, Significant impact guidelines 1.2 - Actions on, or impacting upon, Commonwealth land and Actions by Commonwealth Agencies. Department of the Environment.

DoP 2010 Sydney Growth Centres Strategic Assessment - Program Report. New South Wales Department of Planning

Department of Sustainability, Environment, Water, Populations and Communities (DSEWPaC) 2011. Interim Biogeographic Regionalisation for Australia (IBRA), Version 6.1 DSEWPaC, Canberra, ACT. DSEWPaC 2012a, *Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy*. Department of Sustainability, Environment, Water, Population and Communities, Canberra.

DSEWPaC 2012b, *How to Use the Offsets Assessment Guide*. Department of Sustainability, Environment, Water, Population and Communities, Canberra.

DSEWPaC 2013, Description of EPBC Act offsets assessment guide functionality for fictional offset scenarios – Industry Training. Department of Sustainability, Environment, Water, Population and Communities, Canberra.

Eby, P. and Law, B. 2008, *Ranking the feeding habitats of Grey-headed flying foxes for conservation management*. A report for The Department of Environment and Climate Change (NSW) & the Department of Environment, Water, Heritage and the Arts.

GHD 2014a, Williamswood Biobank BioBanking Assessment. Report prepared for a private client.

GHD 2014b, *SunnysideBiobank Preliminary BioBanking Assessment*. Report prepared for a private client.

GHD 2015, 'Boot Land', Moorebank, NSW Ecological Impact Assessment of Remediation. Report prepared for the Department of Defence.

GHD 2015a, *Stage 1 Montpelier Biobank BioBanking Assessment*. Report prepared for a private client.

GHD 2016a, Western Sydney Airport Biodiversity Assessment. Report prepared for Department of Infrastructure and Regional Development.

GHD 2016b, Western Sydney Airport Environmental Impact Statement. Report prepared for Department of Infrastructure and Regional Development, Western Sydney Unit.

GHD 2016c, *Ropes and South Creek Preliminary BioBanking Assessment Report.* Report prepared for the NSW Department of Planning and Environment.

GHD 2016d, Picton Farm Biobank Assessment. Report prepared for Sydney Water Corporation.

GHD 2015b, Menangle Road Biobank BioBanking Assessment. Report prepared for a private client.

GHD 2015c, *Bruelle biobank site Draft Biobank agreement assessment*. Report prepared for a private client.

GHD 2015d, The Oaks Biobank BioBanking Assessment. Report prepared for a private client.

GHD in prep.a *Stage 2 Montpelier Biobank BioBanking Assessment*. Report prepared for a private client.

GHD in prep.b Hampden Vale Biobank BioBanking Assessment. Report prepared for a private client.

GHD in prep. c. Picton Farm BioBank Assessment. Report prepared for Sydney Water Corporation.

NSW Scientific committee 2009, Cumberland Plain Woodland in the Sydney Basin Bioregion - critically endangered ecological community listing NSW Scientific Committee - Final determination. Accessed at http://www.environment.nsw.gov.au/determinations/cumberlandwoodlandsFD.htm

NSW Government 2016. The Biodiversity Conservation Trust Fact Sheet. Accessed at https://biodiversity-ss.s3.amazonaws.com/Uploads/1462236221/Biodiversity-Conservation-Trust.pdf

OEH 2014a *BioBanking Assessment Methodology 2014*. Accessed at http://www.environment.nsw.gov.au/biobanking/140661BBAM.htm.

OEH 2014b, Framework for Biodiversity Assessment – NSW Biodiversity Offsets policy for Major projects. Office of Environment and Heritage. Accessed at: http://www.environment.nsw.gov.au/biodivoffsets/1482fba.htm

OEH 2014c, *NSW vegetation types database*, Office of Environment and Heritage. Accessed at http://www.environment.nsw.gov.au/biobanking/VegTypeDatabase.htm

OEH 2015a *NSW BioNet: The Website for the Atlas of NSW Wildlife*. Office of Environment and Heritage. Accessed at http://www.bionet.nsw.gov.au/

OEH 2015b, Search for biobanking agreements, Office of Environment and Heritage. Accessed at http://www.environment.nsw.gov.au/bimsprapp/SearchBiobankingAgreement.aspx?Start=1

OEH 2015c, Search for biobank site expressions of interest, Office of Environment and Heritage. Accessed at http://www.environment.nsw.gov.au/bimsprapp/SearchBiobankingEOI.aspx?Start=1

OEH 2015d, *NSW Vegetation Information System: Classification 2.1*. Accessed at: http://www.environment.nsw.gov.au/NSWVCA20PRapp/default.aspx

OEH 2015d Biodiversity Investment Opportunities Map Mapping Priority Investment Areas for the Cumberland Subregion. Office of Environment and Heritage.

OEH (2016) Credit *Calculator for Major Projects and BioBanking Operational Manual*. Downloaded from http://www.environment.nsw.gov.au/resources/biobanking/160096BBCC.pdf

PB 2013, Greening Western Sydney - South and Ropes Creek Ecological Monitoring - Baseline Monitoring Report, Parsons Brinkerhoff, Sydney. Prepared for the Department of Planning and Infrastructure. February 2013.

PPK Environment and Infrastructure 1999, Environmental Impact Assessment.

Royal Botanic Gardens & Domain Trust (undated), Monitoring change in the woodland. Royal Botanic Gardens & Domain Trust. Accessed at:

https://www.rbgsyd.nsw.gov.au/science/Evolutionary\_Ecology\_Research/Ecology\_of\_Cumberland\_Pl ain\_Woodland/woodland\_at\_mount\_annan/monitoring\_change\_in\_the\_woodland

Thackway, R. and Cresswell, I.D. 1995. *An interim biogeographic regionalisation for Australia: a framework for setting priorities in the National Reserves System Cooperative Program, Version 4.0.* Australian Nature Conservation Agency, Canberra.

Toolijooa (various dates) *Quarterly bush regeneration reports for Ropes and South Creeks riparian corridors*. Reports prepared for Department of Planning and Environment.

TSSC 2008, Commonwealth Listing Advice on Cumberland Plain Shale Woodlands and Shale-Gravel *Transition Forest.* Threatened Species Scientific Committee, Department of the Environment, Water, Heritage and the Arts. Canberra, ACT. Accessed at

http://www.environment.gov.au/biodiversity/threatened/communities/pubs/112-listing-advice.pdf.

Webb N.J. and Tidemann C.R. 1996. Mobility of Australian flying-foxes, *Pteropus* spp. (Megachiroptera): evidence from genetic variation. *Proceeding of the Royal Society London Series B* 263, pp497–502.

# Appendices

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**Appendix A** – Potential offset sites

#### Williamswood biobank

The 'Williamswood biobank' offset site is a biobank that has been subject to a detailed field survey and BioBanking assessment and has already been set aside for conservation under a BioBanking agreement. The description of the site presented below is based on the information presented in the BioBanking assessment report for the site (GHD 2014a).

The Williamswood biobank includes 104.4 hectares of land and is located at Mount Hunter within the Wollondilly Local Government Area (LGA). It falls within the Cumberland subregion of the Hawkesbury Nepean Catchment Management Authority (CMA), and within the Sydney Basin Bioregion. The biobank is currently zoned RU2 Rural Landscape under the *Wollondilly Local Environment Plan 2011* and was grazed by cattle prior to being set aside as a biobank.

The Williamswood biobank includes mapped Cumberland Plain Priority Conservation Lands in the recovery plan for Cumberland Plain Woodland (DECCW 2010, 2011) and is in a regional wildlife corridor (OEH 2015d). Conservation of the Williamswood biobank site would ensure the protection and management of core areas of habitat within a recognised regional wildlife corridor as well as increasing the extent and connectivity of habitat though the regeneration of poorer condition vegetation.

There are three NSW vegetation types at the biobank. Each of these vegetation types have been cleared, grazed and subject to weed infestation to varying degrees with areas of Moderate/good-medium, Moderate/good – poor and Low condition vegetation. Vegetation types were split into broad condition classes yielding six vegetation zones. The distribution of vegetation zones at the biobank is closely tied to soil type, underlying geology and geomorphic position.

The biobank site includes vegetation zones which qualify as the EPBC Act listed form of Cumberland Plain Woodland; specifically, vegetation zones that are part of a patch >0.5 hectares in area, with >10% over storey cover of characteristic canopy species, shale-derived soils and >50% perennial native plants in the groundcover as defined in the listing advice for the community (TSSC 2008). EPBC Act Cumberland Plain Woodland at the site includes 'Larger patches (>5 ha) which are inherently valuable due to their rarity' and 'Patches that have large mature trees or trees with hollows (habitat) that are very scarce on the Cumberland Plain' as defined in the listing advice for the community (TSSC 2008). The presence of Cumberland Plain Woodland as defined by these attributes has been confirmed by site surveys (GHD 2014a).

The site contains Grey-headed Flying-fox habitat, comprising woodland and forest dominated by Forest Red Gum and Grey Box, which are recognised as 'significant species' in the blossom diet of the Grey-headed Flying-fox (Eby and Law 2008). Forest Red Gum scores in the upper quartile of all diet plants for the region for productivity and reliability of flowering. This species flowers in late winter and spring, partly during the 'food bottleneck' for the Grey-headed Flying-fox. Habitat at the Williamswood biobank is thus productive during food bottlenecks, and qualifies as habitat critical to the survival of the species, as defined in the draft recovery plan (DECCW 2009).

There are also areas of poorer quality Cumberland Plain Woodland that comprises derived grassland or scrub which could be managed to improve in quality and become EPBC Act Cumberland Plain Woodland. These areas have minimal canopy cover and contain minimal foraging resources for the Grey-headed Flying Fox. Only vegetation zones in Moderate/good- medium condition comprise Greyheaded Flying-fox habitat. The extent of available habitat for the affected threatened biota has been further refined based on the number of biodiversity credits currently available for sale (see Table 18). Matching biodiversity credits from all vegetation zones, including Low condition vegetation, would be suitable for offsetting impacts on plants, animals and their habitat. More exposed slopes and ridges on shale support Grey Box – Forest Red Gum grassy woodland (HN529). This vegetation zone comprises an occurrence of the EPBC Act listed form of Cumberland Plain Woodland.

Grey Box – Forest Red Gum grassy woodland grades into Moderate/good condition Forest Red Gum – Grey Box shrubby woodland (HN524) on sheltered slopes with a fine grained volcanic substrate, which is distinguished from adjoining grassy woodlands on shale by the presence of mesic small trees, a denser shrub layer and mesic understorey species. These vegetation types give way to Forest Red Gum – Rough-barked Apple grassy woodland (HN526) in riparian areas and adjoining alluvial flats.

There are moderate to severe infestations of noxious weeds, such as Lantana (*Lantana camara*), Blackberry (*Rubus fruticosus* spp. agg.) and especially African Olive (*Olea europea* subsp. *cuspidata*) at the site. These weeds are most prevalent on the cleared low lying areas and on more sheltered slopes.

Much of the site has been grazed and canopy vegetation has been extensively cleared or thinned historically. Mid storey vegetation has since re-established across the majority of the biobank though there are very few over storey species in areas of poor or low condition vegetation. There are mature hollow-bearing trees in moderate densities throughout areas of Moderate/good – medium condition vegetation at the biobank.

One threatened fauna species was recorded at the biobank site during field surveys: The Little Eagle (*Hieraaetus morphnoides*) which is listed as a vulnerable species under the TSC Act. One threatened plant has been recorded at the site: Spiked Rice-flower (*Pimelea spicata*) which is listed as an endangered species under the EPBC Act and the TSC Act. A single Spiked Rice-flower was recorded at the site during field surveys by GHD ecologists and a number of other individuals were observed by OEH staff during a site inspection. This species has not been formally included in the BioBanking assessment and no species credits have been created. Systematic targeted surveys for the Spiked Rice-flower will be conducted and species credits will be created based on the results of that survey.

Table 18 Vegetation zones, habitat for the affected threatened biota and available biodiversity credits at the Williamswood biobank (GHD 2014a)

of for Available biodiversity cx3 credits
Area of Habitat fo Grey- Flying fox
Area of poorer quality Cumberlanc Plain Woodland <sup>2</sup> (ha)
Area of EPBC Act Cumberland Plain Woodland¹ (ha)
TSC Act Status
EPBC Act Status
Area (ha)
Condition
Veg Type ID
/egetation Zone

Notes: 1) Features >10 per cent native canopy cover and predominantly native understorey in accordance with the conservation advice for the community (DEWHA 2010) and Is linked to biodiversity credits that are available for sale.

2) Derived native scrub or grassland with <10 per cent native canopy cover and predominantly native understorey that does not comprise EPBC Act Cumberland Plain Woodland in accordance with the conservation advice for the community (DEWHA 2010) and that is linked to biodiversity credits that are available for sale.

3) Comprises critical foraging habitat as defined in the recovery plan for the species (DECCW 2009) and is linked to biodiversity credits that are available for sale.
# The Oaks Biobank

The 'Oaks biobank' offset site is a biobank that has been subject to a detailed field survey and BioBanking assessment and has already been set aside for conservation under a BioBanking agreement. The description of the site presented below is based on the information presented in the BioBanking assessment report for the site (GHD 2015d).

The Oaks biobank includes 40 hectares of land and is located at Mowbray Park within the Wollondilly Local Government Area (LGA). It falls within the Cumberland subregion of the Hawkesbury Nepean Catchment Management Authority (CMA), and within the Sydney Basin Bioregion. The biobank is currently zoned RU2 Rural Landscape under the *Wollondilly Local Environment Plan 2011* and was grazed by cattle prior to being set aside as a biobank.

There are four NSW vegetation types at the biobank. The stands of these vegetation types are in varying condition (according to the BBAM) and were split into broad condition classes yielding six vegetation zones. The distribution of vegetation zones at the biobank is closely tied to soil type, underlying geology and geomorphic position.

The biobank site includes vegetation zones which qualify as the EPBC Act listed form of Cumberland Plain Woodland; specifically, vegetation zones that are part of a patch >0.5 hectares in area, with >10% over storey cover of characteristic canopy species, shale-derived soils and >50% perennial native plants in the groundcover as defined in the listing advice for the community (TSSC 2008). EPBC Act Cumberland Plain Woodland at the site includes 'Larger patches (>5 ha) which are inherently valuable due to their rarity' and 'Patches that have large mature trees or trees with hollows (habitat) that are very scarce on the Cumberland Plain' as defined in the listing advice for the community (TSSC 2008). The presence of Cumberland Plain Woodland as defined by these attributes has been confirmed by site surveys (GHD 2015d).

The site contains Grey-headed Flying-fox habitat, comprising woodland and forest dominated by Forest Red Gum and Grey Box, which are recognised as 'significant species' in the blossom diet of the Grey-headed Flying-fox (Eby and Law 2008). Forest Red Gum scores in the upper quartile of all diet plants for the region for productivity and reliability of flowering. This species flowers in late winter and spring, partly during the 'food bottleneck' for the Grey-headed Flying-fox. Habitat at The Oaks biobank is thus productive during food bottlenecks, and qualifies as habitat critical to the survival of the species, as defined in the draft recovery plan (DECCW 2009).

There are also areas of poorer quality Cumberland Plain Woodland that comprises derived grassland or scrub which could be managed to improve in quality and become EPBC Act Cumberland Plain Woodland. These areas have minimal canopy cover and contain minimal foraging resources for the Grey-headed Flying Fox. Available habitat for these affected threatened biota has been calculated based on the number of biodiversity credits currently available for sale (see Table 19). Matching biodiversity credits from all vegetation zones, including Low condition vegetation, would be suitable for offsetting impacts on plants, animals and their habitat.

More exposed slopes and ridges on shale support Grey Box – Forest Red Gum grassy woodland (HN529). Moderate/good-medium condition patches of this vegetation type comprise an occurrence of the EPBC Act listed form of Cumberland Plain Woodland.

Grey Box – Forest Red Gum grassy woodland grades into Moderate/good condition Forest Red Gum – Grey Box shrubby woodland (HN524) on sheltered slopes with a fine grained volcanic substrate, which is distinguished from adjoining grassy woodlands on shale by the presence of a mid-storey of mesic small trees, a denser shrub layer and mesic understorey species. These vegetation types give way to Forest Red Gum – Rough-barked Apple grassy woodland (HN526) in riparian areas and adjoining alluvial flats. Each of these vegetation types have been cleared, grazed and subject to weed

infestation to varying degrees with areas of Moderate/good- medium, Moderate/good – poor and Low condition vegetation. Moderate/good- medium condition vegetation zones comprise Grey-headed Flying-fox habitat.

There are moderate to severe infestations of noxious weeds, such as Lantana (*Lantana camara*), Blackberry (*Rubus fruticosus* spp. agg.) and especially African Olive (*Olea europea* subsp. *cuspidata*) at the site. These weeds are most prevalent on the cleared low lying areas and on more sheltered slopes.

Much of the site has been grazed and canopy vegetation has been extensively cleared or thinned historically. Mid storey vegetation has since re-established across the majority of the biobank though there are very few over storey species in areas of poor or low condition vegetation. There are mature hollow-bearing trees in moderate densities throughout areas of Moderate/good – medium condition vegetation at the biobank.

Table 19 Vegetation zones, habitat for the affected threatened biota and available biodiversity credits at the Oaks biobank (GHD 2015d)

Vegetation Zone	Veg Type ID	Condition	Area (ha)	EPBC Act Status	TSC Act Status	Area of EPBC Act Cumberland Plain Woodland <sup>1</sup> (ha)	Area of poorer quality Cumberland Plain Woodland <sup>2</sup> (ha)	Area of Habitat for Grey- headed Flying fox <sup>3</sup> (ha)	Available biodiversity credits
Forest Red Gum - Grey Box shrubby woodland (Low)	HN524	Low	8.2		EEC				69
Grey Box - Forest Red Gum grassy woodland (medium)	HN529	Moderate/good - medium	13.9	CEEC	CEEC	10		10	121
Grey Box - Forest Red Gum grassy woodland (poor)	HN529	Moderate/good - poor	5.5	CEEC	EEC		ო		48
Grey Box - Forest Red Gum grassy woodland (Low)	HN529	Low	10.7		EEC				93
Grey Myrtle dry rainforest (poor)	HN538	Moderate/good - poor	0.4	CEEC	EEC			0.4	Q
Forest Red Gum - Rough-barked Apple grassy woodland (Low)	HN526	Low	1.3		EEC				11
		Total	40			10	e	10.4	347
Notes: 1) Features >10 pe to biodiversity credits that	er cent native c are available fe	anopy cover and predominar or sale.	ıtly native ı	understorey in	accordance v	vith the conservation ac	lvice for the community	(DEWHA 2010	and is linked

2) Derived native scrub or grassland with <10 per cent native canopy cover and predominantly native understorey that does not comprise EPBC Act Cumberland Plain Woodland in accordance with the conservation advice for the community (DEWHA 2010) and that is linked to biodiversity credits that are available for sale.

3) Comprises critical foraging habitat as defined in the recovery plan for the species (DECCW 2009) and is linked to biodiversity credits that are available for sale.

#### **Durham biobank**

The 'Durham biobank' offset site is a proposed biobank on land owned by the NSW Department of Planning and Environment (DPE) at Oxley Park in the Ropes Creek riparian corridor. The site has been subject to a detailed field survey and a preliminary BioBanking assessment but has not yet been set aside for conservation under a BioBanking agreement. The remaining steps involved with finalising the BioBanking assessment include definition of site boundaries, BioBanking credit calculations and preparation of a management actions plan (MAP). The description of the site presented below is based on the information presented in the preliminary BioBanking assessment report for the site (GHD 2016c) and supplementary surveys conducted for this offset package. The description of the biodiversity values at the site that is included below is unlikely to substantially change as a result of later stages of the BioBanking assessment. The area of habitat for the affected protected matters that is present at the site will be reassessed based on any additional information obtained prior to the delivery of the biodiversity delivery plan.

The Durham biobank includes 46.85 hectares of land and is located along the riparian corridor of Ropes Creek within the Hawkesbury Nepean CMA, and within the Sydney Basin Bioregion. The Durham biobank is located within the Penrith and Blacktown LGAs.

The Durham biobank includes mapped Cumberland Plain Priority Conservation Lands in the recovery plan for Cumberland Plain Woodland (DECCW 2010, 2011) and is in a regional wildlife corridor (OEH 2015d). Conservation of the Durham biobank site would ensure the protection and management of core areas of habitat within a recognised regional wildlife corridor as well as increasing the extent and connectivity of habitat though the regeneration of poorer condition vegetation.

The site is dominated by Forest Red Gum - Rough-barked Apple grassy woodland (HN526) in varying conditions, which intergrades with Swamp Oak - Prickly Tea-tree - Swamp Paperbark swamp forest (HN594) in several locations along Ropes Creek, presumably where soil salt content is greater. There is a small section of Grey Box - Forest Red Gum grassy woodland on shale (HN528) in the south east corner of the site, associated with a slight increase in topography. There are relatively abundant populations of the threatened plant Juniper-leaved Grevillea (*Grevillea juniperina* subsp. *juniperina*) at the site.

The biobank site includes a vegetation zones which qualify as the EPBC Act listed form of Cumberland Plain Woodland; specifically, vegetation zones that are part of a patch >0.5 hectares in area, with >10% over storey cover of characteristic canopy species, shale-derived soils and >50% perennial native plants in the groundcover as defined in the listing advice for the community (TSSC 2008). EPBC Act Cumberland Plain Woodland at the site includes 'Larger patches (>5 ha) which are inherently valuable due to their rarity' (TSSC 2008). The presence of Cumberland Plain Woodland as defined by these attributes has been confirmed by site surveys).

The site contains Grey-headed Flying-fox habitat, comprising woodland and forest dominated by Forest Red Gum and Grey Box, which are recognised as 'significant species' in the blossom diet of the Grey-headed Flying-fox (Eby and Law 2008). Forest Red Gum scores in the upper quartile of all diet plants for the region for productivity and reliability of flowering. This species flowers in late winter and spring, partly during the 'food bottleneck' for the Grey-headed Flying-fox. Habitat at the Durham biobank is thus productive during food bottlenecks, and qualifies as habitat critical to the survival of the species, as defined in the draft recovery plan (DECCW 2009). A Grey-headed Flying-fox roost camp has been recorded in the Ropes Creek riparian corridor less than 500 metres to the south of the Durham biobank (PB 2013). Mother flying-foxes were recorded suckling young at this roost camp (PB 2013). At this site 'Moderate/good – poor' condition vegetation comprises regrowth vegetation with moderate native over storey cover that would qualify as Cumberland Plain Woodland and that does contain foraging resources for the Grey-headed Flying Fox. The Commonwealth listing advice for Cumberland Plain Woodland notes that the canopy in regrowth stands of EPBC Act Cumberland Plain Woodland may be shorter than 10 m tall (TSSC 2008). Vegetation zones and habitat for the affected threatened biota at the Durham biobank site are presented in Table 20. Additional biodiversity credits associated with Low condition vegetation would be available to offset impacts on plants, animals and their habitat. Targeted surveys conducted during preparation of this offset package have confirmed the presence of the Cumberland Plain Land Snail at the site. These survey results will be used to calculate species credits that will contribute to the airport's offsets for impacts on plants, animals and their habitat as calculated with reference to the FBA. There is considerable scope to improve the biodiversity values of the site if it is included in a biobank through treatment of weed infestations, removal of rubbish from drainage lines and development of vegetation structure and habitat resources.

Table 20 Vegetation zones, habitat for the affected threatened biota and estimated biodiversity credits at the Durham biobank (GHD 2016c)

Estimated biodiversity credits <sup>3</sup>	73	55	119	21	5	0	1	299
Area of Habitat for Grey- headed Flying fox <sup>2</sup> (ha)	10.42	7.8	0	3.01	1.55	1.3	0	24.08
Area of poorer quality Cumberland Plain Woodland (ha)								
Area of EPBC Act Cumberland Plain Woodland <sup>1</sup> (ha)	0	0	0	0	1.55	1.3	0	2.85
TSC Act Status	EEC	EEC		EEC	CEEC	CEEC		
EPBC Act Status					CEEC	CEEC		
Area (ha)	10.42	7.8	16.95	3.01	1.55	1.3	1.63	42.66
Condition	Moderate/ good – medium	Moderate/ good – poor	Low	Moderate/ good	Moderate /good – high	Moderate/ good – poor	Low	Total
Veg Type ID	HN526	HN526	HN526	HN594	HN528	HN528	HN528	
Vegetation Zone	Forest Red Gum - Rough-barked Apple grassy woodland (Moderate/good – medium)	Forest Red Gum - Rough-barked Apple grassy woodland (Moderate/good – poor)	Forest Red Gum - Rough-barked Apple grassy woodland (Low)	Swamp Oak - Prickly Tea-tree - Swamp Paperbark swamp forest (Moderate/good)	Grey Box - Forest Red Gum grassy woodland on shale (Moderate/good – high)	Grey Box - Forest Red Gum grassy woodland on shale (Moderate/good – poor)	Grey Box - Forest Red Gum grassy woodland on shale (Low)	

Notes: 1) Features >10 per cent native canopy cover and predominantly native understorey in accordance with the conservation advice for the community (DEWHA 2010).

2) Comprises critical foraging habitat as defined in the recovery plan for the species (DECCW 2009).

### Mamre biobank

The 'Mamre biobank' offset site is a proposed biobank on a 172 hectare parcel of land owned by DPE at Mamre Park connected to the South Creek riparian corridor. The site has been subject to a detailed field survey and a preliminary BioBanking assessment but has not yet been set aside for conservation under a BioBanking agreement. The description of the site presented below is based on the information presented in the preliminary BioBanking assessment report for the site (GHD 2016c) and targeted surveys conducted for this offset package. As noted for the Durham biobank above, the description of the biodiversity values at the site is unlikely to substantially change but the site will be reassessed based on any additional information obtained prior to the delivery of the biodiversity offsets delivery plan.

The Mamre biobank includes part of a mapped regional wildlife corridor (OEH 2015d). Conservation of the Mamre biobank site would ensure the protection and management of core areas of habitat within a recognised regional wildlife corridor as well as increasing the extent and connectivity of habitat though the regeneration of poorer condition vegetation.

Forest Red Gum - Rough-barked Apple grassy woodland (HN526) occupies the majority of the site, in varying condition. There are several areas that have been revegetated along the boundary of the site, typically mapped as Moderate/good – poor condition vegetation.

Vegetation closest to areas of disturbance (e.g. in areas close to cleared land or land used for horse agistment) is dominated by exotic species. There are several informal tracks throughout vegetated areas of the site that appear to be used on a regular basis as horse trails, despite the presence of fences and gates. There are low to moderate densities of exotic herbaceous and grass species along many of these tracks.

There are extensive planted areas around the site, most of which have been mapped as Moderate/good – poor condition. These areas typically lack a midstorey, having been primarily revegetated with canopy species. There are low to moderate infestations of exotic species in the understorey, and some areas also support moderate to severe infestations of woody weeds and climbers in the midstorey.

The site contains Grey-headed Flying-fox habitat, comprising woodland and forest dominated by Forest Red Gum and Grey Box, which are recognised as 'significant species' in the blossom diet of the Grey-headed Flying-fox (Eby and Law 2008). Forest Red Gum scores in the upper quartile of all diet plants for the region for productivity and reliability of flowering. This species flowers in late winter and spring, partly during the 'food bottleneck' for the Grey-headed Flying-fox. Habitat at the Mamre biobank is thus productive during food bottlenecks, and qualifies as habitat critical to the survival of the species, as defined in the draft recovery plan (DECCW 2009).

At this site 'Moderate/good – poor' condition vegetation comprises planted or regrowth vegetation with moderate native over storey cover that contains foraging resources for the Grey-headed Flying Fox. Vegetation zones and habitat for the affected threatened biota at the Mamre biobank site are presented in Table 21. Matching biodiversity credits from all vegetation zones, including Low condition vegetation, would be suitable for offsetting impacts on plants, animals and their habitat. Targeted surveys conducted during preparation of this offset package have confirmed the presence of the Cumberland Plain Land Snail and Black Bittern at the site. These survey results will be used to calculate species credits that will contribute to the airport's offsets for impacts on plants, animals and their habitat as calculated with reference to the FBA (see Section 3.3).

There is considerable scope to improve the biodiversity values of the site through treatment of weed infestations, removal of rubbish from drainage lines and development of vegetation structure and habitat resources. Preventing use of bushland areas as horse trails would assist in improving the condition of vegetation on site, through a reduction in the spread of weed species seeds, as well as halting the spread of nutrients into bushland areas.

Table 21 Vegetation zones, habitat for the affected threatened biota and estimated biodiversity credits at the Mamre biobank (GHD 2014a)

Vegetation Zone	Veg Type ID	Condition	Area (ha)	EPBC Act Status	TSC Act Status	Area of Cumberland Plain Woodland1 (ha)	Area of Habitat for Grey-headed Flying fox2 (ha)	Estimated biodiversity credits <sup>3</sup>
Forest Red Gum - Rough-barked Apple grassy woodland (Moderate/good – medium)	HN526	Moderate/good – medium	26.86		EEC		26.86	188
Forest Red Gum - Rough-barked Apple grassy woodland (Moderate/good – poor)	HN526	Moderate/good – poor	25.61		EEC		25.61	179
Forest Red Gum - Rough-barked Apple grassy woodland (Low)	HN526	Low	44.62					312
Phragmites australis and Typha orientalis coastal freshwater wetlands (Moderate/good)	HN630	Moderate/good	1.04		EEC			ω
		Total	98.13			0	52.47	687

Notes: 1) Features >10% native canopy cover and predominantly native understorey in accordance with the conservation advice for the community (DEWHA 2010).

2) Comprises critical foraging habitat as defined in the recovery plan for the species (DECCW 2009).

## **Forrester biobank**

The 'Forrester biobank' offset site is a proposed biobank on a 30.4 hectare parcel of land owned by DPE at Tregear, connected to the Ropes Creek riparian corridor. The site has been subject to a detailed field survey and a preliminary BioBanking assessment but has not yet been set aside for conservation under a BioBanking agreement. The description of the site presented below is based on the information presented in the preliminary BioBanking assessment report for the site (GHD 2016c) and supplementary surveys conducted for this offset package. As noted for the Durham biobank above, the description of the biodiversity values at the site is unlikely to substantially change but the site will be reassessed based on any additional information obtained prior to the delivery of the biodiversity offsets delivery plan.

The Forrester biobank includes part of a mapped regional wildlife corridor (OEH 2015d) and is part of a riparian corridor connected to Cumberland Plain Priority Conservation Lands (DECCW 2010, 2011) at the Durham biobank. Conservation of the Forrester biobank site would ensure the protection and management of core areas of habitat within a recognised regional wildlife corridor as well as increasing the extent and connectivity of habitat though the regeneration of poorer condition vegetation.

The majority of the site contains Forest Red Gum - Rough-barked Apple grassy woodland (HN526) on alluvial flats. There is a narrow linear corridor of Swamp Oak - Prickly Tea-tree - Swamp Paperbark swamp forest (HN594) along Ropes Creek. Higher ground supports Grey Box – Forest Red Gum grassy woodland (HN528).

The biobank site includes vegetation zones which qualify as the EPBC Act listed form of Cumberland Plain Woodland; specifically, vegetation zones that are part of a patch >0.5 hectares in area, with >10% over storey cover of characteristic canopy species, shale-derived soils and >50% perennial native plants in the groundcover as defined in the listing advice for the community (TSSC 2008). EPBC Act Cumberland Plain Woodland at the site includes 'Larger patches (>5 ha) which are inherently valuable due to their rarity' (TSSC 2008). The presence of Cumberland Plain Woodland as defined by these attributes has been confirmed by site surveys (GHD 2016c).

The site contains occupied Grey-headed Flying-fox habitat as confirmed through targeted surveys conducted for this offset package. This habitat comprises woodland and forest dominated by Forest Red Gum and Grey Box, which are recognised as 'significant species' in the blossom diet of the Grey-headed Flying-fox (Eby and Law 2008). Forest Red Gum scores in the upper quartile of all diet plants for the region for productivity and reliability of flowering. This species flowers in late winter and spring, partly during the 'food bottleneck' for the Grey-headed Flying-fox. Habitat at the Forrester biobank is thus productive during food bottlenecks, and qualifies as habitat critical to the survival of the species, as defined in the draft recovery plan (DECCW 2009).

At this site 'Moderate/good – poor' or 'Low' condition vegetation comprises derived native grassland or sub-mature planted vegetation and does not contain foraging resources for the Grey-headed Flying Fox. Vegetation zones and habitat for the affected threatened biota at the Forrester biobank site are presented in Table 22. Matching biodiversity credits from all vegetation zones, including Low condition vegetation, would be suitable for offsetting impacts on plants, animals and their habitat. Targeted surveys conducted during preparation of this offset package have confirmed the presence of the Cumberland Plain Land Snail at the site. These survey results will be used to calculate species credits that will contribute to the airport's offsets for impacts on plants, animals and their habitat as calculated with reference to the FBA (see Section 3.3).

There are severe infestations of exotic woody weed and vine species along the riparian strip of Ropes Creek in the north east of the site, as well as infestations of invasive grass species along the edges of an electricity easement in the east.

There is considerable scope to improve the biodiversity values of the site through treatment of weed infestations, removal of rubbish from drainage lines and accessible portions of the site, securing the site to prevent access by recreational vehicles including 4WD vehicles, dirt bikes and mountain bikes and development of vegetation structure and habitat resources.

Vegetation Zone	Veg Type ID	Condition	Area (ha)	EPBC Act Status	TSC Act Status	Area of Cumberland Plain Woodland1 (ha)	Area of Habitat for Grey-headed Flying fox2 (ha)	Estimated biodiversity credits <sup>3</sup>
Forest Red Gum - Rough-barked Apple grassy woodland (Moderate/ good – medium)	HN526	Moderate/ good – medium	14.5		EEC		14.5	102
Forest Red Gum - Rough-barked Apple grassy woodland (Moderate/ good – poor)	HN526	Moderate/ good – poor	0.7		EEC			£
Forest Red Gum - Rough-barked Apple grassy woodland (Low)	HN526	Low	3.0					21
Swamp Oak - Prickly Tea-tree - Swamp Paperbark swamp forest (HN594)	HN594	Moderate/good condition	0.7		EEC		0.7	5
Grey Box – Forest Red Gum grassy woodland (HN528)	HN528	Moderate/good – high	11.6	CEEC	CEEC	11.6	11.6	81
		Total	30.4			11.6	26.7	214

Table 22 Vegetation zones, habitat for the affected threatened biota and estimated biodiversity credits at the Forrester biobank (GHD 2014a)

Notes: 1) Features >10% native canopy cover and predominantly native understorey in accordance with the conservation advice for the community (DEWHA 2010).

2) Comprises critical foraging habitat as defined in the recovery plan for the species (DECCW 2009).

#### Luddenham biobank

The 'Luddenham biobank' offset site is a proposed biobank on a 42-hectare parcel of land owned by DPE at Mamre Park, connected to the South Creek riparian corridor. The site has been subject to a detailed field survey and a preliminary BioBanking assessment but has not yet been set aside for conservation under a BioBanking agreement. The description of the site presented below is based on the information presented in the preliminary BioBanking assessment report for the site (GHD 2016c) and targeted surveys conducted for this offset package. As noted for the Durham biobank above, the description of the biodiversity values at the site is unlikely to substantially change but the site will be reassessed based on any additional information obtained prior to the delivery of the biodiversity offsets delivery plan.

The Luddenham biobank includes part of a mapped regional wildlife corridor (OEH 2015d). Conservation of the Luddenham biobank site would ensure the protection and management of core areas of habitat within a recognised regional wildlife corridor as well as increasing the extent and connectivity of habitat though the regeneration of poorer condition vegetation.

Forest Red Gum - Rough-barked Apple grassy woodland (HN526) occupies the majority of the site, in varying condition. There are several areas that have been revegetated along the boundary of the site, typically mapped as Moderate/good – poor condition vegetation and some low condition vegetation with immature regrowth. There is a small portion of cleared land in the south of the site within an electricity easement. There is around five hectares of Grey Box - Forest Red Gum grassy woodland on shale (HN528) on higher ground.

Revegetated portions of the site appear to have been planted with a mixture of canopy, midstorey and understorey species. The understorey in these areas is typically dominated by exotic herbaceous and grass species, with several small and localised exceptions. Several areas that have been revegetated have moderate to high levels of woody weed infestation as well as low to moderate infestations with Blackberry (*Rubus fruiticosis* sp. agg.).

The biobank site includes vegetation zones which qualify as the EPBC Act listed form of Cumberland Plain Woodland; specifically, vegetation zones that are part of a patch >0.5 hectares in area, with >10% over storey cover of characteristic canopy species, shale-derived soils and >50% perennial native plants in the groundcover as defined in the listing advice for the community (TSSC 2008). The presence of Cumberland Plain Woodland as defined by these attributes has been confirmed by site surveys (GHD 2016c).

The site contains Grey-headed Flying-fox habitat, comprising woodland and forest dominated by Forest Red Gum and Grey Box, which are recognised as 'significant species' in the blossom diet of the Grey-headed Flying-fox (Eby and Law 2008). Forest Red Gum scores in the upper quartile of all diet plants for the region for productivity and reliability of flowering. This species flowers in late winter and spring, partly during the 'food bottleneck' for the Grey-headed Flying-fox. Habitat at the Luddenham biobank is thus productive during food bottlenecks, and qualifies as habitat critical to the survival of the species, as defined in the draft recovery plan (DECCW 2009).

There are also areas of poorer quality Cumberland Plain Woodland that comprises planted or regrowth vegetation that could be managed to improve in quality and become EPBC Act Cumberland Plain Woodland. These areas have moderate native over storey cover and contain foraging resources for the Grey-headed Flying Fox. Vegetation zones and habitat for the affected threatened biota at the Luddenham biobank site are presented in Table 23. Matching biodiversity credits from all vegetation zones, including Low condition vegetation, would be suitable for offsetting impacts on plants, animals and their habitat. Targeted surveys conducted during preparation of this offset package have confirmed the presence of the Cumberland Plain Land Snail at the site. These survey results will be

used to calculate species credits that will contribute to the airport's offsets for impacts on plants, animals and their habitat as calculated with reference to the FBA (see Section 3.3). The Little Eagle was also recorded at the biobank site, however because the Little Eagle is a 'predicted threatened species' according to the FBA this result will not directly influence the offset calculations.

There is considerable scope to improve the biodiversity values of the site through treatment of weed infestations, removal of rubbish from drainage lines and development of vegetation structure and habitat resources. Preventing use of bushland areas as horse trails would assist in improving the condition of vegetation on site, through a reduction in the spread of weed species seeds, as well as halting the spread of nutrients into bushland areas.

Table 23 Vegetation zones, habitat for the affected threatened biota and estimated biodiversity credits at the Luddenham biobank (GHD 2014a)

Vegetation Zone	Veg Type ID	Condition	Area (ha)	EPBC Act Status	TSC Act Status	Area of EPBC Act Cumberland Plain Woodland <sup>1</sup> (ha)	Area of poorer quality Cumberland Plain Woodland (ha) <sup>2</sup>	Area of Habitat for Grey- headed Flying fox <sup>3</sup> (ha)	Estimated biodiversity credits <sup>4</sup>
Forest Red Gum - Rough-barked Apple grassy woodland (Moderate/good – medium)	HN526	Moderate/good – medium	20.46		EEC	0		20.46	143
Forest Red Gum - Rough-barked Apple grassy woodland (Moderate/good – poor)	HN526	Moderate/good – poor	9.26		EEC	0		9.26	65
Forest Red Gum - Rough-barked Apple grassy woodland (Low)	HN526	Low	5.38			0		0	38
Grey Box - Forest Red Gum grassy woodland on shale (Moderate/good – high)	HN528	Moderate/good – high	4.14	CEEC	CEEC	4.14		4.14	29
Grey Box - Forest Red Gum grassy woodland on shale (Moderate/good – poor)	HN528	Moderate/good – poor	0.73		CEEC	0	0.73	0.73	ъ
		Total	39.97			4.14	0.73	34.59	280
Notes: 1) Features >10 per cent pative capopy cover and pre-	dominantly	nativa understorev in	accordanc	a with the c	onservatio	n advice for the	Community (DE	WHA 2010)	

2) Derived native scrub or grassland with <10 per cent native canopy cover and predominantly native understorey that does not comprise EPBC Act Cumberland Plain Woodland in accordance with the conservation advice for the community (DEWHA 2010) and that is linked to biodiversity credits that are available for sale.

3) Comprises critical foraging habitat as defined in the recovery plan for the species (DECCW 2009).

# **Roper biobank**

The 'Roper biobank' offset site is a proposed biobank on a 14 hectare parcel of land owned by DPE at Minchinbury, connected to the Ropes Creek riparian corridor. The site has been subject to a detailed field survey and a preliminary BioBanking assessment but has not yet been set aside for conservation under a BioBanking agreement. The description of the site presented below is based on the information presented in the preliminary BioBanking assessment report for the site (GHD 2016c) and targeted surveys conducted for this offset package. As noted for the Durham biobank above, the description of the biodiversity values at the site is unlikely to substantially change but the site will be reassessed based on any additional information obtained prior to the delivery of the biodiversity offsets delivery plan.

The Roper biobank includes part of a mapped regional wildlife corridor (OEH 2015d) and is part of a riparian corridor connected to Cumberland Plain Priority Conservation Lands (DECCW 2010, 2011) at the Durham biobank in the north and in the Ropes Creek riparian corridor to the south (see Figure 5). Conservation of the Roper biobank site would ensure the protection and management of core areas of habitat within a recognised regional wildlife corridor as well as increasing the extent and connectivity of habitat though the regeneration of poorer condition vegetation.

Close to Ropes Creek, the vegetation is made up of Forest Red Gum - Rough-barked Apple grassy woodland (HN526) in varying condition, including some areas of planted vegetation. Further away from the creek line, the site features Grey Box - Forest Red Gum grassy woodland on shale (HN528). There is a patch of Broad-leaved Ironbark - Grey Box - *Melaleuca decora* grassy open forest (HN512) associated with an area of shale/gravel soil on slightly higher ground.

The biobank site includes vegetation zones which qualify as the EPBC Act listed form of Cumberland Plain Woodland; specifically, vegetation zones that are part of a patch >0.5 hectares in area, with >10% over storey cover of characteristic canopy species, shale-derived soils and >50% perennial native plants in the groundcover as defined in the listing advice for the community (TSSC 2008). The presence of Cumberland Plain Woodland as defined by these attributes has been confirmed by site surveys (GHD 2016c).

The site contains Grey-headed Flying-fox habitat, comprising woodland and forest dominated by Forest Red Gum and Grey Box, which are recognised as 'significant species' in the blossom diet of the Grey-headed Flying-fox (Eby and Law 2008). Forest Red Gum scores in the upper quartile of all diet plants for the region for productivity and reliability of flowering. This species flowers in late winter and spring, partly during the 'food bottleneck' for the Grey-headed Flying-fox. Habitat at the Roper biobank is thus productive during food bottlenecks, and qualifies as habitat critical to the survival of the species, as defined in the draft recovery plan (DECCW 2009).

At this site 'Moderate/good – poor' condition vegetation comprises planted or regrowth vegetation with moderate native over storey cover that contains foraging resources for the Grey-headed Flying Fox as well as comprising poorer quality Cumberland Plain Woodland. Vegetation zones and habitat for the affected threatened biota at the Roper biobank site are presented in Table 15. Matching biodiversity credits from all vegetation zones, including Low condition vegetation, would be suitable for offsetting impacts on plants, animals and their habitat.

Targeted surveys conducted during preparation of this offset package have confirmed the presence of the Cumberland Plain Land Snail at the site. These survey results will be used to calculate species credits that will contribute to the airport's offsets for impacts on plants, animals and their habitat as calculated with reference to the FBA (see Section 3.3). The Little Eagle was also recorded at the biobank site, however because the Little Eagle is a 'predicted threatened species' according to the FBA this result will not directly influence the offset calculations.

Two threatened flora species are present at the site: *Grevillea juniperina* subsp. *juniperina* (and *Dilwynia tenuifolia* (both are vulnerable species listed under the TSC Act).

There are several cleared areas within the site with abandoned buildings and exotic gardens and farm infrastructure. There are also several paddocks that appear to have been used for intensive grazing in the past within these cleared areas.

There is evidence of bush regeneration activities across the site, with some areas of revegetation as well as the presence of silt fences that appear to have been installed in an attempt to protect revegetated areas from grazing by feral herbivores such as rabbits.

There is considerable scope to improve the biodiversity values of the site through treatment of weed infestations, removal of rubbish from drainage lines and unsecured parts of the site (i.e. in areas that are accessible by members of the public such as those lacking secured gates or fences) and development of vegetation structure and habitat resources.

Table 24 Vegetation zones, habitat for the affected threatened biota and estimated biodiversity credits at the Roper biobank (GHD 2014a)

Vegetation Zone	Veg Type ID	Condition	Area (ha)	EPBC Act Status	TSC Act Status	Area of EPBC Act Cumberland Plain (ha)	Area of poorer quality Cumberland Plain Woodland (ha)	Area of Habitat for Grey-headed Flying fox <sup>2</sup> (ha)	Estimated biodiversity credits <sup>4</sup>
Forest Red Gum - Rough-barked Apple grassy woodland (Moderate/good – medium)	HN526	Moderate/ good – medium	0.98		EEC	0		0.98	7
Forest Red Gum - Rough-barked Apple grassy woodland (Moderate/good – poor)	HN526	Moderate/ good – poor	1.05		EEC	0		1.05	7
Forest Red Gum - Rough-barked Apple grassy woodland (Low)	HN526	Low	0.87			0		0	9
Grey Box - Forest Red Gum grassy woodland on shale (Moderate/good – poor)	HN528	Moderate/ good – poor	1.65		CEEC	0	1.65	1.65	12
Grey Box - Forest Red Gum grassy woodland on shale (Low)	HN528	Low	5.22		CEEC	0		0	37
Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest (Moderate/good – medium)	HN512	Moderate/ good – medium	3.04	CEEC	CEEC	3.04		3.04	21
Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest (Low)	HN512	Low	0.47		CEEC	0		0	ę
		Total	13.28			3.04	1.65	6.72	93

Notes: 1) Features >10 per cent native canopy cover and predominantly native understorey in accordance with the conservation advice for the community (DEWHA 2010).

2) Derived native scrub or grassland with <10 per cent native canopy cover and predominantly native understorey that does not comprise EPBC Act Cumberland Plain Woodland in accordance with the conservation advice for the community (DEWHA 2010) and that is linked to biodiversity credits that are available for sale.

3) Comprises critical foraging habitat as defined in the recovery plan for the species (DECCW 2009).

### **Caddens biobank**

The 'Caddens biobank' offset site is a proposed biobank on a 36 hectare parcel of land owned by DPE at Claremont Meadows, connected to the South Creek riparian corridor. The site has been subject to a detailed field survey and a preliminary BioBanking assessment but has not yet been set aside for conservation under a BioBanking agreement. The description of the site presented below is based on the information presented in the preliminary BioBanking assessment report for the site (GHD 2016c) and targeted surveys conducted for this offset package. As noted for the Durham biobank above, the description of the biodiversity values at the site is unlikely to substantially change but the site will be reassessed based on any additional information obtained prior to the delivery of the biodiversity offsets delivery plan.

The Caddens biobank includes part of a mapped regional wildlife corridor (OEH 2015d). Conservation of the Caddens biobank site would ensure the protection and management of core areas of habitat within a recognised regional wildlife corridor as well as increasing the extent and connectivity of habitat though the regeneration of poorer condition vegetation.

The site includes Grey Box - Forest Red Gum grassy woodland on shale (HN528) in varying conditions on higher ground and Forest Red Gum - Rough-barked Apple grassy woodland (HN526) on alluvial flats. Much of the Forest Red Gum - Rough-barked Apple grassy woodland is subject to very severe Privet (*Ligustrum* species) infestation and would require relatively intense and expensive management.

The biobank site includes vegetation zones which qualify as the EPBC Act listed form of Cumberland Plain Woodland; specifically, vegetation zones that are part of a patch >0.5 hectares in area, with >10% over storey cover of characteristic canopy species, shale-derived soils and >50% perennial native plants in the groundcover as defined in the listing advice for the community (TSSC 2008). The presence of Cumberland Plain Woodland as defined by these attributes has been confirmed by site surveys (GHD 2016c).

The site contains occupied Grey-headed Flying-fox habitat as confirmed by field surveys conducted for this offset package in June 2016 and NSW Wildlife Atlas records (OEH 2015a). Habitat at the site comprises woodland and forest dominated by Forest Red Gum and Grey Box, which are recognised as 'significant species' in the blossom diet of the Grey-headed Flying-fox (Eby and Law 2008). Forest Red Gum scores in the upper quartile of all diet plants for the region for productivity and reliability of flowering. This species flowers in late winter and spring, partly during the 'food bottleneck' for the Grey-headed Flying-fox. Habitat at the Caddens biobank is thus productive during food bottlenecks, and qualifies as habitat critical to the survival of the species, as defined in the draft recovery plan (DECCW 2009).

There are also areas of poorer quality Cumberland Plain Woodland vegetation that comprises derived native grassland or planted or regrowth vegetation that could be managed to improve in quality and become EPBC Act Cumberland Plain Woodland. These areas of planted or regrowth vegetation have moderate mid and over storey cover that contains contain foraging resources for the Grey-headed Flying Fox. Vegetation zones and habitat for the affected threatened biota at the Caddens biobank site are presented in Table 25. Matching biodiversity credits from all vegetation zones, including Low condition vegetation, would be suitable for offsetting impacts on plants, animals and their habitat.

Targeted surveys conducted during preparation of this offset package have confirmed the presence of the Cumberland Plain Land Snail at the site. These survey results will be used to calculate species credits that will contribute to the airport's offsets for impacts on plants, animals and their habitat as calculated with reference to the FBA (see Section 3.3).

There are also substantial freshwater wetlands at the site that would have considerable fauna habitat value, including for a potential local population of the Green and Golden Bell Frog (*Litoria aurea*). The Green and Golden Bell Frog has been previously recorded in the vicinity of the site (OEH 2015d).

There is considerable scope to improve the biodiversity values of the site through treatment of weed infestations, removal of rubbish from drainage lines and development of vegetation structure and habitat resources.

Table 25 Vegetation zones, habitat for the affected threatened biota and estimated biodiversity credits at the Caddens biobank (GHD 2014a)

Vegetation Zone	Veg Type ID	Condition	Area (ha)	EPBC Act Status	TSC Act Status	Area of EPBC Act Cumberland Plain Woodland <sup>1</sup> (ha)	Area of poorer quality Cumberland Plain Woodland (ha) <sup>2</sup>	Area of Habitat for Grey- headed Flying fox <sup>3</sup> (ha)	Estimated biodiversity credits <sup>4</sup>
Forest Red Gum - Rough-barked Apple grassy woodland (Moderate/good – medium)	HN526	Moderate/good – medium	6.35		EEC	0		6.35	44
Forest Red Gum - Rough-barked Apple grassy woodland (Moderate/good – poor)	HN526	Moderate/good – poor	6.19		EEC	0		6.19	43
Forest Red Gum - Rough-barked Apple grassy woodland (Low)	HN526	Low	13.28			0		0	93
Phragmites australis and Typha orientalis coastal freshwater wetlands (Moderate/good condition)	HN630	Moderate/good condition	0.71			0		0	сı
Grey Box - Forest Red Gum grassy woodland on shale (Moderate/good – high)	HN528	Moderate/good – high	4.75	CEEC	CEEC	4.75		4.75	33
Grey Box - Forest Red Gum grassy woodland on shale (Moderate/good – poor)	HN528	Moderate/good – poor	1.17		CEEC	0	1.17	0	œ
Grey Box - Forest Red Gum grassy woodland on shale (Low)	HN528	Low	0.85			0		0	9
		Total	33.3			4.75	1.17	17.29	233
Note: 1) East was a 10 mar and a state of a second of a second second second second second second second second	z vitanimok	of the total of total	00000000	o odł dłim o	solitor motion	·			

Notes: 1) Features >10 per cent native canopy cover and predominantly native understorey in accordance with the conservation advice for the community (DEWHA 2010).

2) Derived native scrub or grassland with <10 per cent native canopy cover and predominantly native understorey that does not comprise EPBC Act Cumberland Plain Woodland in accordance with the conservation advice for the community (DEWHA 2010) and that is linked to biodiversity credits that are available for sale.

3) Comprises critical foraging habitat as defined in the recovery plan for the species (DECCW 2009).

### **Dunheved biobank**

The 'Dunheved biobank' offset site is a proposed biobank on a 90 hectare parcel of land owned by DPE at Werrington County, connected to the South Creek riparian corridor. The site has been subject to a detailed field survey and a preliminary BioBanking assessment but has not yet been set aside for conservation under a BioBanking agreement. The description of the site presented below is based on the information presented in the preliminary BioBanking assessment report for the site (GHD 2016c) and targeted surveys conducted for this offset package. As noted for the Durham biobank above, the description of the biodiversity values at the site is unlikely to substantially change but the site will be reassessed based on any additional information obtained prior to the delivery of the biodiversity offsets delivery plan.

The Dunheved biobank includes part of a mapped regional wildlife corridor (OEH 2015d) and immediately adjoins Cumberland Plain Priority Conservation Lands (DECCW 2010, 2011) (see Figure 5). Conservation of the Dunheved biobank site would ensure the protection and management of core areas of habitat within a recognised regional wildlife corridor as well as increasing the extent and connectivity of habitat though the regeneration of poorer condition vegetation.

The majority of the site contains Forest Red Gum - Rough-barked Apple grassy woodland (HN526) on alluvial flats. There are some patches of Grey Box - Forest Red Gum grassy woodland on shale (HN528) along the western boundary and in the central portion of the site.

The biobank site includes vegetation zones which qualify as the EPBC Act listed form of Cumberland Plain Woodland; specifically, vegetation zones that are part of a patch >0.5 hectares in area, with >10% over storey cover of characteristic canopy species, shale-derived soils and >50% perennial native plants in the groundcover as defined in the listing advice for the community (TSSC 2008). The presence of Cumberland Plain Woodland as defined by these attributes has been confirmed by site surveys (GHD 2016c).

The site contains occupied Grey-headed Flying-fox habitat as confirmed by field surveys conducted for this offset package in June 2016. This habitat comprises woodland and forest dominated by Forest Red Gum and Grey Box, which are recognised as 'significant species' in the blossom diet of the Grey-headed Flying-fox (Eby and Law 2008). Forest Red Gum scores in the upper quartile of all diet plants for the region for productivity and reliability of flowering. This species flowers in late winter and spring, partly during the 'food bottleneck' for the Grey-headed Flying-fox. Habitat at the Dunheved biobank is thus productive during food bottlenecks, and qualifies as habitat critical to the survival of the species, as defined in the draft recovery plan (DECCW 2009).

There are also areas of poorer quality Cumberland Plain Woodland that comprises derived native grassland or scrub which could be managed to improve in quality and become EPBC Act Cumberland Plain Woodland. These areas do not contain foraging resources for the Grey-headed Flying Fox. Vegetation zones and habitat for the affected threatened biota at the Dunheved biobank site are presented in Table 26. Matching biodiversity credits from all vegetation zones, including Low condition vegetation, would be suitable for offsetting impacts on plants, animals and their habitat.

Targeted surveys conducted during preparation of this offset package have confirmed the presence of the Cumberland Plain Land Snail at the site. Around 100 individual *Pultenaea parviflora* have previously been recorded at the site (GHD 2014a). These survey results will be used to calculate species credits that will contribute to the airport's offsets for impacts on plants, animals and their habitat as calculated with reference to the FBA (see Section 3.3).

There are substantial freshwater wetlands at the site that would have considerable fauna habitat value, including for a potential local population of the Green and Golden Bell Frog (*Litoria aurea*). The Green and Golden Bell Frog has been previously recorded in the vicinity of the site (OEH 2015a).

There is considerable scope to improve the biodiversity values of the site through treatment of weed infestations, removal of rubbish from drainage lines and development of vegetation structure and habitat resources.

Table 26 Vegetation zones, habitat for the affected threatened biota and estimated biodiversity credits at the Dunheved biobank (GHD 2016c)

Estimated biodiversity credits <sup>4</sup>	134	48	179	27	61	9	455
Area of Habitat for Grey- headed Flying fox <sup>3</sup> (ha)	19.18	0	0	3.82	0	0	23
Area of poorer quality Cumberland Plain Woodland <sup>2</sup> (ha)		0			8.67		8.67
Area of EPBC Act Cumberland Plain Woodland <sup>1</sup> (ha)	0	0	0	3.82	0	0	3.82
TSC Act Status	EEC	EEC		CEEC	CEEC	CEEC	
EPBC Act Status				CEEC			
Area (ha)	19.18	6.84	25.64	3.82	8.67	0.86	65.01
Condition	Moderate/ good – medium	Moderate/ good – poor	Low	Moderate/ good – high	Moderate/ good – poor	Low	Total
Veg Type ID	HN526	HN526	HN526	HN528	HN528	HN528	
Vegetation Zone	Forest Red Gum - Rough-barked Apple grassy woodland (Moderate/ good – medium)	Forest Red Gum - Rough-barked Apple grassy woodland (Moderate/ good – poor)	Forest Red Gum - Rough-barked Apple grassy woodland (Low)	Grey Box - Forest Red Gum grassy woodland on shale (Moderate/ good – high)	Grey Box - Forest Red Gum grassy woodland on shale (Moderate/ good – poor)	Grey Box - Forest Red Gum grassy woodland on shale (Low)	

Notes: 1) Features >10 per cent native canopy cover and predominantly native understorey in accordance with the conservation advice for the community (DEWHA 2010).

2) Derived native scrub or grassland with <10 per cent native canopy cover and predominantly native understorey that does not comprise EPBC Act Cumberland Plain Woodland in accordance with the conservation advice for the community (DEWHA 2010) and that is linked to biodiversity credits that are available for sale.

3) Comprises critical foraging habitat as defined in the recovery plan for the species (DECCW 2009).

### **Stage 1 Montpelier Biobank**

The 'Stage 1 Montpelier Biobank' offset site is a proposed biobank that has been subject to a detailed field survey and BioBanking assessment and is currently awaiting issue of a BioBanking agreement from OEH (GHD, 2015d).

The proposed biobank is located around five kilometres south of village of The Oaks within the Wollondilly LGA. It falls within the Hawkesbury Nepean Catchment Management Authority CMA region, and within the Sydney Basin Bioregion. The biobank is currently zoned RU2 Rural Landscape under the *Wollondilly Local Environment Plan 2011*.

The Stage 1 Montpelier biobank includes mapped Cumberland Plain Priority Conservation Lands in the recovery plan for Cumberland Plain Woodland (DECCW 2010, 2011) and is in a regional wildlife corridor (OEH 2015d). Conservation of the Stage 1 Montpelier biobank site would ensure the protection and management of core areas of habitat within a recognised regional wildlife corridor as well as increasing the extent and connectivity of habitat though the regeneration of poorer condition vegetation.

Field surveys confirmed the presence and distribution of four NSW vegetation types at the biobank. The stands of these vegetation types are in varying condition (according to the BBAM) and were split into broad condition classes yielding six vegetation zones.

The distribution of vegetation zones at the biobank is mainly tied to geomorphic position. More exposed slopes and ridges support Grey Box – Forest Red Gum grassy woodland (HN529). There are occurrences of Grey Box – Forest Red Gum grassy woodland on shale (HN528) on lower undulating slopes and flatter areas of the site. Moderate/good- medium condition patches of these vegetation types comprise an occurrence of the EPBC Act form of Cumberland Plain Woodland.

This vegetation type grades into Forest Red Gum – Grey Box shrubby woodland (HN524) in steeper or more sheltered areas, which is distinguished from adjoining grassy woodlands on shale by the presence of a denser shrub layer and mesic understorey species. These vegetation types give way to Grey Myrtle dry rainforest (HN538) on sheltered alluvial flats and in narrow gullies. Each of these vegetation types have been cleared, grazed and subject to weed infestation to varying degrees with areas of Moderate/good- medium, Moderate/good – poor and low condition vegetation. Moderate/good- medium condition patches of all vegetation types at the site contain a canopy of *Eucalyptus* and other species in the blossom diet of the Grey-headed Flying-fox (Eby and Law 2008) and comprise critical habitat for the species (DEWHA 2010).

There are moderate to severe infestations of noxious weeds, such as Lantana (*Lantana camara*) and Blackberry (*Rubus fruticosus* spp. agg.) across much of the site. These two species form a dense midstorey in many parts of the site. Other noxious weeds present on site in lower numbers include African Olive (*Olea europea* subsp. *cuspidata*), Small-leaved Privet (*Ligustrum sinense*), Fireweed (*Senecio madagascariensis*), African Boxthorn (*Lycium ferocissimum*), Bridal Creeper (*Asparagus asparagoides*), Green Cestrum (*Cestrum parqui*), Moth Vine (*Araujia sericifera*) and Prickly Pear (*Opuntia stricta*).

The biobank site includes vegetation zones which qualify as the EPBC Act listed form of Cumberland Plain Woodland; specifically, vegetation zones that are part of a patch >0.5 hectares in area, with >10% over storey cover of characteristic canopy species, shale-derived soils and >50% perennial native plants in the groundcover as defined in the listing advice for the community (TSSC 2008). The presence of Cumberland Plain Woodland as defined by these attributes has been confirmed by site surveys (GHD 2015a).

There are also areas of poorer quality Cumberland Plain Woodland that comprises derived grassland or scrub which could be managed to improve in quality and become EPBC Act Cumberland Plain Woodland. These areas have minimal canopy cover and contain minimal foraging resources for the Grey-headed Flying Fox. Vegetation zones and habitat for the affected threatened biota at the Stage 1 Montpelier biobank site are presented in Table 27. Matching biodiversity credits from all vegetation zones, including Low condition vegetation, would be suitable for offsetting impacts on plants, animals and their habitat.

Much of the site has been grazed and canopy vegetation has been extensively cleared or thinned historically. Mid-storey vegetation has since re-established across the majority of the biobank though there are very few over storey species in areas of poor or low condition vegetation. There are mature hollow-bearing trees in low to moderate densities throughout areas of Moderate/good – medium condition vegetation at the biobank. There are no hollow-bearing trees within areas of poor or low condition vegetation. There is considerable scope to improve the biodiversity values of the site through treatment of weed infestations and development of vegetation structure and habitat resources.

One threatened fauna species listed under the TSC Act was recorded at the biobank site during field surveys: the Little Eagle.

Table 27 Vegetation zones, habitat for the affected threatened biota and available biodiversity credits at the Stage 1 Montpelier biobank (GHD 2015a)

Vegetation Zone	Veg Type ID	Condition	Area (ha)	EPBC Act Status	TSC Act Status	Area of EPBC Act Cumberland Plain Woodland <sup>1</sup> (ha)	Area of poorer quality Cumberland Plain Woodland <sup>2</sup> (ha)	Area of Habitat for Grey- headed Flying fox <sup>3</sup> (ha)	Available biodiversity credits
Grey Box - Forest Red Gum grassy woodland on shale (Moderate/good – medium)	HN529	Moderate/good - medium	16.83	CEEC	CEEC	16.83		16.83	191
Grey Box - Forest Red Gum grassy woodland on shale (Low)	HN529	Low	10.67			0		0	121
Grey Box - Forest Red Gum grassy woodland on shale (Moderate/good – poor)	HN529	Moderate/good - poor	11.38		CEEC	0	11.38	0	129
Forest Red Gum - Grey Box shrubby woodland (Moderate/good – medium)	HN524	Moderate/good - medium	17.27	CEEC	EEC	17.27		17.27	153
Grey Myrtle dry rainforest	HN538	Moderate/good	6.78	CEEC	EEC	0		6.78	73
Grey Box - Forest Red Gum grassy woodland on flats (Low)	HN528	Low	13.31			0		0	119
		Total	76.24			34.1	11.38	40.88	786
Votes: 1) Features >10 per cent native canopy cover and	id predomina	ntlv native understore	v in accord	ance with th	ne conservati	on advice for the	ecommunity (D	EWHA 2010)	

5

2) Derived native scrub or grassland with <10 per cent native canopy cover and predominantly native understorey that does not comprise EPBC Act Cumberland Plain Woodland in accordance with the conservation advice for the community (DEWHA 2010) and that is linked to biodiversity credits that are available for sale.

3) Comprises critical foraging habitat as defined in the recovery plan for the species (DECCW 2009).

# Stage 2 Montpelier Biobank

The 'Stage 2 Montpelier Biobank' offset site is a proposed biobank that has been subject to a preliminary field survey and BioBanking assessment and will be subject to a detailed BioBanking assessment as part of an application to OEH for a Biobanking agreement (GHD in prep. a). The description of the site presented below is based on the information presented in the preliminary BioBanking assessment report for the site (GHD in prep. a). As noted for similar sites above, the description of the biodiversity values at the site is unlikely to substantially change but the site will be reassessed based on any additional information obtained prior to the delivery of the biodiversity offsets delivery plan.

The proposed biobank is located immediately adjacent to the stage 1 Montpelier biobank described above. The biobank is currently zoned RU2 Rural Landscape under the *Wollondilly Local Environment Plan 2011*.

The Stage 2 Montpelier biobank includes mapped Cumberland Plain Priority Conservation Lands in the recovery plan for Cumberland Plain Woodland (DECCW 2010, 2011) and is in a regional wildlife corridor (OEH 2015d). Conservation of the Stage 2 Montpelier biobank site would ensure the protection and management of core areas of habitat within a recognised regional wildlife corridor as well as increasing the extent and connectivity of habitat though the regeneration of poorer condition vegetation.

Field surveys confirmed the presence and distribution of three NSW vegetation types at the biobank. The stands of these vegetation types are in varying condition (according to the BBAM) and were split into broad condition classes yielding five vegetation zones.

The distribution of vegetation zones at the biobank is mainly tied to geomorphic position. More exposed slopes and ridges support Grey Box – Forest Red Gum grassy woodland (HN529). Moderate/good- medium condition patches of this vegetation type comprise an occurrence of the EPBC Act form of Cumberland Plain Woodland. This vegetation type grades into Forest Red Gum – Grey Box shrubby woodland (HN524) in steeper or more sheltered areas. These vegetation types give way to Grey Myrtle dry rainforest (HN538) in narrow gullies. Each of these vegetation types have been cleared, grazed and subject to weed infestation to varying degrees with areas of Moderate/good-medium, Moderate/good – poor and Low condition vegetation. Moderate/good- medium condition patches of all vegetation types at the site contain a canopy of *Eucalyptus* and other species in the blossom diet of the Grey-headed Flying-fox (Eby and Law 2008) and comprise critical habitat for the species (DEWHA 2010).

There are moderate to severe infestations of noxious weeds, such as Lantana, Blackberry and especially African Olive which form a dense mid storey in many parts of the site. Other noxious weeds present on site include Privet (*Ligustrum* species), Fireweed (*Senecio madagascariensis*), Bridal Creeper (*Asparagus asparagoides*), Green Cestrum (*Cestrum parqui*) and Moth Vine (*Araujia sericifera*).

The biobank site includes vegetation zones which qualify as the EPBC Act listed form of Cumberland Plain Woodland; specifically, vegetation zones that are part of a patch >0.5 hectares in area, with >10% over storey cover of characteristic canopy species, shale-derived soils and >50% perennial native plants in the groundcover as defined in the listing advice for the community (TSSC 2008). The presence of Cumberland Plain Woodland as defined by these attributes has been confirmed by site surveys (GHD in prep. a).

There are also areas of poorer quality Cumberland Plain Woodland that comprises derived grassland or scrub with minimal canopy cover that does not qualify as Cumberland Plain Woodland but which could be managed to improve in quality and become EPBC Act Cumberland Plain Woodland. These areas contain minimal foraging resources for the Grey-headed Flying Fox. Vegetation zones and habitat for the affected threatened biota at the Stage 2 Montpelier biobank site are presented in Table 28. Matching biodiversity credits from all vegetation zones, including Low condition vegetation, would be suitable for offsetting impacts on plants, animals and their habitat.

There is considerable scope to improve the biodiversity values of the site through treatment of weed infestations and development of vegetation structure and habitat resources.

One threatened fauna species listed under the TSC Act was recorded at the biobank site during field surveys: the Little Eagle.

Table 28 Vegetation zones, habitat for the affected threatened biota and estimated biodiversity credits at the Stage 2 Montpelier biobank (GHD in prep. a)

Vegetation Zone	Veg Type ID	Condition	Area (ha)	EPBC Act Status	TSC Act Status	Area of EPBC Act Cumberland Plain Woodland <sup>1</sup> (ha)	Area of poorer quality Cumberland Plain Woodland (ha) <sup>2</sup>	Area of Habitat for Grey- headed Flying fox <sup>3</sup> (ha)	Estimated biodiversity credits <sup>4</sup>
Grey Box - Forest Red Gum grassy woodland on shale (Moderate/good – medium)	HN529	Moderate/good - medium	20.9	CEEC	CEEC	20.9		20.9	146
Grey Box - Forest Red Gum grassy woodland on shale (Low)	HN529	Low	21.8						153
Grey Box - Forest Red Gum grassy woodland on shale (Moderate/good – poor)	HN529	Moderate/good - poor	9.2		CEEC		9.2		64
Forest Red Gum - Grey Box shrubby woodland (Moderate/good – medium)	HN524	Moderate/good - medium	16.9	CEEC	EEC			16.9	118
Grey Myrtle dry rainforest	HN538	Moderate/good	10.7	CEEC	EEC			10.7	75
		Total	79.5			20.9	9.2	48.5	556
				:			!		

Notes: 1) Features >10 per cent native canopy cover and predominantly native understorey in accordance with the conservation advice for the community (DEWHA 2010).

2) Derived native scrub or grassland with <10 per cent native canopy cover and predominantly native understorey that does not comprise EPBC Act Cumberland Plain Woodland in accordance with the conservation advice for the community (DEWHA 2010) and that is linked to biodiversity credits that are available for sale.

3) Comprises critical foraging habitat as defined in the recovery plan for the species (DECCW 2009).

### **Menangle Road Biobank**

The 'Menangle Road biobank' offset site is a proposed biobank on privately owned land that has been subject to a detailed field survey and BioBanking assessment will be included in an application for a BioBanking agreement from OEH. The site has been subject to a detailed field survey and a preliminary BioBanking assessment but has not yet been set aside for conservation under a BioBanking agreement. The description of the site presented below is based on the information presented in the BioBanking assessment report for the site (GHD 2015b).

The remaining steps involved with finalising the BioBanking assessment include definition of site boundaries, BioBanking credit calculations and preparation of a MAP. As discussed for similar proposed biobanks above, the description of the biodiversity values at the site that is included below is unlikely to substantially change but will be reassessed prior to the final delivery of the offset package for the proposed airport and the total quantum of offset will be adjusted if required.

The proposed biobank is located on around 57 hectares of land about 3.6 kilometres south-east of Picton within the Wollondilly LGA. It falls within the Hawkesbury Nepean CMA region, and within the Sydney Basin Bioregion. The biobank is currently zoned RU2 Rural Landscape under the *Wollondilly Local Environment Plan 2011*.

Field surveys confirmed the presence and distribution of four NSW vegetation types at the biobank. The stands of these vegetation types are in varying condition (according to the BBAM) and were split into broad condition classes yielding eight vegetation zones.

The distribution of vegetation zones at the biobank is mainly tied to geomorphic position. More exposed slopes and ridges support Grey Box – Forest Red Gum grassy woodland (HN529). This vegetation type grades into Forest Red Gum – Grey Box shrubby woodland (HN524) in steeper, south facing and more sheltered areas, which is distinguished from adjoining grassy woodlands on shale by the presence of a denser shrub layer and mesic understorey species. There is a small isolated patch of Grey Myrtle dry rainforest (HN538) on a sheltered alluvial slope and linear strips of Forest Red Gum - Rough-barked Apple grassy woodland (HN526) associated with drainage lines. Each of these vegetation types have been cleared, grazed and subject to weed infestation to varying degrees with areas of moderate/good and moderate/good – poor condition vegetation.

There are moderate infestations of noxious weeds, such as African Olive (*Olea europea* subsp. *cuspidata*) and Blackberry (*Rubus fruticosus* spp. agg.) across sections of the site. Other weeds present on site in lower numbers include Lantana (*Lantana camara*), Small-leaved Privet (*Ligustrum* sinense), Fireweed (*Senecio madagascariensis*), African Boxthorn (*Lycium ferocissimum*), Bridal Creeper (*Asparagus asparagoides*), Green Cestrum (*Cestrum parqui*), Moth Vine (*Araujia sericifera*) and Prickly Pear (*Opuntia stricta*).

Portions of the site have been grazed and canopy vegetation has been extensively cleared or thinned historically. Much of the biobank is now covered with native vegetation, with areas of 'low' condition (namely those that lack a native understorey, midstorey or canopy) being excluded from the site. Midstorey vegetation has established across the majority of the biobank though there are very few over storey species in areas of poor condition vegetation. There are mature hollow-bearing trees in low densities throughout areas of moderate/good condition vegetation at the biobank. There are no hollow-bearing trees within areas of poor condition vegetation.

The biobank site includes vegetation zones which qualify as the EPBC Act listed form of Cumberland Plain Woodland; specifically, vegetation zones that are part of a patch >0.5 hectares in area, with >10% over storey cover of characteristic canopy species, shale-derived soils and >50% perennial native plants in the groundcover as defined in the listing advice for the community (TSSC 2008). The

presence of Cumberland Plain Woodland as defined by these attributes has been confirmed by site surveys (GHD 2015b).

The site contains Grey-headed Flying-fox habitat, comprising woodland and forest dominated by Forest Red Gum and Grey Box, which are recognised as 'significant species' in the blossom diet of the Grey-headed Flying-fox (Eby and Law 2008). Forest Red Gum scores in the upper quartile of all diet plants for the region for productivity and reliability of flowering. This species flowers in late winter and spring, partly during the 'food bottleneck' for the Grey-headed Flying-fox. Habitat at the Menangle Road biobank is thus productive during food bottlenecks, and qualifies as habitat critical to the survival of the species, as defined in the draft recovery plan (DECCW 2009).

There are also areas of poorer quality Cumberland Plain Woodland that comprise derived grassland but which could be managed to improve in quality and become EPBC Act Cumberland Plain Woodland. These areas have minimal canopy cover and do not contain foraging resources for the Grey-headed Flying Fox. Vegetation zones and habitat for the affected threatened biota at the Stage 1 Montpelier biobank site are presented in Table 29. Matching biodiversity credits from all vegetation zones, including Low condition vegetation, would be suitable for offsetting impacts on plants, animals and their habitat. Table 29 Vegetation zones, habitat for the affected threatened biota and available biodiversity credits at the Menangle Road biobank (GHD 2015b)

Available biodiversity credits	29	36	255	199	9	525
Area of Habitat for Grey- headed Flying fox <sup>3</sup> (ha)	3.44	5.01	26.96	0	0.58	35.99
Area of poorer quality Cumberland Plain Woodland (ha) <sup>2</sup>				21.08		21.08
Area of EPBC Act Cumberland Plain Woodland <sup>1</sup> (ha)	0	0	26.96	0	0	26.96
TSC Act Status	EEC	EEC	CEEC	CEEC	EEC	
EPBC Act Status	CEEC		CEEC		CEEC	
Area (ha)	3.44	5.01	26.96	21.08	0.58	57.07
Condition	Moderate/good	Moderate/good	Moderate/good	Moderate/good - poor	Moderate/good	Total
Veg Type ID	HN524	HN526	HN529	HN529	HN538	
Vegetation Zone	Forest Red Gum - Grey Box shrubby woodland	Forest Red Gum - Rough-barked Apple grassy woodland	Grey Box - Forest Red Gum grassy woodland on shale	Grey Box - Forest Red Gum grassy woodland on shale (poor)	Grey Myrtle dry rainforest	

Notes: 1) Features >10 per cent native canopy cover and predominantly native understorey in accordance with the conservation advice for the community (DEWHA 2010).

2) Derived native scrub or grassland with <10 per cent native canopy cover and predominantly native understorey that does not comprise EPBC Act Cumberland Plain Woodland in accordance with the conservation advice for the community (DEWHA 2010) and that is linked to biodiversity credits that are available for sale.

3) Comprises critical foraging habitat as defined in the recovery plan for the species (DECCW 2009).

# **Bruelle biobank**

The 'Bruelle biobank' offset site is a proposed biobank on privately owned land that has been subject a detailed field survey and a preliminary BioBanking assessment but has not yet been set aside for conservation under a BioBanking agreement. The description of the site presented below is based on the information presented in the BioBanking assessment report for the site (GHD 2015c). The remaining steps involved with finalising the BioBanking assessment include definition of site boundaries, BioBanking credit calculations and preparation of a MAP. As discussed for similar proposed biobanks above, the description of the biodiversity values at the site that is included below is unlikely to substantially change but will be reassessed prior to the delivery of the biodiversity offsets delivery plan.

The Bruelle biobank includes 28 hectares of land and is located at Mulgoa within Penrith LGA. It falls within the Hawkesbury Nepean CMA region and within the Sydney Basin Bioregion. The biobank is currently zoned E2 Environmental Conservation under the *Penrith City Council Local Environment Plan 2010* and was grazed by cattle prior to being set aside as a biobank.

The Bruelle biobank includes part of a mapped regional wildlife corridor (OEH 2015d) and is connected to Cumberland Plain Priority Conservation Lands at Mulgoa Nature reserve (DECCW 2010, 2011) (see Figure 5). Conservation of the Bruelle biobank site would ensure the protection and management of core areas of habitat within a recognised regional wildlife corridor as well as increasing the extent and connectivity of habitat though the regeneration of poorer condition vegetation. It would comprise an import connecting link between Cumberland Plain Priority Conservation Lands and the Blue Mountains National Park in the west (see Figure 5).

The Bruelle biobank is bound to the west by the Notre Dame estate and to the north, east and south by rural residential adjoining properties. The biobank site is approximately 1 km to the east of the Nepean River and lies on the northern edge of the village of Mulgoa and approximately 10 km south of Penrith town centre.

There are four NSW vegetation types at the biobank. The biobank site comprises undulating hills on shale substrate which are dissected by a deeply incised gully that exposes the underlying lithic sandstone substrate. The ridge and upper slopes of this gully support Red Bloodwood - Grey Gum woodland (HN564), which is dominated by Grey Gum (*Eucalyptus punctata*) and Smooth-barked Apple (*Angophora costata*). HN564 transitions into Grey Myrtle dry rainforest (HN538) at lower elevations, where the gully becomes steeper and more sheltered. HN538 is dominated by Grey Myrtle (*Backhousia myrtifolia*) and Rusty Fig (*Ficus rubiginosa*).

The slopes of the northeastern and southern extents of the site feature Grey Box - Forest Red Gum grassy woodland (HN529), which comprises an occurrence of Cumberland Plain Woodland. HN529 features a canopy of Forest Red Gum and Narrow-leaved Ironbark. The mid-slopes that occupy the central region of the site are influenced by the shale-derived soils above the lithic sandstone substrate. Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest (HN556) dominates this area and displays a canopy of Narrow-leaved Ironbark, Grey Gum and Forest Red Gum. This vegetation type is an occurrence of Shale/Sandstone Transition Forest, which is listed as an EEC under the TSC Act and EPBC Act.

The biobank site includes vegetation zones which qualify as the EPBC Act listed form of Cumberland Plain Woodland; specifically, vegetation zones that are part of a patch >0.5 hectares in area, with >10% over storey cover of characteristic canopy species, shale-derived soils and >50% perennial native plants in the groundcover as defined in the listing advice for the community (TSSC 2008). The presence of Cumberland Plain Woodland as defined by these attributes has been confirmed by site surveys (GHD 2015c).

The site contains Grey-headed Flying-fox habitat, comprising woodland and forest dominated by Forest Red Gum and Grey Box, which are recognised as 'significant species' in the blossom diet of the Grey-headed Flying-fox (Eby and Law 2008). Forest Red Gum scores in the upper quartile of all diet plants for the region for productivity and reliability of flowering. This species flowers in late winter and spring, partly during the 'food bottleneck' for the Grey-headed Flying-fox. Habitat at the Bruelle biobank is thus productive during food bottlenecks, and qualifies as habitat critical to the survival of the species, as defined in the draft recovery plan (DECCW 2009).

Vegetation zones and habitat for the affected threatened biota at the Bruelle biobank site are presented in Table 30. Matching biodiversity credits from all vegetation zones would be suitable for offsetting impacts on plants, animals and their habitat.

Table 30 Vegetation zones, habitat for the affected threatened biota and available biodiversity credits at the Bruelle biobank (GHD 2015c)

Available biodiversity credits	129	141	10	n	283	
Area of Habitat for Grey- headed Flying fox <sup>2</sup> (ha)	11.6	14.4	1.2	0.3	27.5	
Area of poorer quality Cumberland Plain Woodland (ha)	0	0	0	0	0	
Area of EPBC Act Cumberland Plain Woodland <sup>1</sup> (ha)	0	14.4	0	0	14.4	
TSC Act Status	EEC	CEEC				
EPBC Act Status	CEEC	CEEC				
Area (ha)	11.6	14.4	1.2	0.3	27.5	
Condition	Moderate/ good	Moderate/ good	Moderate/ good	Moderate/ good	Total	
Veg Type ID	HN556	HN529	HN564	HN538		
Vegetation Zone	Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest	Grey Box - Forest Red Gum grassy woodland on shale	Red Bloodwood - Grey Gum woodland	Grey Myrtle dry rainforest		

Notes: 1) Features >10 per cent native canopy cover and predominantly native understorey in accordance with the conservation advice for the community (DEWHA 2010).

2) Comprises critical foraging habitat as defined in the recovery plan for the species (DECCW 2009).

### Hampden Vale biobank

The 'Hampden Vale biobank' offset site is a biobank that has been subject to a detailed field survey and BioBanking assessment and is in the process of being set aside for conservation under a BioBanking agreement. The description of the site presented below is based on the information presented in the BioBanking assessment report for the site (GHD in prep. b).

The Hampden Vale biobank includes 101 hectares of land and is located at Razorback within the Wollondilly Local Government Area (LGA). It falls within the Cumberland subregion of the Hawkesbury Nepean Catchment Management Authority (CMA), and within the Sydney Basin Bioregion. The biobank is currently zoned RU2 Rural Landscape under the *Wollondilly Local Environment Plan 2011* and is currently used for grazing cattle.

The Hampden Vale biobank includes mapped Cumberland Plain Priority Conservation Lands in the recovery plan for Cumberland Plain Woodland (DECCW 2010, 2011) and is in a regional wildlife corridor (OEH 2015d). Conservation of the Hampden Vale biobank site would ensure the protection and management of core areas of habitat within a recognised regional wildlife corridor as well as increasing the extent and connectivity of habitat though the regeneration of poorer condition vegetation.

There are five NSW vegetation types at the biobank. Each of these vegetation types have been cleared, grazed and subject to weed infestation to varying degrees with areas of Moderate/good-medium, Moderate/good – poor and Low condition vegetation. Vegetation types were split into broad condition classes yielding eight vegetation zones. The distribution of vegetation zones at the biobank is closely tied to soil type, underlying geology and geomorphic position.

The biobank site includes vegetation zones which qualify as the EPBC Act listed form of Cumberland Plain Woodland; specifically, vegetation zones that are part of a patch >0.5 hectares in area, with >10% over storey cover of characteristic canopy species, shale-derived soils and >50% perennial native plants in the groundcover as defined in the listing advice for the community (TSSC, 2008). The presence of Cumberland Plain Woodland as defined by these attributes has been confirmed by site surveys (GHD in prep. b).

The site contains Grey-headed Flying-fox habitat, comprising woodland and forest dominated by Forest Red Gum and Grey Box, which are recognised as 'significant species' in the blossom diet of the Grey-headed Flying-fox (Eby and Law 2008). Forest Red Gum scores in the upper quartile of all diet plants for the region for productivity and reliability of flowering. This species flowers in late winter and spring, partly during the 'food bottleneck' for the Grey-headed Flying-fox. Habitat at the Hampden Vale biobank is thus productive during food bottlenecks, and qualifies as habitat critical to the survival of the species, as defined in the draft recovery plan (DECCW 2009).

There are also areas of poorer quality Cumberland Plain Woodland that comprises derived grassland or scrub which could be managed to improve in quality and become EPBC Act Cumberland Plain Woodland. These areas have minimal canopy cover and contain minimal foraging resources for the Grey-headed Flying Fox. Only vegetation zones in Moderate/good- medium condition comprise Greyheaded Flying-fox habitat. Matching biodiversity credits from all vegetation zones, including Low condition vegetation, would be suitable for offsetting impacts on plants, animals and their habitat.

More exposed slopes and ridges on shale support Grey Box – Forest Red Gum grassy woodland on shale (HN529). This vegetation zone comprises an occurrence of the EPBC Act listed form of Cumberland Plain Woodland. Grey Box – Forest Red Gum grassy woodland grades into Moderate/good condition Forest Red Gum – Grey Box shrubby woodland (HN524) on sheltered slopes, which is distinguished from adjoining grassy woodlands on shale by the presence of mesic small trees, a denser shrub layer and mesic understorey species. The steepest, most sheltered slopes
and those with substantial rock outcrop that affords fire protection contain Grey Myrtle Dry Rainforest, which features Kurrajong (*Brachichyton populneus*) as a dominant canopy species and a dense mid storey of mesic small trees, abundant climbers and mesic understorey species. Gentle lower slopes and broad flats contain Grey Box – Forest Red Gum grassy woodland on flats (HN528). These vegetation types give way to Forest Red Gum – Rough-barked Apple grassy woodland (HN526) in riparian areas and adjoining alluvial flats.

There are moderate to severe infestations of noxious weeds, such as Lantana (*Lantana camara*), Blackberry (*Rubus fruticosus* spp. agg.) and especially African Olive (*Olea europea* subsp. *cuspidata*) at the site. These weeds are most prevalent on the cleared low lying areas and on more sheltered slopes.

Much of the site has been grazed and canopy vegetation has been extensively cleared or thinned historically. Mid storey vegetation has since re-established across the majority of the biobank though there are very few over storey species in areas of poor or low condition vegetation. There are mature hollow-bearing trees in moderate densities throughout areas of Moderate/good – medium condition vegetation at the biobank.

There is a population of *Marsdenia viridiflora* subsp. *virdiflora* at the site. The site contains around 80 hectares of potential habitat associated with native shale woodlands and dry rainforest. Based on partial survey of the site it contains at least 75 stems of *Marsdenia viridiflora* subsp. *virdiflora*.

		ep. p)							
Vegetation Zone	Veg Type ID	Condition	Area (ha)	EPBC Act Status	TSC Act Status	Area of EPBC Act Cumberland Plain Woodland <sup>1</sup> (ha)	Area of poorer quality Cumberland Plain Woodland <sup>2</sup> (ha)	Area of Habitat for Grey- headed Flying fox <sup>3</sup> (ha)	Available biodiversity credits <sup>4</sup>
<ol> <li>Grey Box - Forest Red Gum grassy woodland on shale (Moderate/good - medium)</li> </ol>	HN529	Moderate/ good - medium	16.0	CEEC	CEEC	16.0		16.0	112
2 -Grey Box - Forest Red Gum grassy woodland on shale (Moderate/good - poor)	HN529	Moderate/ good - poor	42.0		CEEC		42.0		294
3-Grey Box - Forest Red Gum grassy woodland on shale (Low)	HN529	Low	1.5						1
4 - Forest Red Gum - Grey Box shrubby woodland	HN524	Moderate/ good - medium	5.2	CEEC	EEC			5.2	36
<ol> <li>Forest Red Gum – Rough- barked grassy woodland</li> </ol>	HN526	Moderate/ good	7.4					7.4	52
6 - Grey Box - Forest Red Gum grassy woodland on flats	HN528	Moderate/ good	8.1	CEEC	EEC		8.1		57
7 - Grey Box - Forest Red Gum grassy woodland on flats	HN528	Low	18.4						129

Table 31 Vegetation zones, habitat for the affected threatened biota and available biodiversity credits at the Hampden Vale high high and a set the Hampden Vale high and the high and theh

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Available biodiversity credits <sup>4</sup>	16	707
Area of Habitat for Grey- headed Flying fox <sup>3</sup> (ha)	2.3	28.7
Area of poorer quality Cumberland Plain Woodland <sup>2</sup> (ha)		50.1
Area of EPBC Act Cumberland Plain Woodland <sup>1</sup> (ha)		16.0
TSC Act Status	EEC	
EPBC Act Status	CEEC	
Area (ha)	2.3	101
Condition	Moderate./good	Total
Veg Type ID	HN538	
Vegetation Zone	8 - Grey Myrtle dry rainforest	

Notes: 1) Features >10 per cent native canopy cover and predominantly native understorey in accordance with the conservation advice for the community (DEWHA 2010) and is linked to biodiversity credits that are available for sale.

2) Derived native scrub or grassland with <10 per cent native canopy cover and predominantly native understorey that does not comprise EPBC Act Cumberland Plain Woodland in accordance with the conservation advice for the community (DEWHA 2010) and that is linked to biodiversity credits that are available for sale.

3) Comprises critical foraging habitat as defined in the recovery plan for the species (DECCW 2009) and is linked to biodiversity credits that are available for sale.

4) Estimated at a rate of seven credits per hectare because credit calculations are not yet complete.

**Appendix B** – Credit Calculations

īe	ontaining bark or leaf litter accumulation	ontaining escarpments, cliffs, caves, deep crevices, old mine or tunnels	vithin 5 km of coast in South East Coastal Plains CMA gion	I soils	vithin 100 m of emergent aquatic or riparian vegetation	nd damp areas only.	ituated in damp, disturbed sites	vithin 40 m of freshwater and estuarine wetlands, in areas of inent water and dense vegetation or emergent aquatic ation	ithin 40 m of fresh/brackish/saline waters of larger rivers or s; estuaries, coastal lagoons, lakes and/or inshore marine s	lically waterlogged sites (including table drains and farm dams)	vithin 250 m of termite mounds or rock outcrops	vithin 40 m of heath, woodland or forest	<i>i</i> thin 40 m of permanent wetlands with a good surface cover of g vegetation	ontaining brackish or freshwater wetlands
Scientific name Feat	Meridolum corneovirens	Chalinolobus dwyeri land shaft	Pultenaea pedunculata land subru	Eucalyptus benthamii alluv	Litoria aurea land	Hypsela sessilifora Wet	Wahlenbergia multicaulis - endangered land population	Ixobrychus flavicollis land perm vege	Pandion cristatus land creel wate	Pilularia novae-hollandiae	Varanus rosenbergi	Heleioporus australiacus	Irediparra gallinacea land floati	Botaurus poiciloptilus
Common name	Cumberland Plain Land Snail	Large-eared Pied Bat	Matted Bush-pea	Camden White Gum	Green and Golden Bell Frog	Hypsela sessiliflora	Wahlenbergia multicaulis (Tadgells Bluebell) population, Auburn, Bankstown, Baulkham Hills, Canterbury, Hornsby, Parramatta and Strathfield local government areas	Black Bittern	Eastern Osprey	Austral Pillwort	Rosenbergs Goanna	Giant Burrowing Frog	Comb-crested Jacana	Australasian Bittern
- <u>,</u>	2			>	2	>	<u>&gt;</u>	<b>D</b>		2	>	2	2	2
npact														
-							2			2				2

Note: 1) The habitat features are present at the site and would be removed by the proposed development.

Assessment of geographic / habitat features

			4 L		A Let	NA.	-	1.1	A	ć			
n name	Scientific name	Jan	геb	Mar	Apr	May	Jun	Jul	Aug	Sep	Cct	Nov	Dec
iarina glareicola	Allocasuarina glareicola	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pillwort	Pilularia novae-hollandiae	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
sian Bittern	Botaurus poiciloptilus	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
ieebung	Persoonia bargoensis	Yes	Yes	Yes	Yes	Yes							Yes
ttern	Ixobrychus flavicollis	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
omaderris	Pomaderris brunnea	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Wattle	Acacia bynoeana	Yes	Yes	Yes						Yes	Yes	Yes	Yes
Nhite Gum	Eucalyptus benthamii	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
rested Jacana	Irediparra gallinacea	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
land Plain Land Snail	Meridolum corneovirens	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
a tenuifolia	Dillwynia tenuifolia	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
a tenuifolia (a shrub) on, Kemps Creek	Dillwynia tenuifolia - endangered population Kemps Creek	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Nattle	Acacia pubescens	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
errawang	Rulingia prostrata	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pygmy-possum	Cercartetus nanus	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
ang Cockatoo population, / and Ku-ring-gai Local ment Areas	Callocephalon fimbriatum population in the Hornsby and Ku-ring-gai Local Government Areas	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
urrowing Frog	Heleioporus australiacus	Yes	Yes	Yes	Yes	Yes				Yes	Yes	Yes	Yes
nd Golden Bell Frog	Litoria aurea	Yes	Yes	Yes					Yes	Yes	Yes	Yes	Yes
mon thesioides	Gyrostemon thesioides	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
a sp. Bankstown	Hibbertia sp. Bankstown									Yes	Yes	Yes	Yes
sessiliflora	Hypsela sessiliflora									Yes	Yes	Yes	
leaved Grevillea	Grevillea juniperina subsp. juniperina	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Phascolarctos cinereus	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
ia viridiflora subsp. viridiflora inkstown. Blacktown.	Marsdenia viridiflora subsp. viridiflora - endangered population	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Survey-time matrix for threatened species

name         Scientific name           Campbelltown, Fairfield, Liverpool and Penrith local ent areas         Micromyrtus minutiflora           tus minutiflora         Micromyrtus minutiflora           tus minutiflora         Persoonia nutans           Geebung         Persoonia nutans           curviflora subsp. curviflora         Pimelea curviflora subsp. curviflora           a parviflora         Pultenaea parviflora           loneyeater         Anthochaera phrygia           rgs Goanna         Varanus rosenbergi	Jan Yes	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Campbelltown, Fairfield, Liverpool and Penrith local ant areas tus minutiflora Geebung curviflora subsp. curviflora a parviflora subsp. curviflora Pultenaea parviflora loneyeater foneyeater rgs Goanna	Yes											
tus minutiflora deebung Ceebung curviflora subsp. curviflora a parviflora a parviflora buttenaea parviflora foneyeater foneyeater rgs Goanna Varanus rosenbergi	Yes											
GeebungPersoonia nutanscurviflora subsp. curvifloracurviflora subsp. curvifloraa parvifloraPultenaea parvifloraloneyeaterAnthochaera phrygiargs GoannaVaranus rosenbergi		Yes										
curviflora subsp. curviflora a parviflora loneyeater rgs Goanna Varanus rosenbergi	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
a parviflora <i>Pultenaea parviflora</i> Ioneyeater <i>Anthochaera phrygia</i> rgs Goanna <i>Varanus rosenbergi</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
loneyeater Anthochaera phrygia rgs Goanna Varanus rosenbergi	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
rgs Goanna Varanus rosenbergi	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Yes	Yes									Yes	Yes
wer Grevillea parviflora subsp. parviflo	a Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
ice-flower Primelea spicata	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Blider Petaurus norfolcensis	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
lains Greenhood Pterostylis saxicola									Yes	Yes	Yes	
weed Persicaria elatior	Yes	Yes	Yes	Yes	Yes							Yes
ergia multicaulis (Tadgells <i>Wahlenbergia multicaulis -</i> population, Auburn, m, Baulkham Hills, ry, Hornsby, Parramatta and d local government areas	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
wered Wax Plant Cynanchum elegans	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: 'Yes' indicates that targeted surveys for the individual species can be conducted in that month; 'Yes' (i.e. bold type) indicates that targeted surveys tor the individual species were conducted in that month as part of the biodiversity assessment.

Risk of impact	Low. Outside of the species known, limited distribution.	Low	Low	Low. Outside of the species known, limited distribution
Likelihood of occurrence in the airport site	Unlikely	Unlikely	Unlikely	Unlikely
Habitat present in the study area	Potential habitat present in wetlands and adjoining moist grassland.	Marginal habitat present. Not previously recorded in the locality.	Broadly suitable habitat present. Not previously recorded in the locality.	No sandy alluvial soils present. Not previously recorded in the locality
Desktop assessment results	7 records within 10km (OEH 2015a)	Species or species' habitat likely to occur within 10km (DoE 2015a)	No records within 10km (OEH 2015a)	No records within 10km (OEH 2015a)
Habitat association	Currently known from a single location less than 10x15m on the Cumberland Plain in western Sydney. Known to grow in damp places, on the Cumberland Plain, including freshwater wetland, grassland/alluvial woodland and an alluvial woodland/shale plains woodland (Cumberland Plain Woodland) ecotone. May be an early successional species that benefits from some disturbance. Possibly out competed when overgrown by some species such as <i>Cynodon dactylon</i> . Considered extinct under the EPBC Act and may not be a valid taxon (Leonard, G. pers. comm.).	Occurs in western Sydney between Picton and Freemans Reach. Grows in small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines. Associated vegetation above these rock shelves is sclerophyll forest or woodland on shale or shale/sandstone transition soils.	In NSW mainly occurs on the mid coast region from Wollemi NP to Nowra; the ACT and Goulburn regions and the South- west Slopes. Inhabits coastal heathlands, wet and dry sclerophyll forests, woodlands and mallee communities. Termite mounds are an important habitat feature: eggs are laid in the mounds in summer and incubate till spring, when the young dig themselves out. Young may return to the mound as a refuge for some months, while adults shelter in burrows dug under rocks or logs, or in rock crevices, hollow logs or even rabbit burrows (Sass 2008).	Known only from Bankstown airport. Habitat is very heavily modified, lacks canopy species and is currently a low grass/shrub association with many pasture grasses and other introduced herbaceous weeds. Soil at the site is a sandy (Tertiary) alluvium with a high silt content.
EPBC Status	×	ш		CE
TSC Statu s	ш	ш	>	G
Common name		Sydney Plains Greenhood	Rosenberg's Goanna	
Scientific name	Hypsela sessiliflora syn. Isotoma sessiliflora	Pterostylis saxicola	Varanus rosenbergi	Hibbertia sp. Bankstow n

Likelihood of occurrence of species credit-type species not targeted by seasonal surveys

	Risk of impact	Low. Outside of the species known, limited distribution.	Low	Low	Low. Outside of the species known, limited distribution.
	Likelihood of occurrence in the airport site	Unlikely	Unlikely	Unlikely	Unlikely
	Habitat present in the study area	Potential habitat present in wetlands and adjoining moist grassland.	Marginal habitat present. Not previously recorded in the locality.	Broadly suitable habitat present. Not previously recorded in the locality.	No sandy alluvial soils present. Not previously recorded in the locality.
	Desktop assessment results	7 records within 10km (OEH 2015a)	Species or species' habitat likely to occur within 10km (DoE 2015a)	No records within 10km (OEH 2015a)	No records within 10km (OEH 2015a)
· · ·	Habitat association	Currently known from a single location less than 10x15m on the Cumberland Plain in western Sydney. Known to grow in damp places, on the Cumberland Plain, including freshwater wetland, grassland/alluvial woodland and an alluvial woodland/shale plains woodland (Cumberland Plain Woodland) ecotone. May be an early successional species that benefits from some disturbance. Possibly out competed when overgrown by some species such as <i>Cynodon dactylon</i> . Considered extinct under the EPBC Act and may not be a valid taxon (Leonard, G. pers. comm.).	Occurs in western Sydney between Picton and Freemans Reach. Grows in small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines. Associated vegetation above these rock shelves is sclerophyll forest or woodland on shale or shale/sandstone transition soils.	In NSW mainly occurs on the mid coast region from Wollemi NP to Nowra; the ACT and Goulburn regions and the South- west Slopes. Inhabits coastal heathlands, wet and dry sclerophyll forests, woodlands and mallee communities. Termite mounds are an important habitat feature: eggs are laid in the mounds in summer and incubate till spring, when the young dig themselves out. Young may return to the mound as a refuge for some months, while adults shelter in burrows dug under rocks or logs, or in rock crevices, hollow logs or even rabbit burrows (Sass 2008).	Known only from Bankstown airport. Habitat is very heavily modified, lacks canopy species and is currently a low grass/shrub association with many pasture grasses and other introduced herbaceous weeds. Soil at the site is a sandy (Tertiary) alluvium with a high silt content.
	EPBC Status	×	ш		CE
	TSC Statu s	ш	ш	>	G
	Common name		Sydney Plains Greenhood	Rosenberg's Goanna	
	Scientific name	Hypsela sessilifiora syn. Isotoma sessilifiora	Pterostylis saxicola	Varanus rosenbergi	Hibbertia sp. Bankstow n

Likelihood of occurrence of species credit-type species not targeted by seasonal surveys

#### **Biodiversity credit report**



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

Date of report: 21/04/2016
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Time: 12:33:15PM

Calculator version: v4.0

Maior Proiect details	
Proposal ID:	073/2015/2144MP
Proposal name:	Western Sydney Airport
Proposal address:	The airport site Badgerys Creek NSW 2555
<b>D</b>	
Proponent name:	western Sydney Unit Department of Infrastructure and Regional Development
Proponent address:	GPO Box 594 Canberra ACT 2601
Proponent phone:	02 6210 6089
Assessor name:	Ben Harrington
Assessor address:	Level 15 133 Castlereagh Street Sydney NSW 2000
Assessor phone:	02 9239 7189
Assessor accreditation:	073

#### Summary of ecosystem credits required

Plant Community type	Area (ha)	Credits created
Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion	4.79	358.08
Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	42.50	2,140.65
Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	192.30	7,906.06
Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion	50.50	1,946.44
Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion	28.60	873.00
Total	318.69	13,224

#### **Credit profiles**

# 1. Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion, (HN526)

2,141

Number of ecosystem credits created

IBRA sub-region

Offset options - Plant Community types	Offset options - IBRA sub-regions
Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion, (HN526)	Cumberland - Hawkesbury/Nepean and any IBRA subregion that adjoins the
Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion, (HN528)	IBRA subregion in which the development occurs

### 2. Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion, (HN528)

Number of ecosystem credits created

IBRA sub-region

r

7,906

Offset options - Plant Community types	Offset options - IBRA sub-regions
Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion, (HN528)	Cumberland - Hawkesbury/Nepean and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

#### 3. Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion, (HN529)

1,946

Number of ecosystem credits created

IBRA sub-region

c

Offset options - Plant Community types	Offset options - IBRA sub-regions	
Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion, (HN529)	Cumberland - Hawkesbury/Nepean and any IBRA subregion that adjoins the	
Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion, (HN528)	IBRA subregion in which the developme occurs	

## 4. Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion, (HN512)

Number of ecosystem credits created

358

IBRA sub-region

Offset options - Plant Community types	Offset options - IBRA sub-regions
Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion, (HN512) Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion, (HN513) Turpentine - Grey Ironbark open forest on shale in the lower Blue Mountains, Sydney Basin Bioregion, (HN604) Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion, (HN556)	Cumberland - Hawkesbury/Nepean and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

### 5. Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion, (HN630)

873

Number of ecosystem credits created

IBRA sub-region

Offset options - Plant Community types	Offset options - IBRA sub-regions
Phragmites australis and Typha orientalis coastal freshwater wetlands of the	Cumberland - Hawkesbury/Nepean
Sydney Basin Bioregion, (HN630)	and any IBRA subregion that adjoins the
Coastal freshwater lagoons of the Sydney Basin Bioregion and South East	IBRA subregion in which the development
Corner Bioregion, (HN520)	occurs

#### Summary of species credits required

Common name	Scientific name	Extent of impact Ha or individuals	Number of species credits created
Pultenaea parviflora	Pultenaea parviflora	4.00	60
Marsdenia viridiflora subsp. viridiflora in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	Marsdenia viridiflora subsp. viridiflora - endangered population	145.00	5,800
Cumberland Plain Land Snail	Meridolum corneovirens	141.80	1,843
Black Bittern	Ixobrychus flavicollis	62.70	815
Southern Myotis	Myotis macropus	34.20	752

GHD

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