Australian Government

Department of Infrastructure, Regional Development and Cities

WESTERN SYDNEY AIRPORT

Biodiversity Offset Delivery Plan

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Executive summary

Western Sydney Airport Stage 1

Planning investigations to identify a site for a second Sydney airport first commenced in 1946, with a Badgerys Creek site undergoing comprehensive studies and three environmental impact statements (EIS) over the past 30 years. The Australian Government announced on 15 April 2014 that Badgerys Creek will be the site for the new Western Sydney Airport (the airport), to be developed on 1768 hectares of land acquired by the Commonwealth through the 1980s and 1990s. The airport will provide both domestic and international services once airport operations commence in 2026.

The initial development of the airport (Stage 1 development) will include a single runway coupled with both landside and airside facilities capable of supporting the safe and efficient movement of approximately 10 million passengers per year, as well as freight operations. On 23 December 2014, a delegate of the Australian Government Minister for the Environment determined that construction for the airport would require assessment in accordance with the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act). The EIS was finalised and provided to the Minister for the Environment and Energy on 15 September 2016, and contains a biodiversity assessment and biodiversity offset package.

Approval for the construction and operation of the airport is 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 airport. An Airport Plan was created identifying a staged development of the airport, providing details of the initial development being authorised, as well as a long-term vision of the airport over a number of stages. The Airport Plan was determined by the Minister for Urban Infrastructure on 5 December 2016.

Biodiversity legislation and policy

The Airport Plan contains a number of conditions that require measures to reduce potential biodiversity impacts and offset unavoidable residual impacts. Condition 30 requires the preparation for approval of a Biodiversity Offset Delivery Plan (BODP) to compensate for residual significant impacts associated with the Stage 1 development. The BODP must take into account the biodiversity assessment and offset package in the EIS, specified sections of environmental management framework in the EIS and the *Environment Protection and Biodiversity Conservation Act 1999* Environmental Offsets Policy October 2012 (EPBC Act offsets policy).

Biodiversity offsets are required to offset impacts on threatened species and communities listed under the EPBC Act; and threatened plants, animals and their habitat listed under the New South Wales (NSW) *Threatened Species Conservation Act 1995* (TSC Act) (repealed in August 2017 and replaced by the NSW *Biodiversity Conservation Act 2017* (BC Act)). Offsets can take various forms.

The EPBC Act offsets policy generally requires a minimum of 90% of offsets to be 'direct'. Direct offsets are those actions that provide a measurable conservation gain for an impacted protected matter and can include payment for management and conservation of equivalent sites, purchase of credits from existing sites and acquisition of suitable land. In addition to direct offsets, up to 10% of offsets can be delivered through other compensatory measures. These are actions that are anticipated to lead to benefits for the impacted protected matter, for example funding for research or educational programs.

Offsets for significant residual impacts on plants, animals and their habitats are calculated with reference to the NSW Framework for Biodiversity Assessment (FBA) methodology. This provides for the purchasing and retiring of biodiversity credits of a number and type that match the required offset area.

Biodiversity impacts of the Stage 1 development

The assessment of biodiversity impacts of the Stage 1 development is based on the biodiversity survey and assessment results presented in the GHD Biodiversity Assessment in the Western Sydney Airport Environmental Impact Statement and the Stage 1 Biodiversity Assessment Report (Stage 1 BAR) and the Stage 1 BAR addendum. The Stage 1 BAR addendum has been independently verified in accordance with Condition 30(4)(c) of the Airport Plan.

The Stage 1 Construction Impact Zone (CIZ) will include the area of bulk earthworks in the northern half of the airport site, which would facilitate the development of the runway, terminal and aviation support facilities. Areas of disturbance outside the bulk earthworks boundary that would be used for ancillary infrastructure such as drainage controls, detention ponds, perimeter roads, security fencing and site services would also be included in the Stage 1 CIZ. Construction of the Stage 1 development would result in direct impacts within a 1199.1-hectare disturbance footprint, including 359 hectares of native vegetation.

The indicative CIZ in the Airport Plan has been subject to ongoing design development following the determination of the Airport Plan in December 2016. This has resulted in an approved Stage 1 CIZ with a marginal reduction in biodiversity impacts. Impacts such as the removal of threatened ecological communities have been reduced by locating new disturbance areas within exotic vegetation areas and by reducing associated construction areas. A desktop assessment, targeted field surveys and habitat assessments were used to identify the suite of biota listed under relevant legislation that could occur in the airport site or be affected by the construction or operation of the airport.

EPBC Act-listed biota

The EPBC Act-listed biota requiring biodiversity offsets are Cumberland Shale Plains Woodland and Shale-Gravel Transition Forest (Cumberland Plain Woodland), habitat for the vulnerable species Grey-headed Flying-fox (*Pteropus poliocephalus*), potential winter foraging habitat for the critically endangered Swift Parrot (*Lathamus discolour*) and the endangered Spiked Rice-flower (*Pimelea spicata*), which has been recorded at the airport site.

Cumberland Plain Woodland

Construction of Stage 1 of the airport would require the permanent removal of 141 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. The Cumberland Plain Woodland at the airport site comprises remnant or regrowth native vegetation in generally moderate condition. The local occurrence of the community exists in a highly fragmented, rural landscape. Patches of woodland are moderately to severely degraded, notably through exotic plant cover averaging over 30% in the plots sampled.

Grey-headed Flying-fox habitat

There are no Grey-headed Flying-fox camps located at the airport site. However, there are at least seven known camps within 20 kilometres and all native woodland and forest in the airport site provides potential foraging habitat for this species. As such, an area of 187.8 hectares of potential foraging habitat would be impacted in the Stage 1 CIZ, all of which comprises critical foraging habitat as defined in the Recovery Plan for the Grey-headed Flying-fox (DECCW 2009).

Swift Parrot foraging habitat

The Swift Parrot may occur in the Stage 1 CIZ on occasion during its winter migration, but was not detected during targeted surveys. Construction of the airport would impact an area of 187.8 hectares of potential Swift Parrot foraging habitat. All native woodland and forest in the airport site provides potentially productive foraging habitat within the range of this highly mobile species, but there is no evidence of use by large numbers of individuals.

Pimelea spicata

The population of *Pimelea spicata* is located at five locations in the north-western portion of the Stage 1 CIZ, with 4118 *Pimelea spicata* plants recorded. This population occurs within an area of 2.94 hectares of occupied habitat in good condition for the ecological requirements of the species.

Offset requirements for plants, animals and their habitat

Offsets are required for the impacts of the airport on plants, animals and their habitat under NSW legislation. Ecosystem-specific offsets are required for impacts of the airport on:

- 224.1 hectares of Grey Box – Forest Red Gum grassy woodland on flats in varying condition
- 48.7 hectares of Grey Box – Forest Red Gum grassy woodland on shale in varying condition
- 47.6 hectares of Forest Red Gum – Rough-barked Apple grassy woodland in varying condition
- 5.9 hectares of Broad-leaved Ironbark – Grey Box – Melaleuca decora grassy open forest in varying condition, and
- 32.7 hectares of good condition artificial freshwater wetland on floodplain.

Species-specific offsets are required for impacts on the Cumberland Land Snail (*Meridolum corneovirens*); Dillwynia tenuifolia; Marsdenia viridiflora subsp. viridiflora; Pultenaea parviflora; Southern Myotis (*Myotis macropus*) roosting habitat; and the Spiked Rice-flower (*Pimelea spicata*).

Consultation

Advice on biodiversity offsets and complementary outcomes was sought from a variety of stakeholders, including the Department of Environment and Energy (Environment and Energy), the NSW Government, local councils, conservation groups, community groups, Aboriginal land councils and other Aboriginal groups, as well as other individuals and organisations with relevant expertise.

Biodiversity Experts Group

In accordance with Condition 31 of the Airport Plan, the Department of Infrastructure (the Department) was required to establish a Biodiversity Experts Group (Experts Group) and to consult with them on the development of the BODP. Membership of the group included representatives from NSW Office of Environment and Heritage (OEH), NSW Government Local Land Services, local councils in the vicinity of the project, local Aboriginal Land Councils, other Western Sydney Aboriginal stakeholder groups, a university and conservation groups. The Experts Group provided advice on a range of issues including on the development of Offset Assessment Criteria to guide the identification and consideration of potential offset sites as well as offset measures more broadly, the conservation outcomes of the overall offsets package and on potential direct offsets and other compensatory measures.

Aboriginal Stakeholder Consultation

The Department has engaged with Aboriginal stakeholders to identify complementary outcomes for biodiversity conservation and Aboriginal cultural heritage on the Cumberland Plain. Engagement included a briefing session with local Aboriginal Land Councils and Aboriginal groups that have landholdings on the Cumberland Plain, follow up meetings with interested parties, and involving Aboriginal groups Deerubbin Local Aboriginal Land Council, Gandangara Local Aboriginal Land Council and Muru Mittigar in the Experts Group and the development of the BODP.

Member Advice Report of the Biodiversity Experts Group

The Experts Group represented a broad range of organisations, and members held a variety of perspectives on the preferred approach for an offsets package. Experts Group members generally supported the overall offsets package and felt the conservation outcomes would improve or maintain the viability of biodiversity values lost as a consequence of the construction of Western Sydney Airport, provided certain conditions were met. There was strong support for a package with a diverse range of measures. The main objective should be to improve management of biodiversity to safeguard Western Sydney's unique ecosystems. This advice was then taken into account in the development of the BODP.

Biodiversity Offset Package

The Department will meet its biodiversity offsets obligations via a number of mechanisms. A majority of offsets is intended to be delivered through conservation of Department of Defence (Defence) land at Orchard Hills. Additional offsets will likely include purchasing of credits through the NSW Biodiversity Offsets Scheme, acquisition of land, restoration and rewilding programs, and other compensatory measures. The relative contributions of each offset proposal can be determined by assessment guides under either the EPBC Act or the BC Act. These contributions are generally affected by the quality of the conservation gain anticipated, the tenure security of the project or land and the likelihood of the land otherwise being developed.

Orchard Hills offset site

The Department and Defence is in discussions about establishing an offset site at the Defence Establishment Orchard Hills (Orchard Hills). Orchard Hills is about 50 kilometres west of central Sydney and seven kilometres north of the Western Sydney Airport. Orchard Hills is an ammunition depot of approximately 1740 hectares that is owned, used and managed by Defence. The offset site would be established under a Memorandum of Understanding (MOU) to be entered into between Defence and the Department.

Approximately 1370 hectares of Orchard Hills is recorded on the Commonwealth Heritage List as a Commonwealth Heritage Place for its natural heritage values, including areas of Cumberland Plain Woodland. The Orchard Hills offset site is located within the Cumberland Conservation Corridor, which is a community-developed proposal that recognises the biodiversity value of conservation and especially connectivity of habitat on the Cumberland Plain. The majority of the Orchard Hills offset site is also recognised as a conservation priority in the *Biodiversity Investment Opportunities Map, Mapping Priority Investment Areas for the Cumberland Subregion* (BIO Map) (OEH 2015). As such, the Orchard Hills offset site presents the opportunity to secure offsets with strategic value.

The potential offset site includes a core area of not less than 900 hectares within the Commonwealth Heritage List Area and contains species and communities that would provide appropriate 'like for like' offsets for the Stage 1 development of the airport. The site would make a substantial direct offset contribution, including approximately 63% of the offset requirement for EPBC Act Cumberland Plain Woodland; 35% of the offset requirement for poorer quality Cumberland Plain Woodland; 71% for Grey-headed Flying-fox habitat; 47% for Swift Parrot foraging habitat; habitat for *Pultenaea parviflora*, *Dillwynia tenuifolia* and *Marsdenia viridiflora viridflora*; and potentially all of the required offsets for the Cumberland Plain Land Snail, Black Bittern and the Southern Myotis.

The offset area will be secured as a result of a number of factors including:

- The site is located on Commonwealth-owned land.
- The EPBC Act provides a comprehensive environment and planning framework for the site under the control of the Environment Minister including through controls contained in Parts 3 (Requirements for environmental approvals) and Part 13 (Species and Communities).

The core offset area is contained within a Commonwealth Heritage Listed area that is subject to additional controls under Part 15 of the EPBC Act. The obligations contained in the MOU will be additional to the Commonwealth Heritage Listing requirements. The MOU entered into between Defence and the Department will provide for:

- the area and boundaries of the Orchard Hills offset site to be formalised, with an expectation that the area will include a core area of no less than 900 hectares and any other additional areas agreed between Defence and the Department
- an Offset Plan to be developed, funded and implemented over a period, expected to be up to 20 years, to provide measurable ecological improvements to the quality of habitat for the affected threatened biota at the Orchard Hills offset site, consistent with the EPBC Act Offsets Policy and through the potential management actions outlined in this BODP
- various monitoring, record keeping, reporting and auditing arrangements to be put in place, consistent with this BODP and the Airport Plan
- the Orchard Hills offset site to be maintained following completion of the improvements, so as to retain long-term benefits of the quality improvements delivered following implementation of the Offset Plan expected to take up to 20 years.

To achieve the proposed improvements in biodiversity values, the Offset Plan would provide details about the management actions that would be required. These details include activities, responsibilities, costs, monitoring and auditing, and a timeline for each proposed management action.

Potential management actions would include activities such as:

- retention of regrowth and remnant native vegetation and habitat resources
- supplementation of habitat resources in revegetated and naturally regenerating areas
- management of human disturbance and exclusion of land uses that are inconsistent with biodiversity conservation to the extent practical, having regard to ongoing Defence use of the site
- management of light pollution from roads and facilities and its impacts on nocturnal fauna
- maintenance of fences, gates, signs and access tracks
- remediation of contaminated sites
- weed control
- revegetation or supplementary planting where natural regeneration will not be sufficient to achieve management outcomes
- reintroduction of locally extinct native fauna
- management of fire for conservation with consideration of existing fire management plans and the need to maintain the diversity of habitat types and meet Defence operational and safety requirements
- mechanical removal of Native Blackthorn scrub to help restore a natural vegetation structure and native groundcover diversity in areas where it would not be possible to use fire to achieve this aim given the risk of damaging wildfire
- erosion remediation and control
- removal of barriers and reinstatement of natural flows in drainage lines (where consistent with track maintenance and other Defence activities)
- feral cat and fox control and exclusion and control of feral herbivores such as rabbits and deer, coordinated with existing control programs in the locality
- management of over-abundant native herbivores (kangaroos and wallabies) with consideration of existing monitoring and control programs
- ongoing support for research programs and experimental ecosystem restoration projects at the Orchard Hills site in support of achieving and improving the required offset outcomes

These types of management actions would improve the condition and viability of Cumberland Plain Woodland and the quality of habitat for the Grey-headed Flying-fox and Swift Parrot. Performing these management actions would also increase the viability of populations and quality and condition of habitat for native species.

The Department would provide funds for the intensive management of the site for biodiversity conservation and restoration for a period expected to take up to 20 years. Defence would implement the plan, including completion of all monitoring, reporting and auditing requirements. Once the quality improvements have been achieved, Defence would continue to manage the Orchard Hills offset site so as to maintain the long long-term benefits of the quality improvements achieved at the completion of the Offset Plan.

Purchase of credits through the NSW Biodiversity Offsets Scheme

The NSW Biodiversity Offsets Scheme provides for conservation of offset sites under a biodiversity stewardship agreement (BSA). A developer can purchase and retire biodiversity credits from a BSA site to secure an offset. A BSA is the strongest conservation covenant available on private land in NSW and the NSW Scheme provides for sound calculation of offset contributions, a management plan, secure and performance-based funding, monitoring and oversight by the NSW Biodiversity Conservation Trust. This combination of attributes makes the NSW Biodiversity Offsets Scheme an effective means of delivering direct offsets. This approach could deliver the full quantum of offset required for impacts on *Pimelea spicata* and substantial contributions for other species.

Acquisition of land

The Department is also considering the acquisition of suitable parcels of land, containing biodiversity characteristics relevant to the impacts of the airport development, being acquired and secured for conservation and given to local conservation groups to manage. It is envisaged that the Department would establish an advisory group that would provide advice on parcels of land for acquisition according to clear criteria. This would 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 airport development.

It is anticipated that the acquisition of land for conservation could deliver around 1 to 5% of the total quantum of offset required for the airport. This is likely to include up to 5% of the offset requirement for Cumberland Plain Woodland and an associated contribution towards the ecosystem credit requirement for impacts on plants, animals and their habitats. A contribution toward the offset requirement for impacts on *Pimelea spicata* or for other species credits within the offset requirement for plants, animals and their habitats may also be achieved, depending on the sites identified by the advisory group.

Restoration and rewilding programs

The Department is also considering other forms of direct offsets that deliver a clear conservation outcome but are not linked to a parcel of land that could be secured under a conservation covenant. The Department, through its consultation with the Experts Group, has identified a number of options that could deliver direct offsets, collectively referred to as 'restoration and rewilding programs'. While yet to be developed, restoration and rewilding programs would make a valuable contribution to conservation outcomes.

Programs would be selected based on consideration of the Department's criteria for evaluation of potential biodiversity offsets which take account of the criteria in the EPBC Act offsets policy. These would include a focus on restoring species, communities and their habitats that are equivalent to the affected protected matters relevant to the airport development. Programs would be funded, including allowance for ongoing management and monitoring. They would also be located on a site that would not be at substantial risk of future development (given the absence of a secure conservation covenant), and that preferably has not already been set aside for conservation.

At this stage of the delivery of offsets for the airport development, it is anticipated that restoration or rewilding projects could deliver up to 10% of the total quantum of offset required for the airport development.

Other compensatory measures

The EPBC Act offsets policy requires that, subject to specified exceptions, a minimum of 90% of a project's impacts must be directly offset and the remainder may be met by other compensatory measures providing they contribute to the ongoing viability of the affected biota. The Department's proposed other compensatory measures include research, capacity building and education programs.

Threatened Flora Propagation Program

The Threatened Flora Propagation Program (TFPP) would be a compensatory measure for *Pimelea spicata*, *Marsdenia viridiflora* subsp. *viridiflora* and *Pultenaea parviflora*. The program involves collecting seeds and cuttings from the airport site and/or other sources to conduct trials of seed germination and cutting propagation at the Australian Botanic Garden Mount Annan (ABGMA) to establish the best techniques to grow these species. The program would directly contribute to translocation and ecosystem restoration activities by providing source populations of these threatened plants. Processing of seed and cuttings, propagation trials and potting to date has resulted in successful generation of each of *Pimelea spicata*, *Marsdenia viridiflora* subsp. *viridiflora* and *Pultenaea parviflora*. The majority of the plants are likely to be used in revegetation programs at direct offset sites to help maintain the population size and genetic viability of the regional populations of these species.

The ABGMA will also deliver an extension of the TFPP in the form of a regional-scale genetic research project, to help understand the ecology of *Pimelea spicata* and assist with its conservation, as well as maintain an ex situ *Pimelea spicata* potted collection for five years.

Greening Australia seed collection and production program

The Department has entered into an agreement with Greening Australia to contribute $10 million in funding to the organisation's Cumberland Seed Hub program in Western Sydney. The program will produce a reliable source of native seed for ecological restoration work in Western Sydney's Cumberland Plain, specifically the threatened vegetation communities and species associated with Cumberland Plain Woodland. The seed supply program is presented in this BODP as an 'other compensatory measure', contributing to the offset requirement for Cumberland Plain Woodland, *Pimelea spicata* and for plants, animals and their habitats, by facilitating ecological restoration of these species and their habitats at offset sites and other lands across Western Sydney.

Longer term other compensatory measures

The Department, in consultation with various stakeholders, has considered potential longer term other compensatory measures, which could deliver suitable biodiversity offsets for the airport development. Proposals under consideration include research into effective restoration techniques for threatened ecological communities and species on the Cumberland Plain, and capacity building and training opportunities, including Aboriginal land management as part of on-ground conservation and ecological restoration activities. Due to the requirements of the EPBC Act offsets policy and Commonwealth procurement and funding policies, the specifics of these research and conservation programs would be defined during the longer term implementation of this BODP.

Implementation of the BODP

The Department will implement this BODP consistent with Condition 30(10) of the Airport Plan. The primary tasks involved with implementing the plan will be securing the Orchard Hills offset site, implementation of existing offset measures, and identification and implementation of additional offsets.

In terms of direct offsets, the Offset Plan for the Orchard Hills offset site would be prepared in consultation with Environment and Energy, and Defence would be expected to put this plan in place within approximately 18 months of the approval date of this BODP.

The Department has existing agreements in place with Greening Australia and ABGMA that will contribute to the offset requirement as other compensatory measures. The contract with Greening Australia includes a scheme of annual reports, project plan updates and contractual milestones over the five years of the agreement, with a final report to be provided by August 2021. The TFPP is nearing the end of stage 1, with positive results recorded so far for plant propagation and potting. Stage 2 of the TFPP, incorporating a genetic research project and the establishment of an ex situ *Pimelea spicata* potted collection, will commence this financial year, with funding provided to maintain the collection for a period of up to five years.

This BODP has outlined several further offset measures as part of the offset proposal. Purchase of credits would be staged, with an initial tranche of credits purchased in the 2018/19 Financial Year, and the required credits expected to be purchased and secured within three years of BODP approval. For the acquisition of land, an advisory group will be established in the 2018/19 Financial Year, and it is expected that suitable parcels of land will be identified and secured within three years of the establishment of the advisory group. Scoping and identifying restoration and rewilding programs will commence in the 2018/19 Financial Year, with programs expected to be delivered for up to 10 years. Scoping and identifying longer term research and capacity building programs, including Aboriginal land management, will commence in the 2018/19 Financial Year, with programs expected to be funded and delivered for up to 10 years.

Based on the preliminary calculations completed for this BODP additional offset sites and other compensatory measures may be identified and implemented to address any shortfall in offsets. The Department will consult with Environment and Energy as the process for implementing these additional offsets is developed.

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Glossary of terms

Term	Definition
Affected threatened biota	Threatened species 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 Offset Policy. In this BODP it comprises: • Cumberland Plain Woodland • Grey-headed Flying-fox (*Pteropus poliocephalus)* • Swift Parrot (*Lathamus discolor)* foraging habitat • Spiked Rice-flower (*Pimelea spicata*)
Airport site	The site for Sydney West Airport as defined in the Airports Act.
Approver	Under the Airport Plan, the Approver for this BODP is the Minister for the Environment and Energy or an SES employee (under the Public Service Act 1999) of the Department of the Environment and Energy.
BAM	Biodiversity Assessment Methodology
BAR	Biodiversity Assessment Report
BBAM	The NSW BioBanking Assessment Methodology (OEH 2014).
BC Act	Biodiversity Conservation Act 2017 (NSW)
BCT	NSW Biodiversity Conservation Trust (BCT, formerly Nature Conservation Trust)
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 FBA or the BBAM. Includes ecosystem credits or species credits.
Biodiversity credit report	Specifies the number and type of biodiversity credits required to offset the impacts of a Major Project in accordance with the FBA or that would be generated through conservation and management of an offset site under a BioBanking agreement or a BSA.
Biodiversity offset delivery plan (BODP)	This plan, which sets out the specific actions to be taken to meet the offset conditions for the airport as set out in the Airport Plan.
Biodiversity offset package	See GHD (2016a). Appendix K2 to the airport EIS, which outlines the approach to the delivery of biodiversity offsets for the 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.

Term	Definition
Biodiversity Stewardship Agreement (BSA)	An agreement made under Division 2 of Part 5 of the BC Act.
Biodiversity values	The composition, structure and function of ecosystems, including native species, populations and ecological communities, and their habitats.
BOS	NSW Biodiversity Offset Strategy
CEEC	Critically endangered ecological community.
Defence	The Australian Government Department of Defence
Department of Infrastructure, Regional Development and Cities (the Department)	The Australian Government Department responsible for preparing and implementing this BODP.
DoE	The Australian Government Department of the Environment (now Department of the Environment and Energy).
DPI	The NSW Department of Primary Industries.
DSEWPaC	The former Department of Sustainability, Environment, Water, Populations and Communities, now the Australian Government 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, FBA and BAM.
EEC	Endangered ecological community
EIS	Environmental Impact Statement
Environment and Energy	The Australian Government Department of the Environment and Energy.
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 Airport Plan (see the Airport Plan).
EPBC Act	The Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (Cth)
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 Environmental Planning and Assessment Act 1979 (EPA Act) and in accordance with The NSW Biodiversity Offsets Policy for Major Projects (OEH 2014a).
FM Act	The Fisheries Management Act 1994 (NSW)

Term	Definition
Food tree	A tree species that is recognised as being of value as a foraging resource for a given fauna species.
GIS	Geographic information systems
Habitat tree	A tree that is recognised as being of value as a shelter, roosting and/or nesting resource for fauna species. Includes hollow-bearing trees, stags (standing dead trees) and trees with nests or other signs of fauna occupancy.
Long-term development	The longer term development of the airport, including parallel runways and facilities for up to 82 million passengers annually (nominally occurring in 2063).
Main Construction Works	Substantial physical works on a particular part of 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 TransGrid Relocation Works or Preparatory Activities.
Migratory species	Species that are listed as migratory under the EPBC Act.
NPW Act	The National Parks and Wildlife Act 1974 (NSW)
NPWS	The NSW National Parks and Wildlife Service
NSW-listed biota	Threatened species, populations and communities listed under the NSW BC Act or FM Act.
OEH	The NSW Office of Environment and Heritage
Orchard Hills	Defence Establishment Orchard Hills
PCT	Plant community type
Potential offset areas	The areas within the potential offset sites 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.
Potential offset sites	The potential offset sites that have been identified in order to offset biodiversity impacts.

Term	Definition
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 (eg 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, but excluding bulk earthworks) d) enabling preparatory activities such as: ○ demolition or relocation of existing structures (including buildings, services, utilities and roads); ○ the disinterment of human remains located in grave sites identified in the European and other heritage technical report in volume 4 of the EIS; and ○ application of some environmental impact mitigation measures. e) any other activities which an Approver determines are Preparatory Activities for this definition
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, FBA and BAM.
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.
Stage 1 Construction Impact Zone (CIZ)	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 airport, including a single runway and facilities for 10 million annual passengers.
TEC	Threatened ecological community listed under the EPBC Act and/or the BC Act.
The EPBC Act Offsets Policy	The Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy October 2012 (DSEWPaC 2012)
The locality	Land within a 10km radius of the airport site.
The offsets assessment guide	The spreadsheet offset calculator that accompanies the Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy (DSEWPaC 2012).
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, BC Act or FM Act.

Term	Definition
TSC Act	The Threatened Species Conservation Act 1995 (NSW), which was repealed and replaced by the BC Act in August 2017.
Western Sydney Airport (or 'the airport')	The 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 three previous environmental impact statements (EIS) 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 for the new Western Sydney Airport (the airport). The airport is planned to be developed on approximately 1780 hectares of land acquired by the Australian Government in the 1980s and 1990s as shown on Figure 1. Airport operations are expected to commence in 2026.

The airport will provide both domestic and international services, with development staged in response to demand. The initial development of the airport (referred to as the Stage 1 development) includes a single 3700 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. Consistent with the practice at all federally leased airports, non-aeronautical commercial uses could be permitted on the airport site subject to relevant approvals.

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 annual 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 airport EIS were issued in January 2015. Approval for the construction and operation of the airport is controlled by the *Airports Act 1996* (Cth) (Airports Act). The Airports Act provides for the preparation of an Airport Plan, which serves as the authorisation for the development of the airport.

The airport EIS was finalised and provided to the Minister for the Environment and Energy on 15 September 2016. The airport EIS contains biodiversity assessment (Appendix K1) and biodiversity offset package (Appendix K2) technical reports.

An Airport Plan was developed identifying a staged development of the 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 was determined by the Minister for Urban Infrastructure on 5 December 2016. The Airport Plan contains a number of biodiversity conditions, which require mitigation and management measures to be implemented to reduce the potential impacts on biodiversity and to offset unavoidable residual impacts

1.2 Overview of the offset proposal

The Airport Plan conditions require the Department of Infrastructure, Regional Development and Cities (the Department) to prepare for approval a Biodiversity Offset Delivery Plan (BODP) to compensate for residual significant impacts associated with the Stage 1 development. The BODP must meet the requirements set out in condition 30 of the Airport Plan which, among other requirements, requires that the BODP takes into account the biodiversity assessment and offset package in the airport EIS and the *EPBC Act 1999 Environmental Offsets Policy October 2012* (EPBC Act Offsets Policy) (DSEWPaC 2012a).

The BODP development and implementation process is at Figure 2.

Biodiversity offsets are required for significant residual impacts of the Stage 1 development on:

- threatened species and communities listed under the EPBC Act (affected threatened biota)
- plants, animals and their habitat, including threatened biota listed under the New South Wales (NSW) *Threatened Species Conservation Act 1995* (TSC Act) (repealed in August 2017 and replaced by the NSW *Biodiversity Conservation Act 2017* (BC Act))

The EPBC Act Offsets Policy requires the calculation of offsets for impacts on affected threatened biota using the 'offsets assessment guide' spreadsheet. The guide calculates the percentage of the total requirement for the individual protected matter that would be delivered by an offset proposal. Further to this, offsets for significant residual impacts on plants, animals and their habitat 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, which was the methodology used to calculate offsets for major projects in NSW at the time that the airport EIS was prepared.

The EPBC Act Offsets Policy recognises that there are various options available for delivery of direct offsets, including market-based tools such as BioBanking – now the NSW Biodiversity Offset Strategy (BOS) – and Biodiversity Assessment Methodology (BAM). The EPBC Act Offsets Policy requires biodiversity offset sites to be securely titled under a legally binding conservation covenant (or other appropriate mechanisms) and actively managed.

At this stage of the planning and implementation of the BODP, the intent is to deliver a large majority of biodiversity offsets through conservation of suitable offset sites.

A large component of the direct offsets to be implemented under this BODP are associated with an offset site at the Defence Establishment Orchard Hills (Orchard Hills). The Orchard Hills offset site is owned by the Commonwealth and entered on the Commonwealth Heritage List. It is subject to the comprehensive environmental protection framework set out in the EPBC Act under the control of the Environment Minister.

A Memorandum of Understanding (MOU) to be entered into between the Department of Defence (Defence) and the Department of Infrastructure, Regional Development and Cities includes provisions intended to be additional to any Commonwealth Heritage Listing requirements. The MOU will provide for:

- the area and boundaries of the Orchard Hills offset site to be formalised, with an expectation that the area will include a core area of no less than 900 hectares and any other additional areas agreed between Defence and the Department
- an Offset Plan to be developed, funded and implemented over a period, expected to be up to 20 years, to provide measurable ecological improvements to the quality of habitat for the affected threatened biota and plants, animals and their habitat at the Orchard Hills offset site, consistent with the EPBC Act Offsets Policy and through the potential management actions outlined in this BODP
- various monitoring, record keeping, reporting and auditing arrangements to be put in place, consistent with this BODP and the Airport Plan
- the Orchard Hills offset site to be maintained following completion of the improvements, so as to retain long-term benefits of the quality improvements following implementation of the Offset Plan.

The objectives of the Offset Plan will be to improve the quality of habitat for the affected threatened biota and plants, animals and their habitat in the Offset Area in order to help meet the requirements of this BODP. Specifically, the Offset Plan management actions will be designed to achieve the following objectives:

a. ‘Future quality with offset’ score that is two greater than the ‘Start quality’ score that is defined in the Initial Ecological Survey for the area of Cumberland Plain Woodland

b. ‘Future quality with offset’ score that is one greater than the ‘Start quality’ score that is defined in the Initial Ecological Survey for the area of habitat for the Swift Parrot and Grey-headed Flying-fox in the Offset Area

c. ‘Future quality with offset’ score for the area of poorer quality Cumberland Plain Woodland in the Offset Area that is at least:

    i. as high as the quality score for the Cumberland Plain Woodland in the Stage 1 Construction Impact Zone (6 out of 10), and

    ii. two greater than the ‘Start quality’ score that is defined in the Initial Ecological Survey for the area of poorer quality Cumberland Plain Woodland in the Offset Area.

Formalisation of the final area and boundaries of the offset site, confirmation of the characteristics to be protected through further ecological survey and assessment, and agreement on suitable management measures to be implemented, will determine the ultimate quantum of offset that will be delivered by the Orchard Hills site.

As part of the development of this BODP a variety of biodiversity restoration and management projects have been identified that would deliver substantial conservation outcomes but not all would be applied to a permanently secured offset site. The EPBC Act Offsets Policy acknowledges that 'in some circumstances there may be difficulties in permanently securing a site for conservation purposes due to the existing tenure of the land' and that 'such situations will be considered by the Department of Environment and Energy (Environment and Energy) on a case by case basis' (DSEWPaC 2012, p19). Where the security of the offset is diminished, the level of direct offset that would be delivered should be discounted accordingly (DSEWPaC 2012). This requirement would be addressed using the offsets assessment guide, which accounts for the level of security of an offset proposal.

As described above, a proportion of the direct offsets for the airport would be secured by purchasing and retiring biodiversity credits from Biodiversity Stewardship Agreement (BSA) sites. To confirm the quantum of offset for affected threatened biota, this approach requires 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. These biodiversity credits would also directly contribute to the offset requirement for impacts on plants, animals and their habitats.

Biodiversity credits will also be used as a standard metric for tracking the quantum of biodiversity offsets delivered by other types of direct offset proposals and compensatory measures that are secured through the implementation of this BODP (see Section 1.6 below).

In addition to these direct offsets, a Threatened Flora Propagation Program and a native seed production program will be implemented as other compensatory measures in accordance with the Airport Plan conditions and the EPBC Act Offsets Policy. Additional research or conservation programs will be strategically implemented as part of this BODP where they can contribute to specific outcomes for affected threatened biota.

Due to a variety of factors, most notably the scale and nature of the biodiversity offsets required for the airport, it will not be possible to specifically detail all of the proposed biodiversity offsets as part of this BODP. The Department has identified strategic offsetting opportunities and approaches, which would involve working with the NSW Government and local stakeholders to source and manage suitable biodiversity offsets. A number of these strategic opportunities cannot be realised immediately. The Department will need to enter into several contractual processes and through them set delivery outcomes. Also, because of the assessment and approval requirements for a BSA, there is likely to be a delay between the identification of an offset site with suitable biodiversity values and the generation of biodiversity credits that can be purchased and retired to secure the offset.

This BODP sets out the 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 BODP, which sets out the final offsets proposal, based on the biodiversity offset package (GHD 2016b) and in accordance with the Airport Plan conditions, comprising:
   - a summary of the updated biodiversity impact assessment for the Stage 1 development

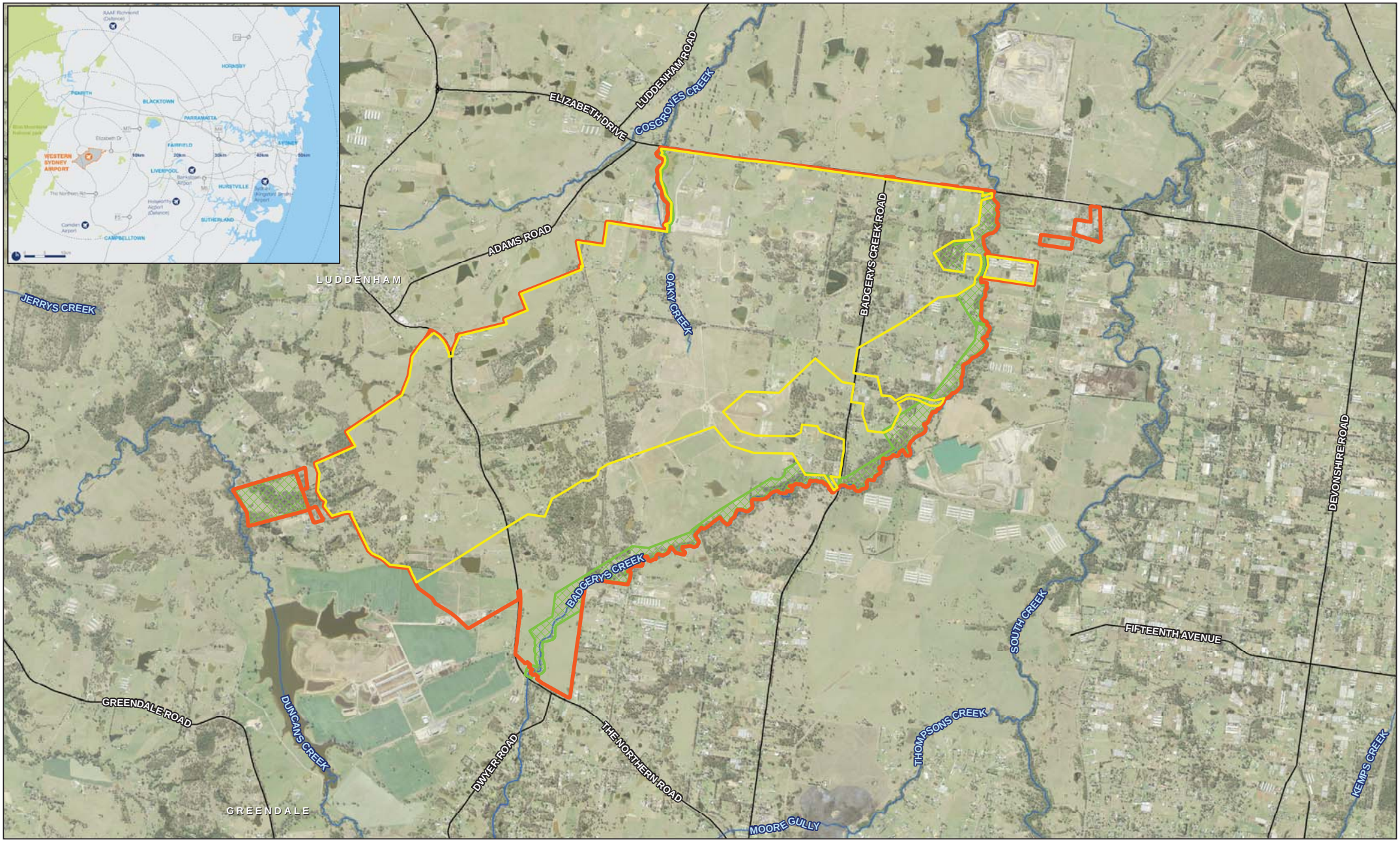
- confirmation of the quantum of impacts and biodiversity offsets required, based on offsets assessment guide calculations in accordance with the EPBC Act Offsets Policy and credit calculations with reference to the FBA for impacts on plants, animals and their habitat
- a description of known direct offsets and other compensatory measures that will be implemented
- an outline of the approach for delivering additional biodiversity offsets, including a description of the process that will be undertaken to identify potential offset sites and other compensatory measures.

2. Implementation of this BODP, including:
   - additional field surveys, assessment, consultation, confirmation of legal arrangements and payment of compensation as required to secure the known offsets presented in this BODP
   - additional field surveys, assessment and consultation as required to identify additional offsets, followed by the steps outlined above to secure those offsets
   - preparation of Implementation Audit Assessment reports to ensure independent verification of the effective implementation of the BODP.

The BODP requires approval from the Environment Minister or a Senior Executive Service (SES) employee in Environment and Energy prior to the commencement of Main Construction Works for the Stage 1 development of the 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 the TransGrid Relocation Works or Preparatory Activities (see Glossary).

This BODP takes into account the EPBC Act Offsets Policy, the offsets assessment guide and the FBA methodology. It has been prepared in consultation with Environment and Energy, the Biodiversity Experts Group (Experts Group) and other stakeholders, and having regard to an extensive review of submissions received on the airport EIS.



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

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LEGEND

- The airport site
- Environmental conservation
- Stage 1 Construction Impact Zone
- Watercourses
- Roads

Department of Infrastructure, Regional Development and Cities
Western Sydney Airport
Biodiversity Offset Delivery Plan

Job Number	21-26204
Revision	A
Date	13 Jul 2018

Development site location

Figure 1

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Data source: Topographic Features and Inset data - NSW LPI DTDB 2015, Airport layout data - WSU 2016, Aerial imagery - NSW LPI 2013. Created by:jrprice

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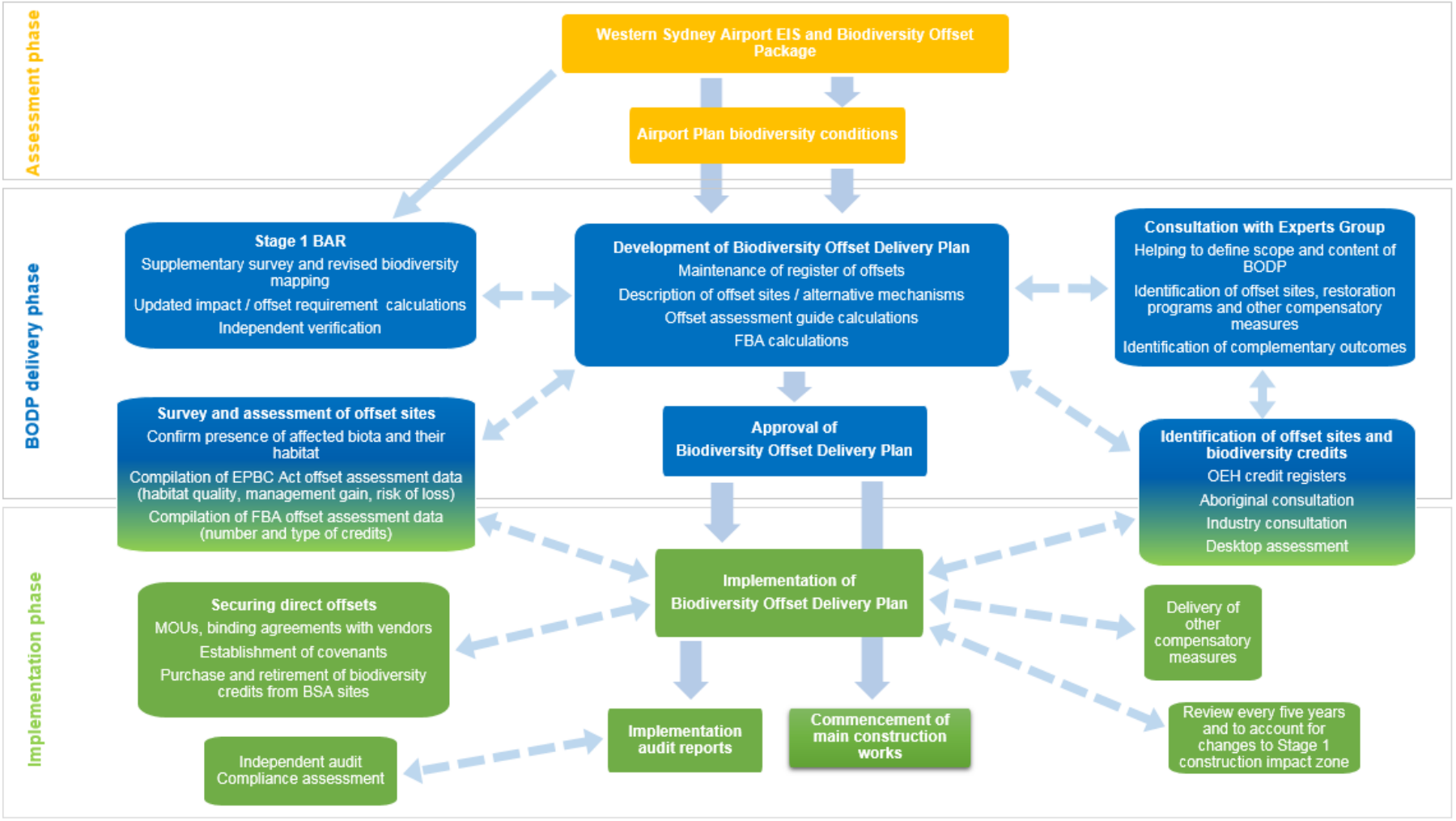
Figure 2 Development and implementation of the BODP



1.3 Stage 1 Construction Impact Zone

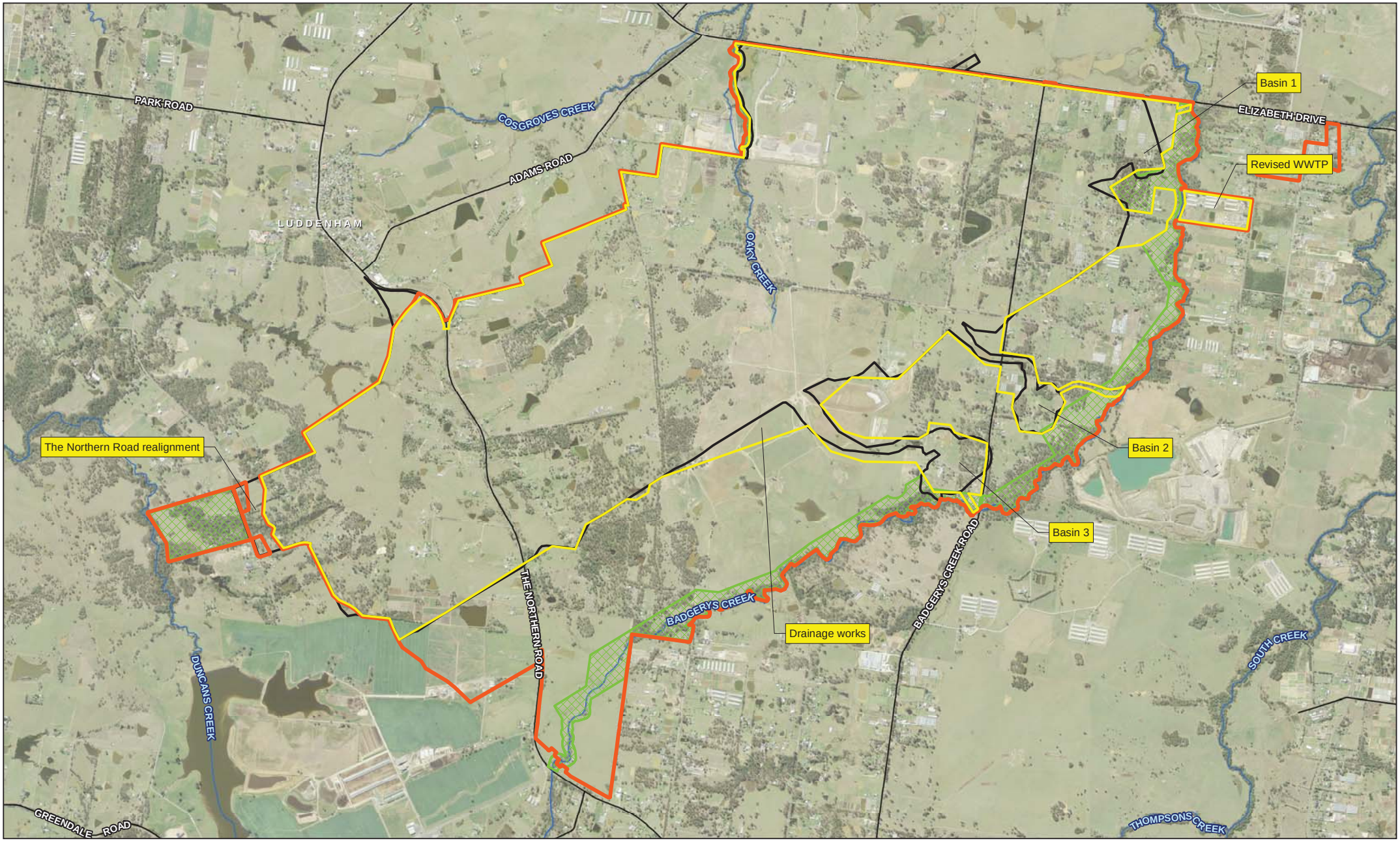
The Stage 1 Construction Impact Zone (CIZ) shown in the indicative airport layout has been subject to ongoing design development following the determination of the Airport Plan in December 2016. The CIZ incorporates a number of design changes to the indicative CIZ described in the Airport Plan and assessed in the Appendix K1 to the airport EIS (GHD 2016b) and the Stage 1 Biodiversity Assessment Report (BAR) (GHD 2017). This design development has resulted in the approval of the CIZ as part of a preliminary plan under Condition 2(3) of the Airport Plan. The *Western Sydney Airport Stage 1 Biodiversity Assessment Report Addendum* (Stage 1 BAR addendum, GHD 2018) has been prepared to update the impacts calculations to reflect the Stage 1 CIZ approved as part of a preliminary plan.

The differences between the approved Stage 1 CIZ and the indicative CIZ result in an overall marginal reduction in biodiversity impacts. The differences are shown in Figure 3 and include:

- expansion of the CIZ in relation to the flow paths required to transfer water from the detention basins to receiving waters comprising:
  - flow paths from basins 1, 2 and 3 to Badgerys Creek
  - flow path from Basin 6 to Oakey Creek
- a proposed bio-retention basin at the re-configured Basin 1
- earthworks in the vicinity of Basin 1 to enable remediation of the site topography through site contouring to smooth out undulations created by existing roads and old farm dams
- drainage works upstream of Basin 3 to ensure positive flow to the basin
- the site of the wastewater treatment plant and adjacent land
- exclusion of certain parcels from the airport site, which will be used for the disturbance footprint for the realignment of The Northern Road, which is the subject of a separate approval process
- fine-scale adjustments to the design of water management features and the construction area offset from the earthworks interface to reduce impacts on biodiversity values where possible.

The Stage 1 CIZ would result in additional impacts on biodiversity values at the locations of features that are required to provide for the treatment and detention of stormwater run-off from the airport site prior to release into surrounding waterways. The other changes to the CIZ from the indicative CIZ are located in disturbed, cleared land and would not result in any additional impacts on biodiversity values. Impacts, especially the removal of threatened ecological communities, have been reduced as far as possible by locating new disturbance areas within exotic vegetation areas and by reducing associated construction areas as far as possible.

Construction within the Stage 1 CIZ would result in direct impacts within a 1199.1-hectare disturbance footprint, including 359 hectares of native vegetation of varying quality. This compares with a 1153.6-hectare disturbance footprint, including 359.6 hectares of native vegetation, within the indicative Stage 1 CIZ (GHD 2017).



Paper Size A3

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Metres

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

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LEGEND

- The airport site
- Environmental conservation
- Stage 1 Construction Impact Zone
- Indicative Stage 1 Construction Impact Zone
- Watercourses
- Roads

Department of Infrastructure, Regional Development and Cities
Western Sydney Airport
Biodiversity Offset Delivery Plan

Job Number	21-26204
Revision	A
Date	13 Jul 2018

Stage 1 Construction Impact Zone

Figure 3

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Data source: Topographic Features and Inset data - NSW LPI DTDB 2015, Airport layout data - WSU 2016, Aerial imagery - NSW LPI 2013. Created by:jrprice

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The calculation of offset requirements for affected threatened biota presented in Chapter 2 of this BODP is based on the description of the existing environment of the airport site provided by the Stage 1 BAR (GHD 2017) but includes updated impact area calculations from the Stage 1 BAR addendum. An addendum was determined to be the most appropriate method of updating the Stage 1 BAR, due to the similarity of the existing environment of the Stage 1 CIZ assessed in the Stage 1 BAR Addendum to the CIZ assessed in the Stage 1 BAR, as well as the overall marginal reduction in biodiversity impacts.

The Stage 1 BAR addendum included updated FBA calculations for the quantum of biodiversity offsets required for impacts on plants, animals and their habitats in the Stage 1 CIZ. These are summarised in Chapter 3 below.

The Stage 1 BAR addendum was independently verified in accordance with Condition 30(4)(c) of the Airport Plan.

1.4 Purpose and structure of this report

This BODP report outlines the approach to the delivery of biodiversity offsets for the airport and includes:

- identification of the affected threatened biota listed under the EPBC Act that require biodiversity offsets under the EPBC Act Offsets Policy and a description of the extent and magnitude of impacts (Chapter 2)
- an estimate of the quantum of biodiversity offsets required for residual impacts on plants, animals and their habitat, including threatened biota listed under the BC Act, as calculated with reference to the FBA and using the credit calculator for a major project (Chapter 3)
- the approach to consultation with the Experts Group and with Aboriginal stakeholders (Chapter 4)
- an overview of the Experts Group's advice on specific offset measures (Chapter 5)
- a description of known direct offset sites (Chapter 6), including:
  - a description of the existing environment of the site, including the extent and quality of habitat for the affected threatened biota
  - the conservation and management framework that would be applied at the site
  - the quantum of offset that would be delivered for affected threatened biota as calculated with the EPBC Act offsets guide
  - the quantum of offset that would be delivered for plants, animals and their habitats based on the number and type of biodiversity credits that would be purchased and retired from a BSA site or the credit equivalent
  - the anticipated cost and timeframe for securing offsets
- a description of known other compensatory measures (Chapter 7), including:
  - a description of the offset proposal, including the scope of works, responsible parties and how it would benefit the affected threatened biota
  - the monitoring and reporting framework that would be applied to the proposal
  - the quantum of offset that would be delivered for affected threatened biota as calculated with the EPBC Act offsets guide

  - the quantum of offset that would be delivered for plants, animals and their habitats based on an equivalent percentage discount to the matching biodiversity credit requirement
  - the anticipated cost and timeframe for delivering the proposal
- the approach and criteria for identifying additional offset contributions, including:
  - offset sites with biodiversity credits that are available for sale
  - existing or potential offset sites that would generate suitable biodiversity credits, or direct offsets secured through another mechanism, in the future
  - restoration and conservation programs delivered on land that cannot be practically secured under a conservation covenant
  - other compensatory measures (sections 6.2 and 7.4)
- the approach to implementing the BODP (Section 8.2)
- concluding statements demonstrating compliance with the Airport Plan conditions and that the BODP for the airport, when implemented, would improve or maintain the viability of the protected matters (Section 9).

1.5 Airport Plan conditions

Section 3.10 of the Airport Plan sets out the conditions to be complied with in relation to the Stage 1 development, including the conditions specified in the notice given by the Environment Minister in response to a draft Airport Plan. These conditions include the preparation of this BODP. Conditions that relate to the requirement for the Stage 1 BAR and its content are detailed in Table 1.1 along with reference to where each condition is addressed in this BODP and related reports.

Table 1.1 Airport Plan conditions related to the BODP

No.	Environmental Condition	Where addressed in this BODP and related reports
30.(1)	The Infrastructure Department must: (a) prepare; and (b) submit to an Approver for approval; a Biodiversity Offset Delivery Plan in relation to the carrying out of the developments described in Part 3 of the Airport Plan.	This BODP report.

No.	Environmental Condition	Where addressed in this BODP and related reports
30.(2)	The criteria for approval of the Biodiversity Offset Delivery Plan are that an Approver is satisfied that the Biodiversity Offset Delivery Plan: (a) takes into account: (i) sections 28.5.3.3 to 28.5.3.5 in Chapter 28 of the EIS; and (ii) the Biodiversity Offset Package in volume 4 of the EIS; and (iii) the EPBC Act Environmental Offsets Policy issued by the Environment Department in October 2012; and (b) is otherwise appropriate.	These requirements are referenced throughout this report and summarised in Sections 1.2 and 8. Consistency with these criteria is demonstrated in Chapter 9.
30.(3)	The Site Occupier must not commence Main Construction Works until the Biodiversity Offset Delivery Plan has been approved in accordance with this condition.	This BODP report.
30.(4)	The Biodiversity Offset Delivery Plan must be based on and informed by a Biodiversity Assessment Report that:	
	(a) includes the results of an updated ecological survey that has applied the field survey methodology of the FBA for areas within the Construction Impact Zone;	Section 4, Section 5, Section 6 in the Stage 1 BAR (GHD 2017). Results are summarised in chapters 2 and 3 of this BODP.
	(b) has had regard to the key diagnostic characteristics and condition thresholds specified in the Commonwealth Listing Advice on Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest (Threatened Species Scientific Committee, 2008), particularly regarding patch size and contiguous native vegetation; and	Section 3.3.2 and Section 4.5.1 in the Stage 1 BAR (GHD 2017). Results are summarised in Chapter 2 and 3 of this BODP.
	(c) has been independently verified by a person accredited in accordance with section 142B(1)(c) of the *Threatened Species Conservation Act 1995* (NSW), appointed following consultation with OEH.	Section 8 in the Stage 1 BAR (GHD 2017).
30.(5)	The Biodiversity Offset Delivery Plan must be prepared by a Suitably Qualified Expert.	This report has been prepared by GHD's nominated Suitably Qualified Expert whose qualifications are presented in Section 1.8.

No.	Environmental Condition	Where addressed in this BODP and related reports
30.(6)	The Biodiversity Offset Delivery Plan must:	
	(a) be consistent with the EPBC Act Environmental Offsets Policy (2012) to the satisfaction of the Approver, including in particular: (i) offsets must deliver an overall conservation outcome that improves or maintains the viability of the protected matter;	This requirement is considered in the description of offset proposals throughout this report and summarised in Chapter 8. Consistency with specific criteria is demonstrated in Chapter 9.
	(ii) offsets must be built around direct offsets but may include other compensatory measures (including that the offsets must be like-for-like);	Chapter 6, Direct Offsets and Chapter 7, Other Compensatory Measures.
	(iii) offsets must be additional to what is already required, determined by law or planning regulations, or agreed to under other schemes or programs; and (iv) the identification of offsets must be informed by scientifically robust information and incorporate the precautionary principle in the absence of scientific certainty;	This requirement was considered in the process of identifying offset proposals documented throughout this report and summarised in Chapter 8. Consistency with specific criteria is demonstrated in Chapter 9.
	(b) include measures to offset impacts on foraging habitat for the Swift Parrot (*Lathamus discolor*) in addition to those species and ecological communities listed in the Biodiversity Offset Strategy provided as part of the EIS;	Offset requirements for removal of Swift Parrot foraging habitat are documented in Section 2.2.3. Offset contributions are described in chapters 6 and 7; the total quantum of offset is presented in Chapter 8.
	c) identify biodiversity credits (or other measure as appropriate) required to offset the total impacts of the Stage 1 development on biodiversity, determined in accordance with the relevant policies;	Offset requirements are documented in Section 3. Offset contributions are described in chapters 6 and 7; the total quantum of offset is presented in Chapter 8.

No.	Environmental Condition	Where addressed in this BODP and related reports
	(d) provide evidence that the required biodiversity credits (or other measure as appropriate) can be secured in accordance with the relevant policies;	The total quantum of offset that is known or anticipated to be implemented according to this BODP is presented in Chapter 8. The process for securing direct offset contributions is presented in Section 8.2, and the process for implementing other compensatory measures is presented in Section 8.2.
	(e) provide evidence that the arrangements for managing the direct offsets will be provided through mechanisms that are enduring, enforceable and auditable; and	This requirement was considered in the process of identifying offset proposals documented throughout this report and summarised in Chapter 8 Sections 8.2.1 and 8.2.3.
	(f) if any other compensatory measures are proposed, provide details of those measures along with a justification of why they should be considered acceptable.	Chapter 7, Other compensatory measures.
30.(7)	The Biodiversity Offset Delivery Plan should capitalise wherever possible on opportunities to improve connectivity or contribute to Commonwealth, state or local government initiatives to secure offsets with strategic value.	This requirement was considered at all stages of the process of identifying and assessing the offset proposals described in chapters 6 and 7 and was a particular focus for the Experts Group as documented in Section 4.1 and Chapter 5.
30.(8)	In preparing the Biodiversity Offset Delivery Plan, the Infrastructure Department must consult with local Aboriginal Land Councils and Aboriginal groups in Western Sydney, to identify complementary outcomes for biodiversity conservation and Aboriginal cultural heritage on the Cumberland Plain.	This requirement was considered at all stages of the process of identifying and assessing the offset proposals described in chapters 6 and 7 as well as the Aboriginal stakeholder consultation program documented in Section 4.2.

No.	Environmental Condition	Where addressed in this BODP and related reports
30.(9)	The Infrastructure Department must provide the Environment Department with Shapefiles identifying the location and boundaries of each direct offset site within three months of legally securing and establishing management arrangements for the site, unless otherwise approved by an Approver.	Section 8.2
30.(10)	The Infrastructure Department must implement the approved Biodiversity Offset Delivery Plan on behalf of the Commonwealth.	Chapter 8
30.(11)	The Infrastructure Department must: (a) ensure that an independent audit of its compliance with condition 30(10) is conducted in respect of; (i) the 12-month period commencing with the approval of the Biodiversity Offset Delivery Plan; and (ii) each subsequent 18-month period until all biodiversity offsets required by the Biodiversity Offset Delivery Plan have been secured or implemented; and (b) submit a report of each audit that is carried out to the Environment Department within six months of the end of the period in respect of which the audit was conducted.	Chapter 1, Chapter 8
30.(12)	For each audit, the independent auditor must be approved by an Approver prior to the commencement of the audit. Audit criteria must be agreed to by an Approver and the audit report must address the criteria to the satisfaction of an Approver.	Not applicable until after the BODP is approved.
30.(13)	If there is a change to the Construction Impact Zone after the Biodiversity Offset Delivery Plan is approved, a variation of the Biodiversity Offset Delivery Plan in relation to that change must be prepared by the Infrastructure Department and submitted for approval in accordance with condition 41 (Variation of Approved Plans), unless an Approver decides that the change is not material to biodiversity offset requirements.	Not applicable until after the BODP is approved.
30.(14)	The Infrastructure Department must review the Biodiversity Offset Delivery Plan every five years to ensure that the Biodiversity Offset Delivery Plan continues to meet the approval criteria for that plan. The Infrastructure Department must provide a report on the review to the Environment Minister. If the plan does not continue to meet the approval criteria, within three months of the provision of the report, the Infrastructure Department must prepare and submit for approval under condition 41(1), a variation to the Approved Plan to ensure it continues to meet the approval criteria.	Not applicable until five years after the BODP is approved.

No.	Environmental Condition	Where addressed in this BODP and related reports
30.(15)	The Environment Minister may: (a) vary an approved Biodiversity Offset Delivery Plan; or (b) request in writing that the Infrastructure Department prepare and seek approval for a specified variation of an approved Biodiversity Offset Delivery Plan in accordance with condition 41(1), if the Environment Minister believes on reasonable grounds that: (c) this condition 30 has been contravened; and (d) the variation or the request for a specified variation (as the case may be) will address the contravention.	Not applicable until after the BODP is approved.

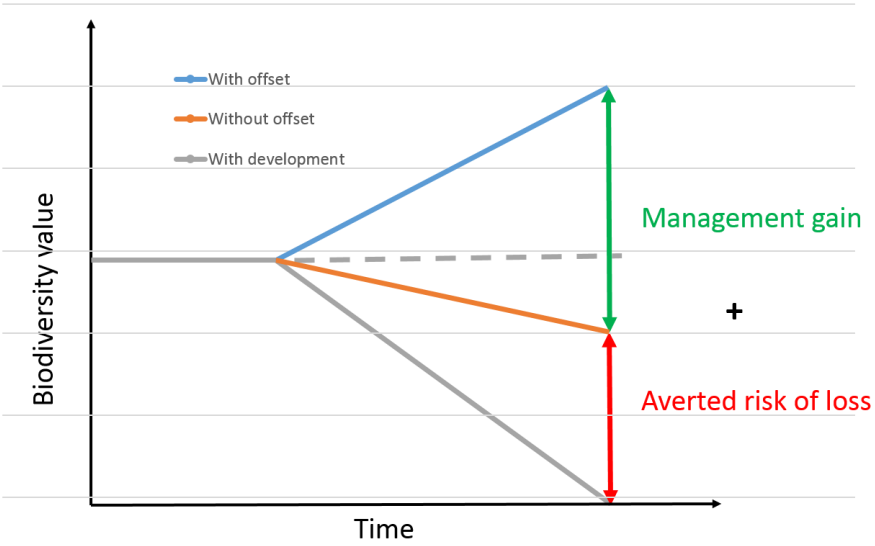
1.6 Methodology for calculating and securing offset contributions

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 uses 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% direct offset except in limited circumstances specified in the policy. 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 through:

- a management gain delivered by measures that:
    - improve existing habitat
    - create new habitat
    - reduce threats
- averting the loss of a protected matter or its habitat that is under threat.

Figure 4 illustrates how a biodiversity offset delivers a conservation gain (ie an increase in biodiversity value over time) through a combination of a management gain and the averted risk of loss.

Figure 4 Conceptual model for offset calculations



The majority of the direct offsets for the 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 resources, mitigation of threats and averted risk of loss through development or agricultural activities. A single offset area can compensate for impacts on multiple threatened biota if they have common habitat requirements (DSEWPaC 2012b). Therefore, some offset areas at potential offset sites would contribute to meeting EPBC Act Cumberland Plain Woodland, Grey-headed Flying-fox and Swift Parrot foraging habitat offset requirements.

Preliminary offsets assessment guide calculations have been performed based on the significant residual impacts on affected threatened biota documented in Chapter 2 and the likely conservation and management of offset sites identified in Chapter 6. The attributes of the potential offset sites described in Chapter 6 have been used as a guide to the quantum of offset required for the airport and to demonstrate that offset areas are currently available that would substantially meet this requirement. The quality of habitat for the affected threatened biota at offset sites has been estimated through desktop assessments and preliminary field surveys and with reference to relevant listing and conservation advice.

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. In accordance with Airport Plan conditions 30(2)(a)(ii) and 30(4)(a), the impacts of the airport on plants, animals and their habitat were assessed with reference to the FBA and using the associated credit calculator.

Aside from Orchard Hills, which is secured under the EPBC Act framework, offset sites will generally be secured using a conservation covenant, and an appropriate biodiversity management framework would then be implemented. The NSW BOS and BAM (formerly known as BioBanking) provides a mechanism for biodiversity offset sites to be securely titled under a legally binding conservation covenant known as a BSA (formerly known as a BioBanking agreement). This system expresses the conservation gain delivered through conservation and management of the offset site in terms of biodiversity credits and provides rules for the like-for-like trading of credits to offset the impacts of a development.

If the offset sites are secured under a BSA then the number and type of biodiversity credits that are linked to the offset areas for the affected threatened biota would be purchased and retired. This outcome will be achieved either through identification of suitable offset areas and completion of a BSA assessment to secure a new offset site, or purchase of biodiversity credits from existing BSA sites that contain habitat for the affected threatened biota. If an offset site is conserved under an alternative mechanism (including the Orchard Hills offset site), the quantum of offset would be expressed in terms of the biodiversity credit equivalent. This can be readily achieved by subjecting the offset site to a notional BioBanking or BAM assessment and credit calculations without submitting a formal application for a BSA to the NSW Office of Environment and Heritage (OEH).

The biodiversity credits that are purchased and retired for affected threatened biota (or credit equivalent secured through other means) will also be used to provide offsets for impacts on the plants, animals and their habitat as calculated in Chapter 3. Additional biodiversity offsets will be required to provide for impacts on species and communities not listed under the EPBC Act and to fully offset significant impacts on plants, animals and their habitat not otherwise accounted for through the credits purchased for affected threatened biota. If these offsets are associated with BSA sites, the offsets will be secured through purchase and retirement of matching biodiversity credits. If secured through other means, the credit equivalent will be calculated with a notional BAM/BioBanking assessment as described above.

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' (DSEWPaC 2012a). Suitable measures have been identified in consultation with Environment and Energy and the Experts Group and are described in Chapter 7.

The summary of compensatory measures presented in Chapter 7 includes detailed consideration of how each proposed measure will improve the viability of protected matters and how these conservation gains have been calculated using the offset assessment guide. This offset contribution is expressed as a percentage offset contribution to the total requirement for each affected protected matter, along with justification for how the value was derived. If the compensatory measure also contributes to the offset requirement for plants, animals and their habitats then this offset contribution has also been presented as an estimate of the credit equivalent for each class of biodiversity credit linked to the proposal outcomes. These estimates have been obtained by assuming that the percentage offset calculated using the offsets assessment guide is equal to an equivalent percentage of the total biodiversity credit requirement for the affected biota.

The BODP will be implemented by the Department in accordance with Condition 30(10) of the Airport Plan. The direct offsets and other compensatory measures that have been delivered will be specified in BODP Implementation Audit Reports. The offsets assessment guide calculations and biodiversity credit calculations will be updated and finalised in the BODP Implementation Audit Reports, based on specific data for individual offset sites. The precise quantum of offset delivered will be specified in BODP Implementation Audit Reports that will be prepared 12 months after the approval of this plan and at the conclusion of each 18-month period thereafter until the full quantum of offset has been secured.

The Department will track the total quantum of biodiversity offset delivered through implementation of the BODP until 100% of the offset requirement for affected threatened biota has been secured and the full suite of biodiversity credits to offset impacts on plants, animals and their habitats has been purchased and retired from BSA sites, or an equivalent offset has been delivered through other means. The offset proposal presented in Chapter 8 demonstrates how the biodiversity offsets presented in this BODP would secure the full quantum required to maintain the viability of the biota impacted by the airport in accordance with the EPBC Act offset policy.

1.7 Relationship with other reports

This BODP should be read in conjunction with the *Western Sydney Airport Stage 1 Biodiversity Assessment Report* (GHD 2017) (the Stage 1 BAR) and the *Western Sydney Airport Stage 1 Biodiversity Assessment Report Addendum* (Stage 1 BAR addendum, GHD 2018).

The Stage 1 BAR:

- 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 airport based on the indicative CIZ contained in the Airport Plan
- assesses the potential impacts arising from the construction and operation of the airport
- recommends measures to avoid or mitigate impacts consistent with the Airport Plan
- assesses the significance of residual impacts on affected threatened biota and other protected matters (GHD 2017).

The Stage 1 BAR addendum updates the impact assessment and offset calculations presented in the Stage 1 BAR to account for the approved Stage 1 CIZ (GHD 2018).

This BODP takes into account the Stage 1 development impact assessment and mitigation measures presented in the Stage 1 BAR and addendum to calculate the quantum of significant residual impacts that require biodiversity offsets.

This BODP takes into account the biodiversity offset package report (offset package), which was prepared to support the EIS for the airport (GHD 2016a).

The information presented in the offset package was compiled from the *Western Sydney Airport Biodiversity Assessment* (Appendix K1 to the airport EIS, GHD 2016b) (Biodiversity Assessment) and the *Western Sydney Airport Environmental Impact Statement* (GHD 2016c).

The airport EIS provided:

- a detailed description of the proposed construction and operation of the Stage 1 development, and an overview of a potential longer term development
- an assessment of 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
- measures to manage impacts (GHD 2016c).

This BODP relies on the environmental assessment and mitigation measures presented in the airport EIS to inform the assessment of potential impacts on biodiversity values. This includes inputs from specialist disciplines, such as hydrology or noise, that were beyond the scope of the Stage 1 BAR (GHD 2017).

This BODP will be implemented by the Department in accordance with Condition 30(10) of the Airport Plan. The direct offsets and other compensatory measures delivered will be specified in BODP Implementation Audit Reports that will be prepared 12 months after the approval of this plan and at the conclusion of each 18-month period thereafter until the full quantum of offset has been secured. The final quantum of biodiversity offsets delivered for the airport would be determined on the basis of information presented in this BODP and detailed biodiversity assessments for offset sites and program delivery reports for other compensatory measures as summarised in the BODP Implementation Audit Report(s).

1.8 Qualifications

Ben Harrington is the Suitably Qualified Expert responsible for the preparation of the BODP in accordance with Airport Plan Condition 30(5). Ben is the technical lead of GHD's biodiversity offset group and an accredited assessor under the NSW BC Act. He has extensive experience preparing biodiversity offset assessments for major projects in accordance with the EPBC Act Offsets Policy, FBA and NSW Environmental Offsets Policy. Ben is a recognised industry specialist in the application of the former BioBanking assessment methodology and in developing offset strategies.

Ben has over 15 years of experience conducting ecological surveys and assessments in NSW, including over 13 years of experience in environmental consulting. He has extensive field survey and project experience on the Cumberland Plain.

Qualifications of staff that provided input to this BODP or undertook recent field surveys and provided inputs to the Stage 1 BAR are provided in Table 1.2. Flora and fauna surveys were conducted under a Section 132C scientific licence (SL100146) issued under the NSW *National Parks and Wildlife Act 1974* and complied with GHD's animal ethics Research Authority requirements.

Table 1.2 Qualifications of staff

Name	Position/Role	Qualifications	Years' experience
Ben Harrington (GHD)	Technical Director – Biodiversity / technical lead for offset assessments, site surveys, credit calculations and reporting	BSc, MSc (Physical Geography) NSW BAM Assessor Accreditation (number 0073)	15+ years
Jayne Tipping (GHD)	Technical Director – Biodiversity / direction and technical review	BSc, MEnvLaw	23+ years
Malith Weerakoon (GHD)	Graduate Ecologist / desktop assessment, site surveys, data processing.	BSc, MPhil. (Zoology)	6+ years

Name	Position/Role	Qualifications	Years' experience
Dan Williams (GHD)	Technical Director – Environmental science / offset vendor consultation and technical review	B. App. Sc. NSW BAM Assessor Accreditation	17+ years
Elle Davidson (GHD)	Indigenous Engagement Leader / Aboriginal stakeholder consultation	BPlan GradCert Indig Engage (current)	10 years
Kath Chesnut (GHD)	Senior Ecologist / site surveys	BEnvSc (Hons) Bush Regeneration Cert 2 NSW BAM Assessor Accreditation	9+ years
Hannah Urwin (GHD)	Graduate Environmental Scientist / site surveys	BSc (Plant science)	2+ years
Alex Cockerill (WSP)	Ecology National Team Executive / Independent verifier	BSc (Hons) NSW BAM Assessor Accreditation	20+ years

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 (ie 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 airport. Assessments of the likely significance of impact on EPBC Act-listed biota with the potential to be affected by the airport were 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 and the Stage 1 BAR, GHD 2017).

The outcome of these assessments as outlined in the conditions to the Airport Plan is that biodiversity offsets are required for:

- 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 airport would require the permanent removal of 141 hectares of vegetation within the local occurrence of Cumberland Plain Woodland as shown on Figure 6. 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 airport is likely to have a significant impact on the local and regional occurrence of Cumberland 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.
- Grey-headed Flying-fox, which is listed as a vulnerable species under the EPBC Act and has been observed at the airport site. Construction of Stage 1 of the airport would remove 187.8 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 airport will further fragment foraging habitat for this species within an already highly fragmented landscape.
- Swift Parrot foraging habitat, as the Swift Parrot (*Lathamus discolor*) may occur in the Stage 1 Construction Impact Zone (CIZ) on occasion during its winter migration, although it was not detected during targeted surveys. This species is listed as a critically endangered species under the EPBC Act. Construction of Stage 1 of the airport would remove 187.8 hectares of potential winter foraging habitat for the Swift Parrot. The airport will further fragment foraging habitat for this species within an already highly fragmented landscape.

- Spiked Rice-flower (*Pimelea spicata*), which is listed as an endangered species under the EPBC Act. A total of 4118 clumps of *Pimelea spicata* were recorded at the airport site in March–April 2017, including many flowering plants. Stage 1 of the airport is likely to have a significant impact on *Pimelea spicata* through the complete removal of this population and 2.94 hectares of occupied habitat.

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

The Stage 1 CIZ at the airport site is part of an elevated ridge system dividing the Nepean River and South Creek catchments on the Cumberland Plain. The dominant geological formations beneath the Stage 1 CIZ are Bringelly Shale, the Luddenham Dyke and Alluvium (Bannerman & Hazelton 1990).

Field surveys conducted in accordance with the NSW FBA methodology confirmed the presence and distribution of five NSW plant community types (PCTs) at the airport site. Stands of these PCTs include near-intact vegetation in moderate/good to high condition, partially cleared or regrowth vegetation in moderate/good to poor condition and extensively modified areas in low condition (according to the FBA (OEH 2014a)). Accordingly, 12 vegetation zones (plant community types and broad condition classes) were identified and mapped at the airport site, as shown on Figure 5.

Grey Box – Forest Red Gum grassy woodland on flats is associated with mid and lower slopes, on shale-derived soils across the Stage 1 CIZ and is the most extensive native plant community type. It comprises an open forest or woodland of Forest Red Gum (*Eucalyptus tereticornis*) and Grey Box (*Eucalyptus moluccana*) with a grassy understorey and occasional dense patches of the shrub species Native Blackthorn (*Bursaria spinosa spinosa*). Steeper, more undulating terrain at the site contains Grey Box – Forest Red Gum grassy woodland on shale, which features similar over-storey and mid-storey species but a different suite of shrubs, herbs and grasses in the understorey. There are poor condition forms of both of these PCTs at the site comprising derived native grassland or Native Blackthorn scrub.

There are small areas of tertiary gravel influenced soils in the east of the Stage 1 CIZ that support Broad-leaved Ironbark – Grey Box – *Melaleuca decora* grassy open forest with a canopy of Forest Red Gum and Grey Box along with Broad-leaved Ironbark (*Eucalyptus fibrosa*), a characteristic mid storey of Honey Myrtle (*Melaleuca decora*) and a shrub and grass understorey. Poor condition Broad-leaved Ironbark – *Melaleuca decora* grassy open forest comprises a derived scrub or shrubland form of this plant community type.

Larger patches in better condition 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 (TSSC 2009, DEWHA 2010). Specifically each of the patches of the CEEC feature characteristic native tree species with projective foliage cover of greater than 10% and are greater than 0.5 hectares in area and:

a) greater than 50% of the groundcover present is native; or

b) greater than 30% of the groundcover present is native and part of a contiguous patch of native vegetation greater than five hectares in area or the patch has at least one tree with hollows or tree with diameter at breast height greater than 80cm per hectare.

A 'patch' was defined as a discrete and continuous area that comprises the ecological community (based on canopy cover and native groundcover as defined above). 'Contiguous vegetation' was defined as an area of predominantly native vegetation, including derived grassland or scrub that is within 100 metres of a patch of the community. Both patch size and the distance between patches and remnant vegetation were calculated with geographic information systems (GIS). Additional detail about the methodology for identifying the CEEC is provided in Section 3 of the Stage 1 Biodiversity Assessment Report (BAR) (GHD 2017).

The condition of vegetation against these thresholds was measured with plot/transects and then extrapolated across other contiguous or structurally and floristically similar vegetation. Plot/transect data is presented in Appendix A of the Stage 1 BAR (GHD 2017).

Patches of woodland at the airport site that comprise an occurrence of EPBC Act Cumberland Plain Woodland are shown on Figure 6. There are 141 hectares of EPBC Act Cumberland Plain Woodland at the airport site.

Derived native grassland and other moderate/good to 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 less than 0.5 hectares in area, not contiguous with a native vegetation remnant at least five hectares in area and/or feature native groundcover less than 30% and so have also been excluded in accordance with the guidelines (DEWHA 2010).

Construction of Stage 1 of the airport would require the permanent removal of 141 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. Therefore an impact area of 141 hectares has been entered in the area of community field in the impact calculator section of each set of offsets assessment guide calculations for Cumberland Plain Woodland.

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 Airport Plan, includes around 117 hectares of land that is zoned EC 1 Environmental Conservation and that would be managed for biodiversity conservation. The environmental conservation zone would provide a buffer between edge effects arising from the 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 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 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 on-airport sources of contamination such as runways, storage areas and parking areas and sensitive receptors outside the airport site. Surface water features on the airport site 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 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 10 for offsets assessment guide calculations. Environment and Energy'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) (ie their relative contribution to the total score out of 10). The weighting of these three attributes for Cumberland Plain Woodland at the airport site was defined as follows:

- site condition – 50% 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% 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
- species stocking rate – 0% because this attribute is not directly relevant to threatened communities

Each characteristic was then scored based on the results of field surveys conducted in accordance with the FBA (GHD 2016a; GHD 2017) and supplementary desktop assessment conducted for this BODP. Site condition was scored as 6/10 based on consideration of the condition thresholds in the listing advice for the community (TSSC 2008), the 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 104.8 hectares out of the 141 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 only moderate and was above benchmark in just one of the four plot/transects sampled in this vegetation zone. 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. There are few hollow-bearing trees and only one was recorded in the plots sampled. There were generally low quantities of fallen woody debris, and none found in four of the 10 plots sampled. There is frequently high exotic plant cover (10% to 70% in plot/transects sampled, average 31% cover), mainly consisting of grasses and herbs in the understorey.

- Good condition Grey Box – Forest Red Gum grassy woodland on hills (HN529, around 35.5 hectares out of the 141 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, but moderate quantities of woody debris. There is frequently high exotic plant cover (26% to 44% 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 5.5 hectares out of the 141 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 occasional hollow-bearing trees and moderate quantities of fallen woody debris. This vegetation zone contains moderate to severe exotic plant cover, including 16% to 78% exotic plant cover along the transects sampled.

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. Patches of woodland are moderately to severely degraded by edge effects, notably through the average exotic plant cover of over 30% in the plots sampled. 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 weighted average of the inputs described above, 'Impact calculator – quantum of impact – quality' (ie 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 for offset proposals for EPBC Act Cumberland Plain Woodland included in this BODP and will be used to confirm the quantum of offset provided by longer term offsets. The link between the qualitative assessment provided above and the quantitative site quality scores is summarised in Table 2.1. Table 2.1 includes site quality scores for the impact area at the airport site and the 'current', 'future with offset' and 'future without offset' quality scores for the Defence Establishment Orchard Hills (Orchard Hills) offset site. Values in the table that relate to these various inputs to the offsets assessment guide calculations for the project are indicated in bold, along with a description of the attributes that define the given values at the airport site or at Orchard Hills and references to source documents. This confirms the consistency of the approach to scoring site quality between the impact and offset areas. Descriptions of the relevant attribute values for the range of site quality scores are provided for context.

Table 2.1 Offsets assessment guide site quality score values for Cumberland Plain Woodland

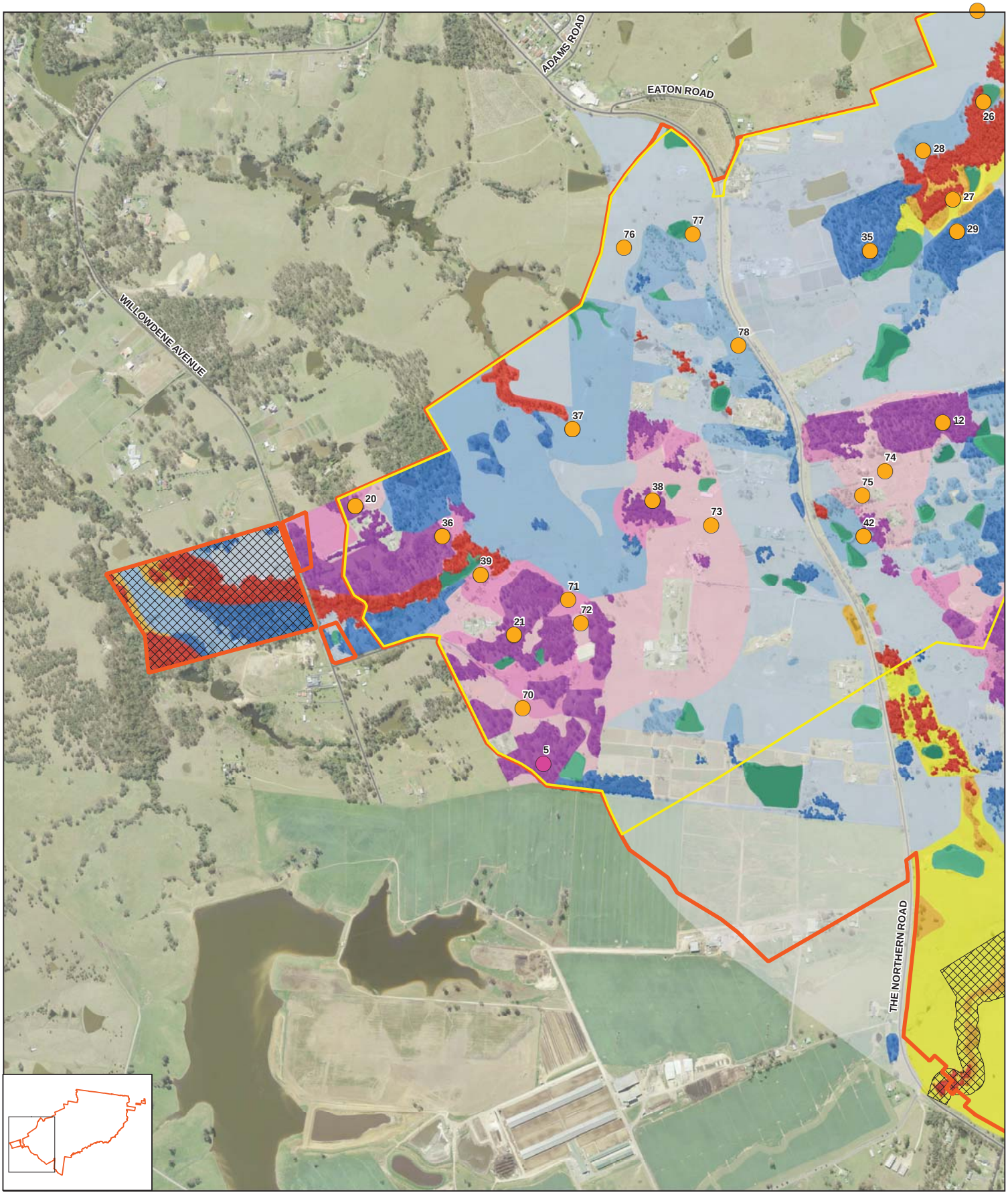
Score	Site condition values 50% of site quality score	Site context values 50% of site quality score
10	Undisturbed old growth patches of the community. Plant species richness, native vegetation cover and habitat attributes all at benchmark values including abundant over-mature and hollow-bearing trees.[1] Exotic plant cover very low to nil. Pest fauna and overabundant native herbivores absent or being actively suppressed.	Part of a continuous remnant patch of native vegetation greater than 500ha in area. Minimal clearing and fragmentation of habitat in the surrounding region.
9	**EPBC Act Cumberland Plain Woodland at Orchard Hills future condition with offset score** – a mix of mature regrowth and old growth patches of the community. Plant species richness, native vegetation cover and habitat attributes all at benchmark values including moderate numbers of over-mature and hollow-bearing trees.[2] Exotic plant cover very low. Pest fauna and overabundant native herbivores being actively suppressed.	**EPBC Act Cumberland Plain Woodland at Orchard Hills future context with offset score** – part of a near-continuous remnant patch of native vegetation greater than 500ha in area. Occasional less than 10m wide gaps in habitat associated with access tracks, fence lines etc. Widespread clearing and fragmentation of habitat in the surrounding region. Poorer quality Cumberland Plain Woodland and other gaps in habitat regenerated to improve connectivity.
8	A mix of mature regrowth and old growth patches of the community. Plant species richness and the majority of native vegetation cover and habitat attributes at or close to benchmark values including moderate numbers of over-mature and hollow-bearing trees. Exotic plant cover low. Pest fauna and overabundant native herbivores absent or being actively suppressed.	Part of a near-continuous remnant patch of native vegetation greater than 100ha in area. Occasional 10 to 100m wide gaps in habitat associated with localised clearing of vegetation, access tracks, fence lines, etc.

Score	Site condition values 50% of site quality score	Site context values 50% of site quality score
7	**EPBC Act Cumberland Plain Woodland at Orchard Hills start condition score** – a mix of mature regrowth and old growth patches of the community. Plant species richness and the majority of native vegetation cover and habitat attributes at or close to benchmark values including moderate numbers of over-mature and hollow-bearing trees. Exotic plant cover is low.[3] Pest fauna and overabundant native herbivores present. **Poorer quality Cumberland Plain Woodland at Orchard Hills future condition with offset score** – meets the EPBC Act Cumberland Plain Woodland condition thresholds. A mix of regrowth and mature regrowth with canopy cover greater than 10%. Plant species richness, native vegetation cover and habitat attributes all at benchmark values with the exception of low numbers of over-mature and hollow-bearing trees. Exotic plant cover very low. Pest fauna and overabundant native herbivores being actively suppressed.[4]	**EPBC Act Cumberland Plain Woodland at Orchard Hills start context score** – part of a near-continuous remnant patch of native vegetation greater than 100ha in area. Frequent 10 to 100m wide gaps in habitat associated with cleared land, access tracks, fence lines, etc. Remnant patches exposed to moderate edge effects and generally adjoin derived native grassland. **Poorer quality Cumberland Plain Woodland at Orchard Hills future context with offset score** – poorer quality Cumberland Plain Woodland regenerated to comprise regrowth patches within a near-continuous patch of native vegetation greater than 100ha in area. Occasional 10 to 100m wide gaps in habitat associated with less mature regrowth, access tracks, fence lines, etc. Remnant patches exposed to moderate edge effects and generally adjoin derived native grassland.

Score	Site condition values 50% of site quality score	Site context values 50% of site quality score
6	**EPBC Act Cumberland Plain Woodland at the airport site condition score** – meets the EPBC Act Cumberland Plain Woodland condition thresholds but plant species richness and native vegetation cover and habitat attributes frequently below benchmark values.[5] Low numbers of over-mature and hollow-bearing trees. Exotic plant cover moderate to high. Pest fauna and domestic exotic herbivores present.	**EPBC Act Cumberland Plain Woodland at the airport site context score** – part of a network of remnant patches of native vegetation 5 to 100ha in area. Fragmented by frequent greater than 100m wide gaps in habitat associated with extensive clearing of vegetation, sealed roads etc. Remnant patches exposed to moderate to severe edge effects including edges adjacent to dense exotic plant infestations.
	EPBC Act Cumberland Plain Woodland at Orchard Hills future condition without offset score – a mix of mature regrowth and old growth patches of the community. Plant species richness and native vegetation cover and habitat attributes frequently below benchmark values. Moderate numbers of over-mature and hollow-bearing trees with abundance declining along with senescence, dieback, low recruitment and inappropriate fire regimes. Exotic plant cover moderate. Pest fauna and domestic exotic herbivores present.	**EPBC Act Cumberland Plain Woodland at Orchard Hills future context without offset score** – part of a near-continuous remnant patch of native vegetation greater than 100ha in area. Frequent 10 to 100m wide gaps in habitat associated with access tracks, fence lines, etc. and more substantial barriers associated with sealed roads and other infrastructure. Remnant patches exposed to moderate to severe edge effects including edges adjacent to dense exotic plant infestations.
5	**Poorer quality Cumberland Plain Woodland at Orchard Hills start condition score** – does not meet the EPBC Act Cumberland Plain Woodland condition thresholds because of canopy cover less than 10% or is part of a remnant patch less than 0.5ha in area. Plant species richness and native groundcover at or close to benchmark values. Exotic plant cover moderate to low.[6] Pest fauna and overabundant native herbivores present.	**Poorer quality Cumberland Plain Woodland at Orchard Hills start context score** – comprises treeless gaps in habitat associated with partial clearing of vegetation contiguous with continuous remnant patches of native vegetation greater than 100ha in area.
4	**Poorer quality Cumberland Plain Woodland at Orchard Hills future condition without offset score** – does not meet the EPBC Act Cumberland Plain Woodland condition thresholds and plant species richness and/or most native groundcover and habitat attributes are below benchmark values. No hollow-bearing trees. Exotic plant cover moderate to high. Domestic exotic herbivores and/or pest fauna present.	**Poorer quality Cumberland Plain Woodland at Orchard Hills future context without offset score** – comprises treeless gaps in habitat associated with partial clearing of vegetation. Contiguous with near-continuous remnant patches of native vegetation 5 to 100ha in area. Includes edges adjacent to dense exotic plant infestations.

Score	Site condition values 50% of site quality score	Site context values 50% of site quality score
3	Does not meet the EPBC Act Cumberland Plain Woodland condition thresholds and plant species richness and native groundcover are below benchmark values. No mature or hollow-bearing trees. Exotic plant cover moderate to high. Domestic exotic herbivores and/or pest fauna present.	Part of an extensively fragmented landscape with all contiguous patches below 100ha in area and frequent greater than 100m wide gaps in habitat associated with extensive clearing of vegetation, sealed roads etc. Includes edges adjacent to dense exotic plant infestations.
2	Minimal native vegetation cover or habitat at the site. Domestic exotic herbivores and pest fauna present.	Minimal native vegetation cover or habitat at the site or the surrounding area.
1	No native vegetation cover or habitat at the site. Domestic exotic herbivores and pest fauna present.	No native vegetation cover or habitat at the site or the surrounding area.

Notes: 1) Benchmark values as for the relevant PCTs as defined in the NSW Vegetation Information System: Classification 2.1 (OEH 2018c). 2) Based on likely improvements in site condition along with active management outlined in Section 6.1.4 when compared with baseline condition recorded in plot/transects, observations against the EPBC Act condition thresholds completed in the site inspection of Orchard Hills and biodiversity monitoring data from the site (SKM 2014) as documented in sections 6.1.2 and 6.1.7 of the BODP. 3) As recorded in plot/transects, observations against the EPBC Act condition thresholds completed in the site inspection of Orchard Hills and biodiversity monitoring data from the site (SKM 2014) as documented in sections 6.1.2 and 6.1.7 of the BODP. 4) Based on likely improvements in site condition along with active management outlined in Section 6.1.4 when compared with baseline condition set in observations against the EPBC Act condition thresholds completed in the site inspection of Orchard Hills and biodiversity monitoring data from the site (SKM 2014) as documented in sections 6.1.2 and 6.1.7 of the BODP. 5) As recorded in plot/transects and observations against the EPBC Act condition thresholds at the airport site as documented in Section 4.2.2, Section 4.5.1 and Appendix A of the Stage 1 BAR (GHD 2017). 6) Based on observations against the EPBC Act condition thresholds completed in the site inspection of Orchard Hills and biodiversity monitoring data from the site (SKM 2014) as documented in sections 6.1.2 and 6.1.7 of the BODP.



LEGEND

- Airport site
- Stage 1 Construction Impact Zone
- Environmental conservation
- Plot/transect
- Rapid plot/transect

- 1 - Good condition Grey Box - Forest Red Gum grassy woodland on flats (HN528, Moderate/good - high)
- 2 - Poor condition Grey Box - Forest Red Gum grassy woodland on flats (HN528, Moderate/good - poor)
- 3 - Good condition Grey Box - Forest Red Gum grassy woodland on hills (HN529, Moderate/good - high)
- 4 - Poor condition Grey Box - Forest Red Gum grassy woodland on hills (HN529,Moderate/good - poor)
- 5 - Good condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526, Moderate/good - high)
- 6 - Poor condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526, Moderate/good - poor)
- 7 - Good condition Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest (HN512, Moderate/good - high)
- 8 - Poor condition Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest (HN512, Moderate/good - poor)
- 9 - Good condition artificial freshwater wetland on floodplain (HN630, Moderate/good)
- 10 - Low condition Grey Box - Forest Red Gum grassy woodland on flats (HN528, Low)
- 11 - Low condition Grey Box - Forest Red Gum grassy woodland on hills (HN529, Low)
- 12 - Low condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526, Low)
- 13 - Medium condition Grey Box - Forest Red Gum grassy woodland on flats (HN528, Moderate/good - medium)
- x - Cleared land or cropland

Paper Size A3

0 100 200 400

Metres

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

N

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Vegetation zones

Figure 5A

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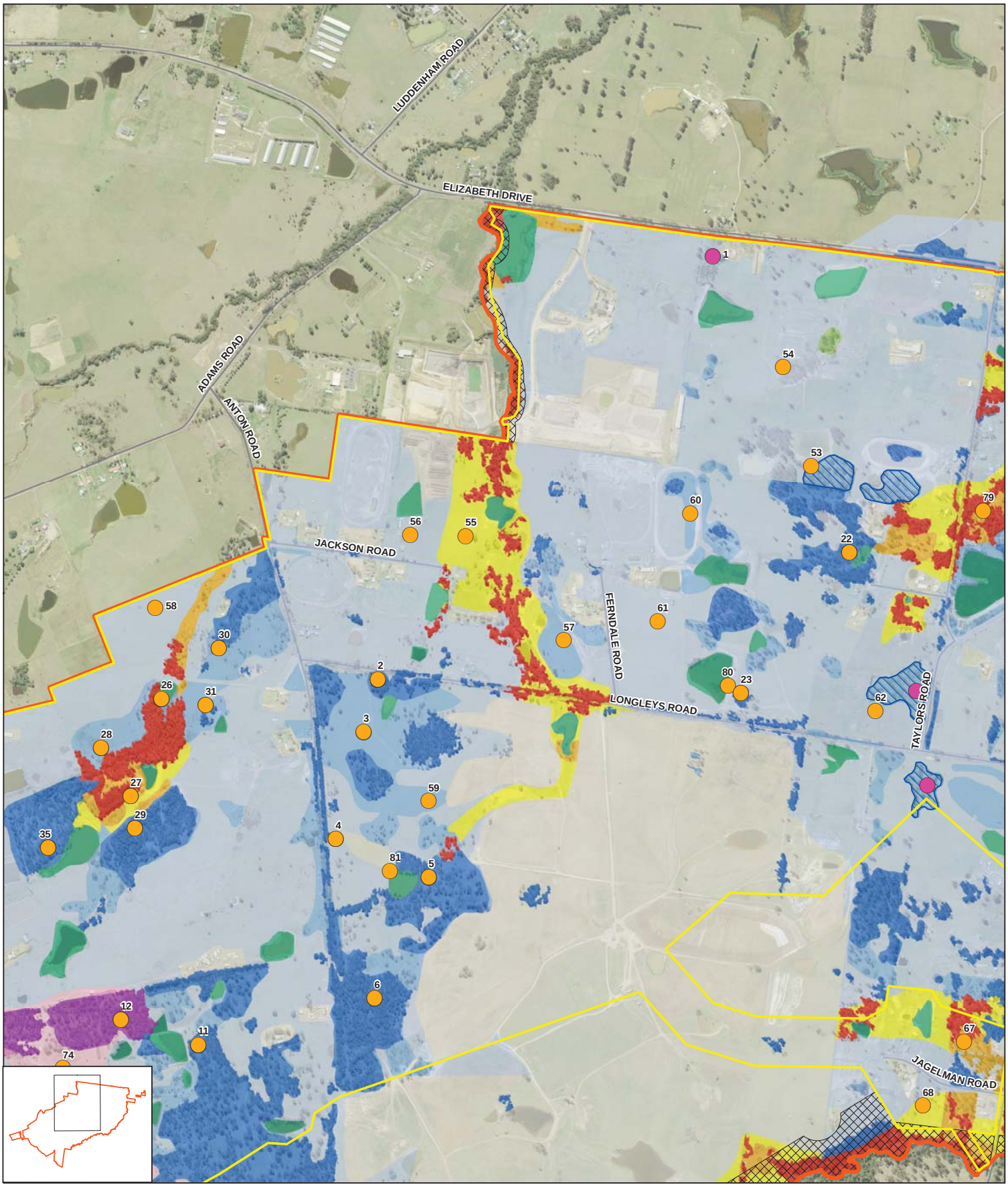
Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data source:Topographic Features - NSW LPI DTDB 2015, Airport layout data - WSU 2016, Aerial imagery - NSW LPI 2013, Vegetation mapping - OEH & GHD 2017, Ecological survey data - GHD 2017. Created by:jrprice



LEGEND

- Airport site
- Stage 1 Construction Impact Zone
- Environmental conservation
- Plot/transect
- Rapid plot/transect

- 1 - Good condition Grey Box - Forest Red Gum grassy woodland on flats (HN528, Moderate/good - high)
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- 13 - Medium condition Grey Box - Forest Red Gum grassy woodland on flats (HN528, Moderate/good - medium)
- x - Cleared land or cropland

Paper Size A3

0 100 200 400

Metres

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

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Revision A
Date 13 Jul 2018

Vegetation zones

Figure 5B

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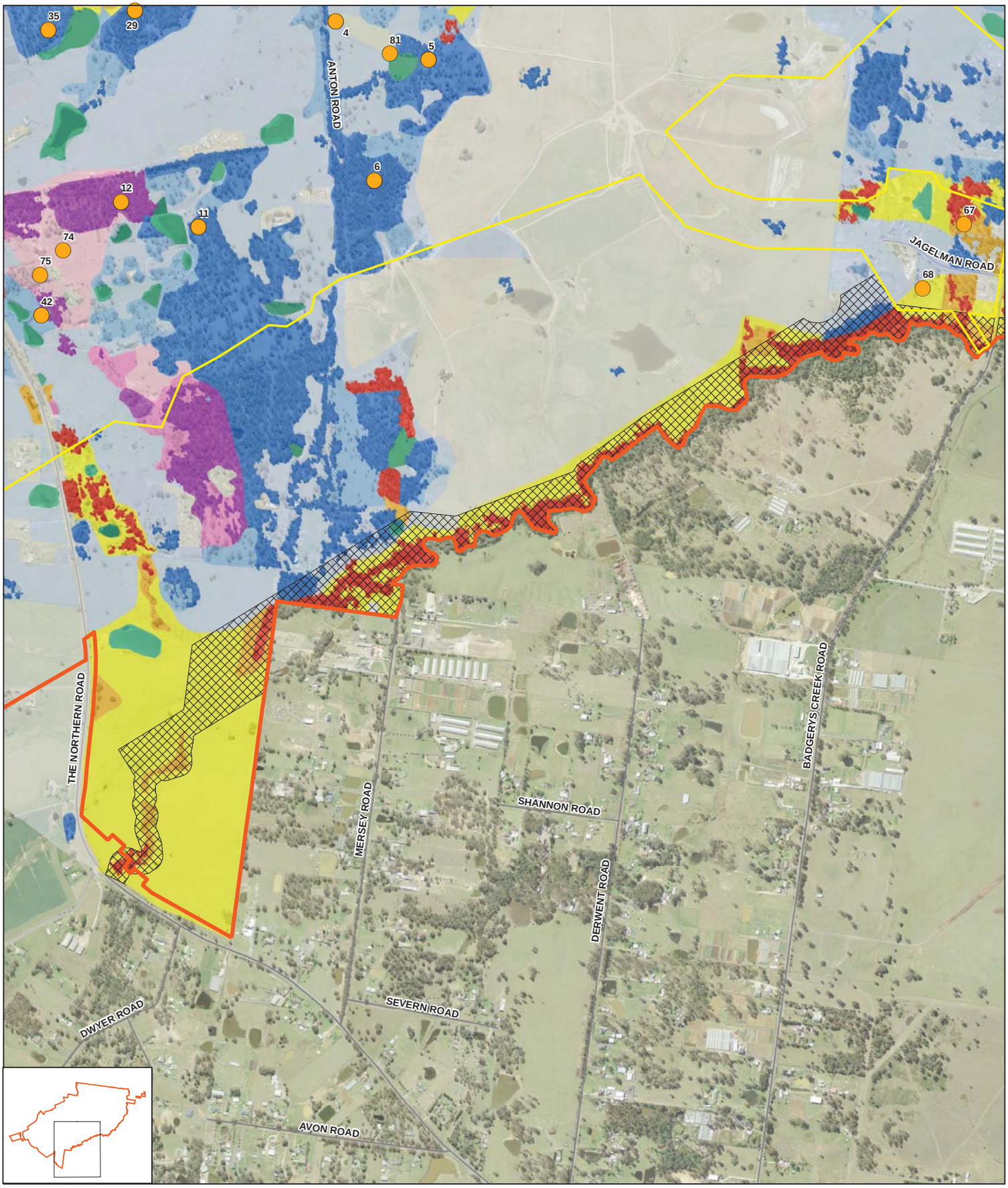
Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data source:Topographic Features - NSW LPI DTDB 2015, Airport layout data - WSU 2016, Aerial imagery - NSW LPI 2013, Vegetation mapping - OEH & GHD 2017, Ecological survey data - GHD 2017. Created by:jrprice



LEGEND

- Airport site
- Stage 1 Construction Impact Zone
- Environmental conservation
- Plot/transect
- Rapid plot/transect

- 1 - Good condition Grey Box - Forest Red Gum grassy woodland on flats (HN528, Moderate/good - high)
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- 4 - Poor condition Grey Box - Forest Red Gum grassy woodland on hills (HN529,Moderate/good - poor)
- 5 - Good condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526, Moderate/good - high)
- 6 - Poor condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526, Moderate/good - poor)
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- 12 - Low condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526, Low)
- 13 - Medium condition Grey Box - Forest Red Gum grassy woodland on flats (HN528, Moderate/good - medium)
- x - Cleared land or cropland

Paper Size A3

0 100 200 400

Metres

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

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Vegetation zones

Figure 5C

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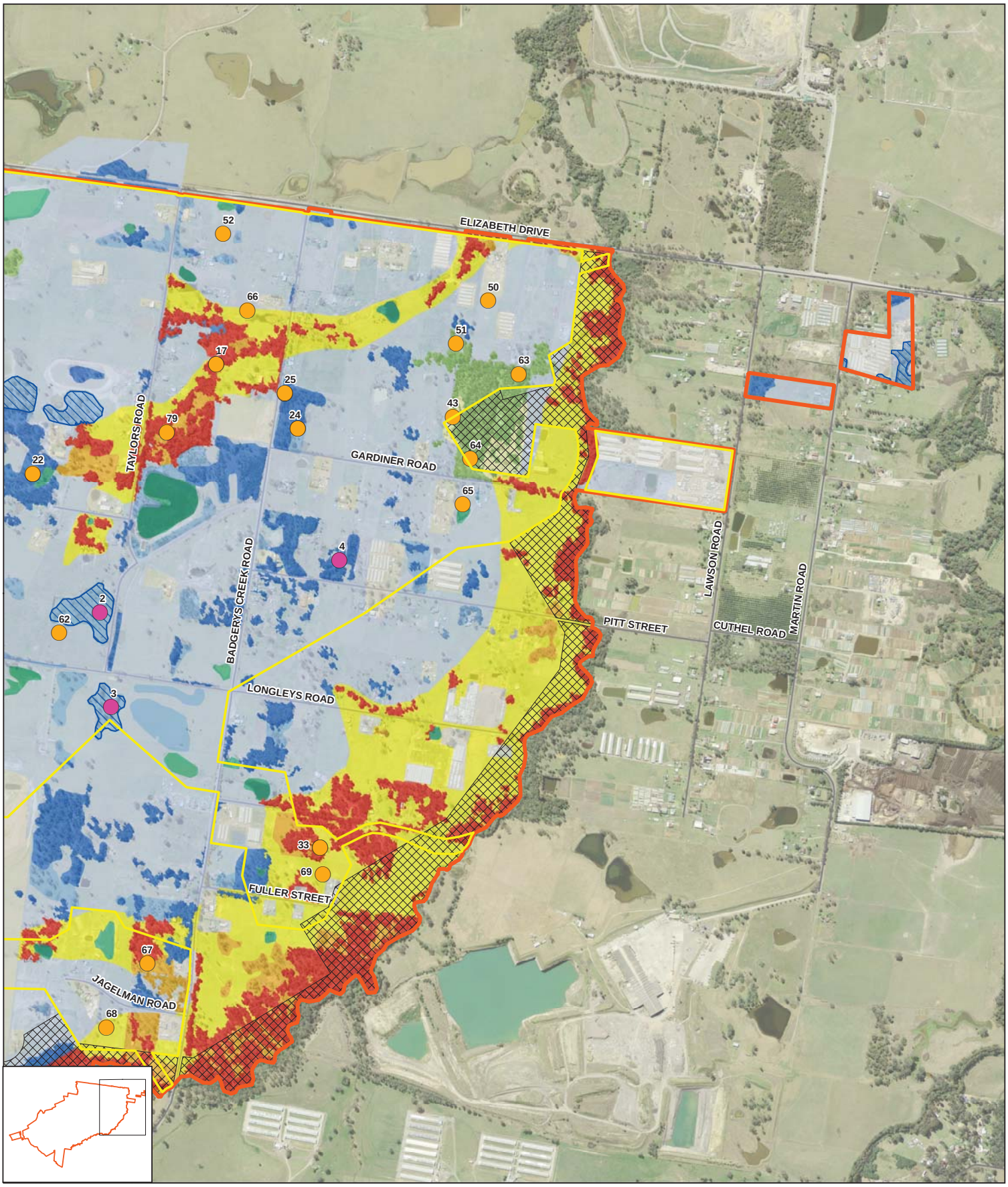
Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data source:Topographic Features - NSW LPI DTDB 2015, Airport layout data - WSU 2016, Aerial imagery - NSW LPI 2013, Vegetation mapping - OEH & GHD 2017, Ecological survey data - GHD 2017. Created by:jrprice



LEGEND

- Airport site
- Stage 1 Construction Impact Zone
- Environmental conservation
- Plot/transect
- Rapid plot/transect
- 1 - Good condition Grey Box - Forest Red Gum grassy woodland on flats (HN528, Moderate/good - high)
- 2 - Poor condition Grey Box - Forest Red Gum grassy woodland on flats (HN528, Moderate/good - poor)
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Paper Size A3

0 100 200 400

Metres

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

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Vegetation zones

Figure 5D

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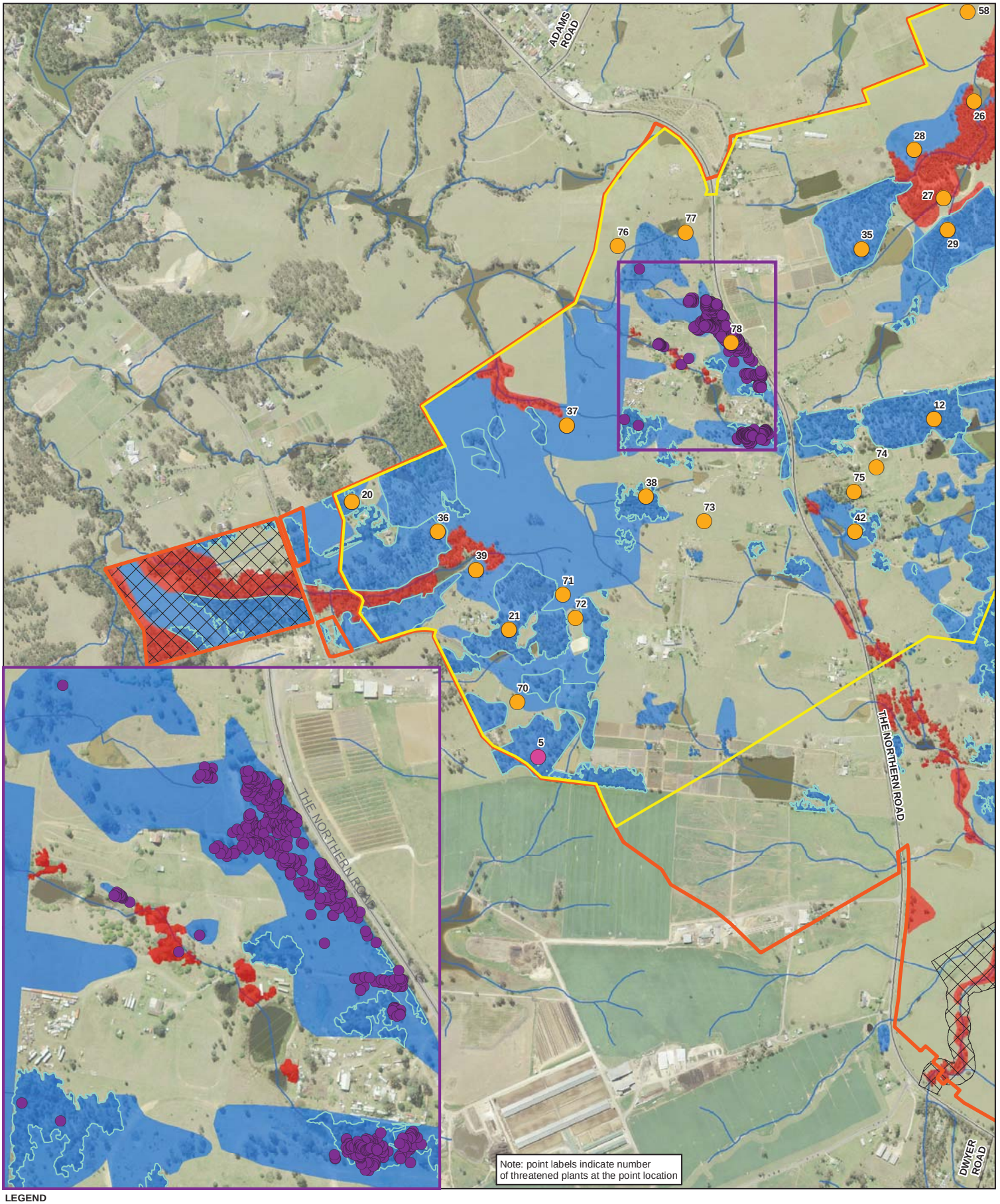
Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data source:Topographic Features - NSW LPI DTDB 2015, Airport layout data - WSU 2016, Aerial imagery - NSW LPI 2013, Vegetation mapping - OEH & GHD 2017, Ecological survey data - GHD 2017. Created by:jrprice



LEGEND

- The airport site
- Stage 1 Construction Impact Zone
- Environmental conservation
- Roads
- Watercourses

- *Pultenaea parviflora* (endangered species under the EPBC Act and BC Act)
- *Marsdenia viridiflora* subsp. *viridiflora* (endangered population under the BC Act)
- *Dillwynia tenuifolia* (vulnerable species under the BC Act)
- *Pimelea spicata*) (endangered species under the BC Act and EPBC Act)

- Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest (CEEC under EPBC Act and BC Act)
- Cumberland Plain Woodland (CEEC under the BC Act)
- River Flat Eucalypt Forest (EEC under the BC Act)
- Shale/gravel Transition Forest (EEC under the BC Act)

- Plot/transect
- Rapid plot/transect

Paper Size A3

0 100 200 400

Metres

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

N

Note: point labels indicate plot ID

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Biodiversity Offset Delivery Plan

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Threatened flora and ecological communities

Figure 6A

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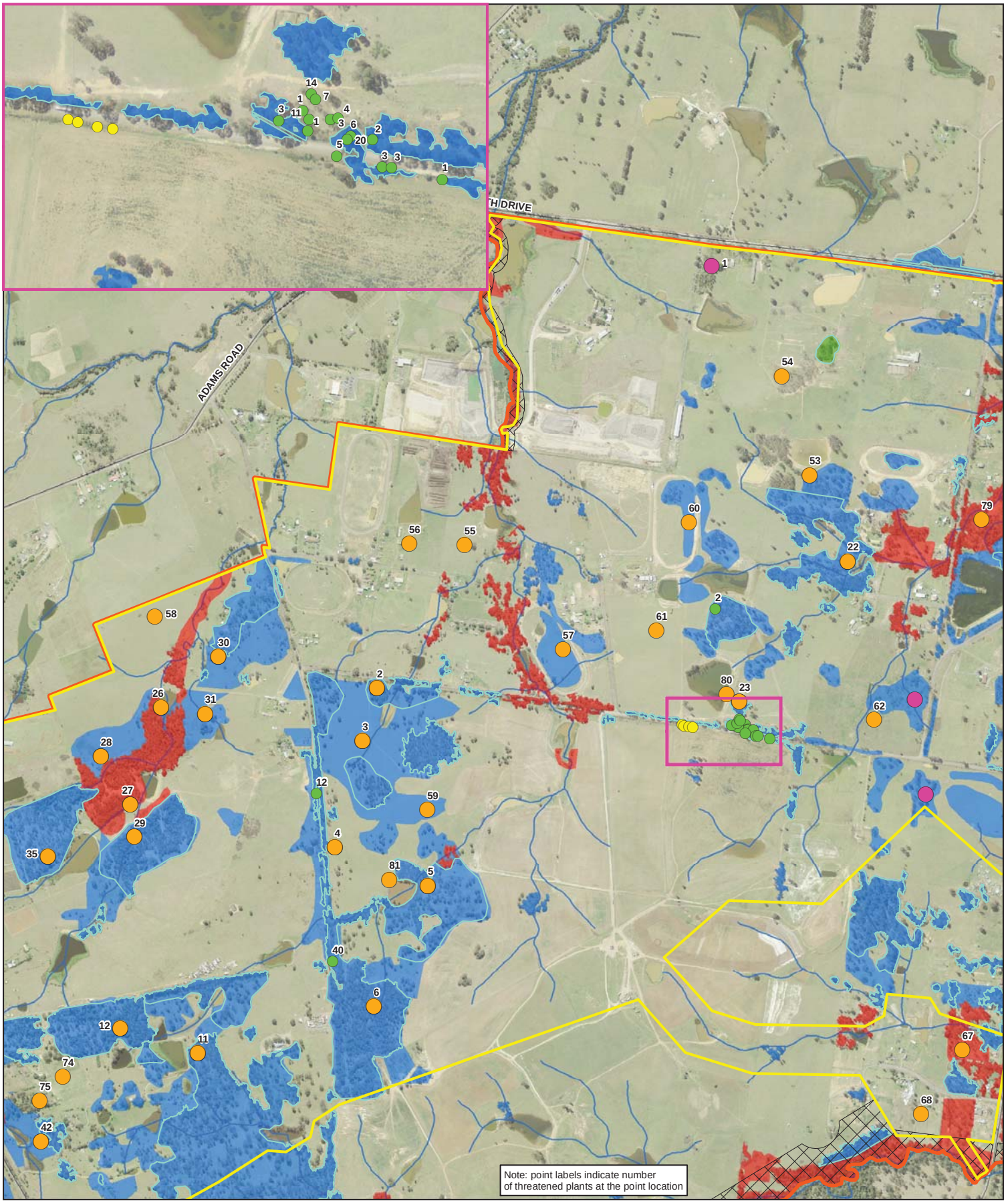
Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data source: Topographic Features - NSW LPI DTDB 2015, Airport layout data - WSU 2016, Aerial imagery - NSW LPI 2013, Vegetation mapping - OEH & GHD 2017, Ecological survey data - GHD 2017, Threatened species mapping - GHD 2017. Created by:jrprice



LEGEND

- The airport site
- Stage 1 Construction Impact Zone
- Environmental conservation
- Roads
- Watercourses

- *Pultenaea parviflora* (endangered species under the EPBC Act and BC Act)
- *Marsdenia viridiflora* subsp. *viridiflora* (endangered population under the BC Act)
- *Dillwynia tenuifolia* (vulnerable species under the BC Act)
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- Cumberland Plain Woodland (CEEC under the BC Act)
- River Flat Eucalypt Forest (EEC under the BC Act)
- Shale/gravel Transition Forest (EEC under the BC Act)

- Plot/transect
- Rapid plot/transect

Paper Size A3

0 100 200 400

Metres

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

N

Note: point labels indicate plot ID

Department of Infrastructure, Regional Development and Cities
Western Sydney Airport
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Threatened flora and ecological communities

Figure 6B

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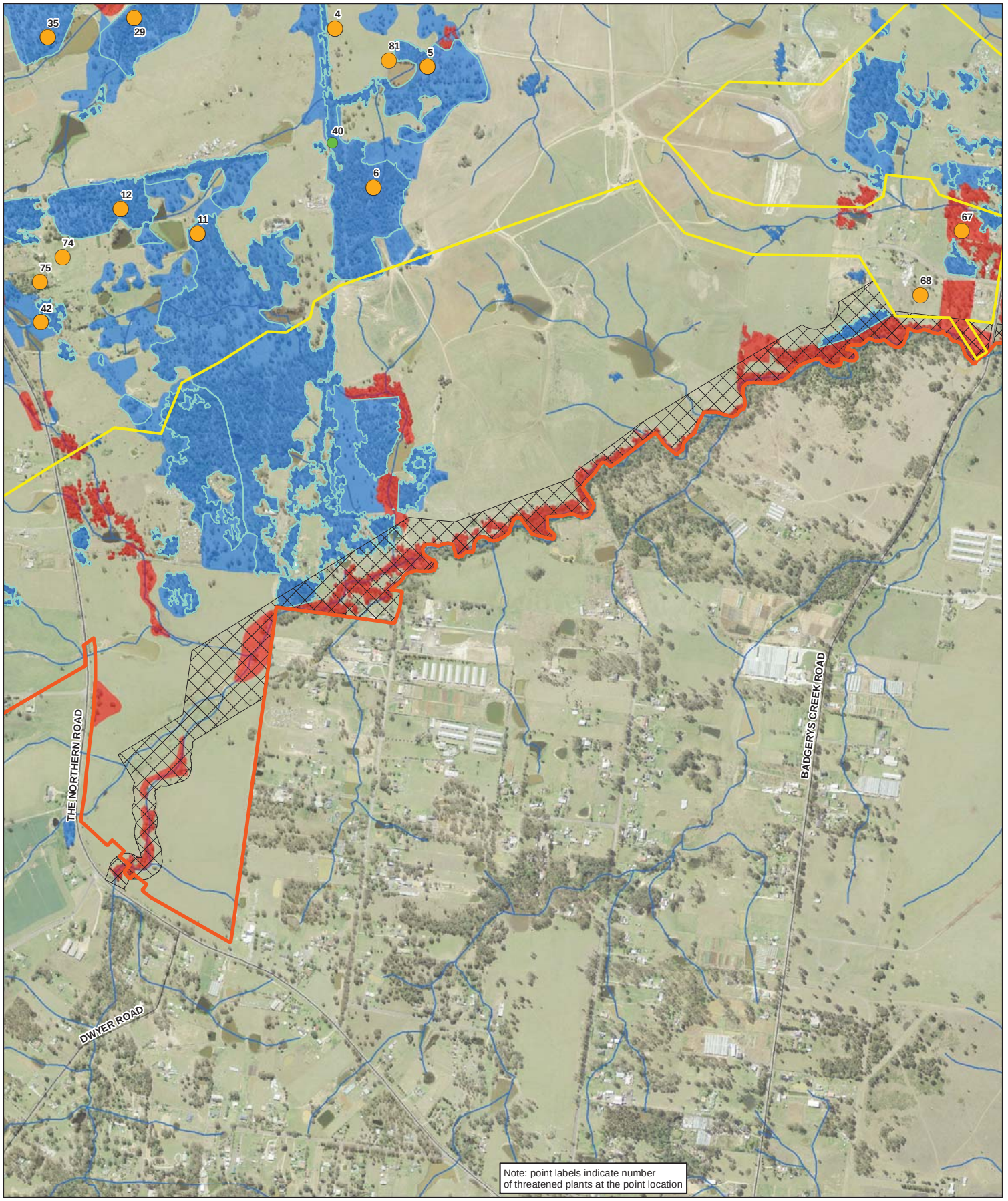
Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data source: Topographic Features - NSW LPI DTDB 2015, Airport layout data - WSU 2016, Aerial imagery - NSW LPI 2013, Vegetation mapping - OEH & GHD 2017, Ecological survey data - GHD 2017, Threatened species mapping - GHD 2017. Created by:jrprice



LEGEND

- The airport site
- Stage 1 Construction Impact Zone
- Environmental conservation
- Roads
- Watercourses

- *Pultenaea parviflora* (endangered species under the EPBC Act and BC Act)
- *Marsdenia viridiflora* subsp. *viridiflora* (endangered population under the BC Act)
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- Cumberland Plain Woodland (CEEC under the BC Act)
- River Flat Eucalypt Forest (EEC under the BC Act)
- Shale/gravel Transition Forest (EEC under the BC Act)

- Plot/transect
- Rapid plot/transect

Paper Size A3

0 100 200 400

Metres

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

N

Note: point labels indicate plot ID

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Western Sydney Airport
Biodiversity Offset Delivery Plan

Job Number	21-26204
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Threatened flora and ecological communities

Figure 6C

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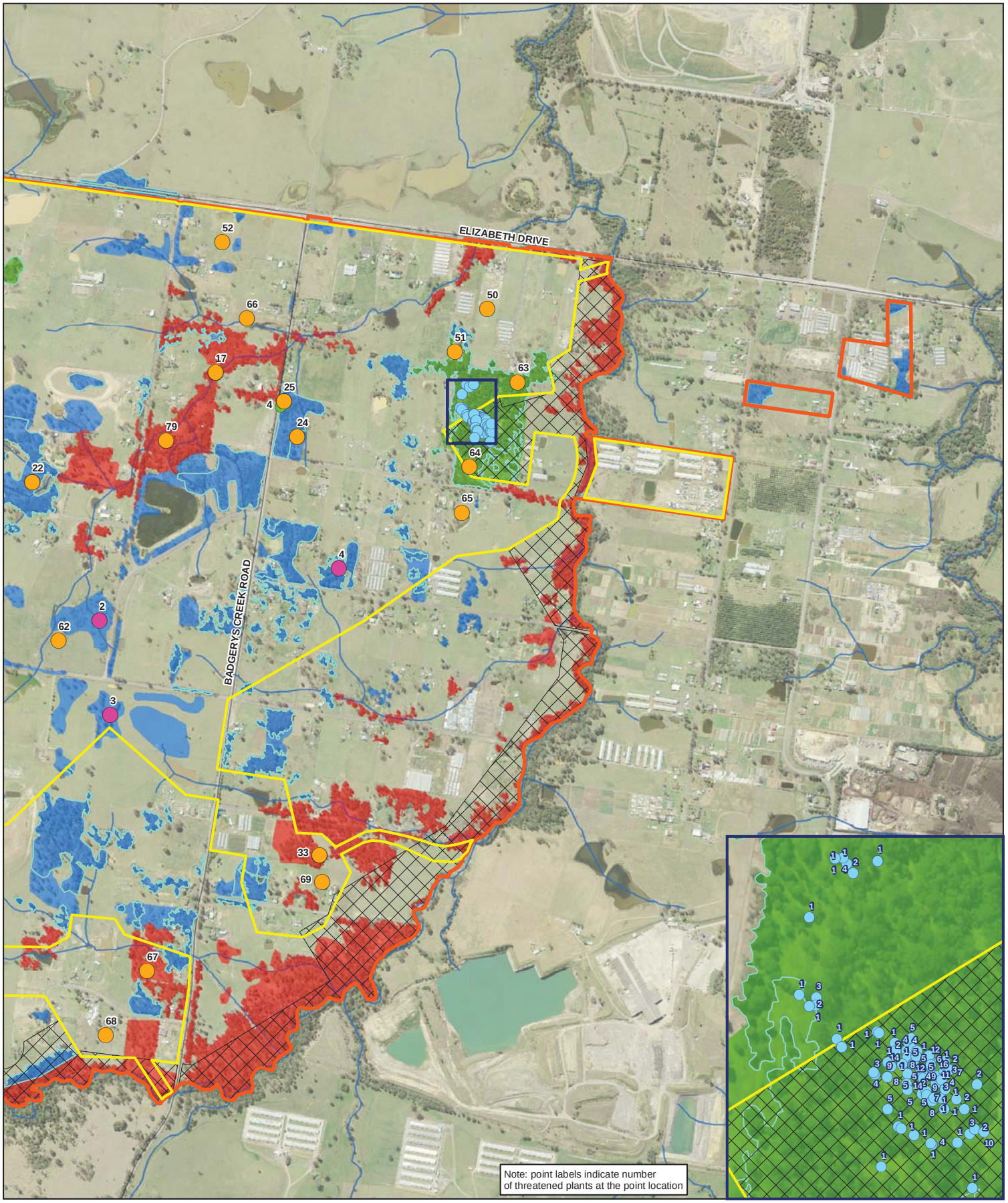
Data source: Topographic Features - NSW LPI DTDB 2015, Airport layout data - WSU 2016, Aerial imagery - NSW LPI 2013, Vegetation mapping - OEH & GHD 2017, Ecological survey data - GHD 2017, Threatened species mapping - GHD 2017. Created by:jrprice



LEGEND

- The airport site
- Stage 1 Construction Impact Zone
- Environmental conservation
- Roads
- Watercourses
- *Pultenaea parviflora* (endangered species under the EPBC Act and BC Act)
- *Marsdenia viridiflora* subsp. *viridiflora* (endangered population under the BC Act)
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- River Flat Eucalypt Forest (EEC under the BC Act)
- Shale/gravel Transition Forest (EEC under the BC Act)
- Plot/transect
- Rapid plot/transect

Paper Size A3

0 100 200 400

Metres

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

N

Note: point labels indicate plot ID

Department of Infrastructure, Regional Development and Cities
Western Sydney Airport
Biodiversity Offset Delivery Plan

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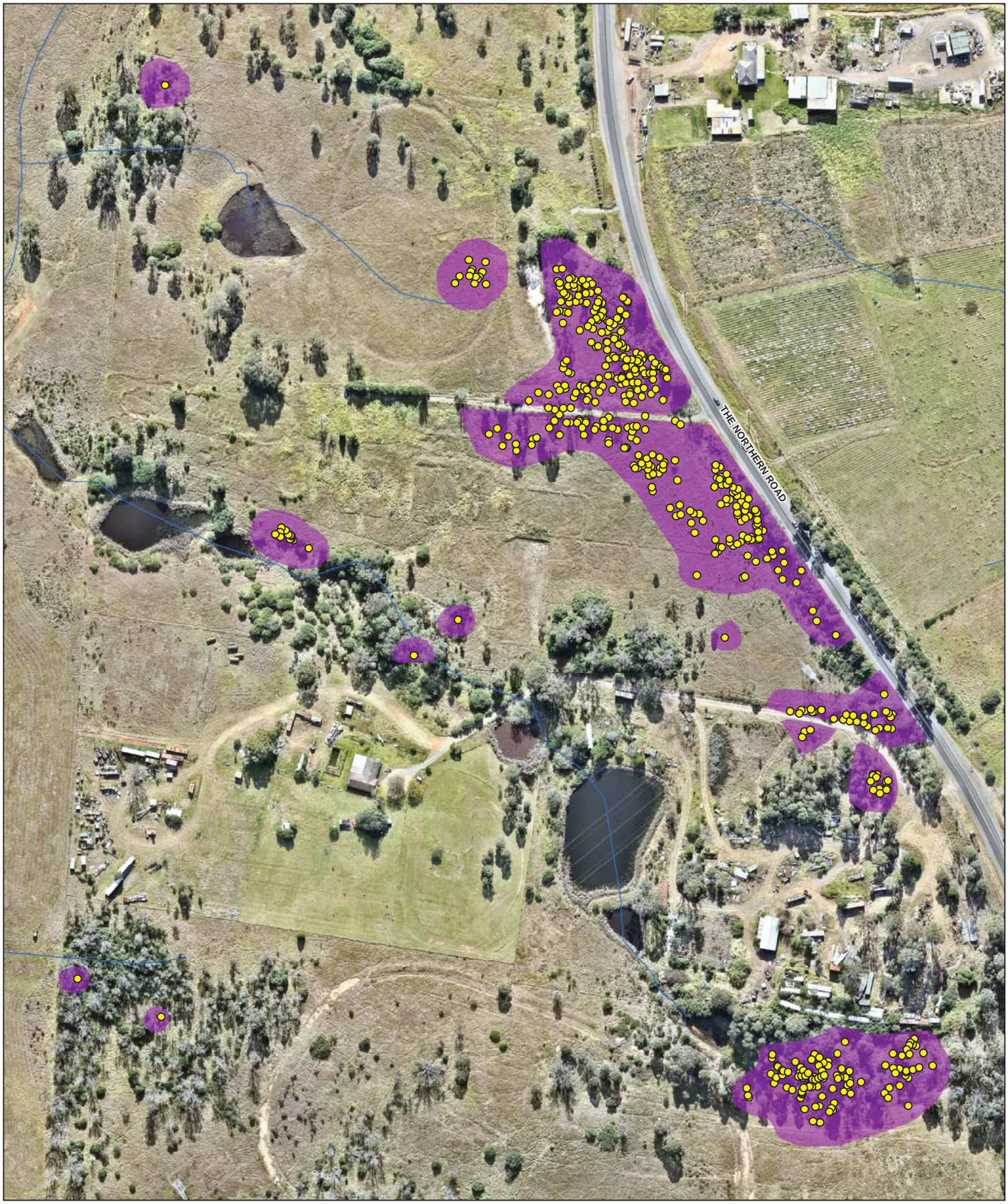
Threatened flora and ecological communities

Figure 6D

N:\AU\Sydney\Projects\21\26204\GIS\Maps\Deliverables\BODP_AirportSite\21_26204_Z004_BODP_AirportSite_ThreatenedFlora.mxd (SMA record: 4)

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

Data source: Topographic Features - NSW LPI DTDB 2015, Airport layout data - WSU 2016, Aerial imagery - NSW LPI 2013, Vegetation mapping - OEH & GHD 2017, Ecological survey data - GHD 2017, Threatened species mapping - GHD 2017. Created by:jrprice



LEGEND

- The airport site
- Roads
- Watercourses
- *Pimelea spicata* (endangered species under the BC Act and EPBC Act)
- Occupied *Pimelea spicata* habitat

Paper Size A3

0 20 40 80

Metres

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

N

Department of Infrastructure, Regional Development and Cities
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Revision	A
Date	13 Jul 2018

Threatened flora and ecological communities

Figure 6E

N:\AU\Sydney\Projects\21\26204\GIS\Maps\Deliverables\21_26204_Z029_Pimelea_Spicata_population.mxd

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

Data source: Topographic Features - NSW LPI DTDB 2015, Airport layout data - WSU 2016, Aerial imagery - NSW LPI 2013, Vegetation mapping - OEH & GHD 2017, Ecological survey data - GHD 2017, Threatened species mapping - GHD 2017. Created by:jrprice

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 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.

There are 187.8 hectares of foraging habitat in the Stage 1 CIZ associated with the native woodland and forest shown in Figure 7, all of which comprises critical foraging habitat as defined in the Recovery Plan for the Grey-headed Flying-fox (DECCW 2009).

The airport 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 airport. Therefore an area of habitat of 187.8 hectares has been entered in the impact calculator section of the offsets assessment guide calculations for the Grey-headed Flying-fox.

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 airport is unlikely to materially 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, Grey Box and Broad-leaved Ironbark. 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 at 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).

Environment and Energy'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% 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% 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.
- Species stocking rate – 20% 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 regularly travels up to 50km in a night to forage, and has been shown to make migratory movements of almost 1000km 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 field surveys conducted in accordance with the FBA (GHD 2016a; GHD 2017) and supplementary desktop assessments conducted for this BODP.

Site condition was scored as 7/10 based on:

- the health and condition of the vegetation zones that comprise Grey-headed Flying-fox habitat based on plot/transects, the health and abundance of food tree species and other field survey data. The majority of the habitat in the Stage 1 CIZ is Cumberland Plain Woodland (around 141 out of 187.8 hectares), which is in moderate condition as described above. Forest Red Gum – Rough-barked Apple grassy woodland (the remaining 35.9 out of 187.8 hectares) is also in moderate condition, comprising remnant or regrowth native vegetation with near-intact over storey that was slightly below benchmark values in the four plot/transects sampled
- 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).

Site context was scored as 6/10 given:

- 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 20km of the site and so it is appropriately located to provide foraging resources for individuals from these camps

- 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 to 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' (ie the quality of habitat in the airport disturbance footprint) was scored as 7/10 overall (rounded to the nearest whole number).

The link between the qualitative assessment provided above and the quantitative site quality scores is summarised in Table 2.2. Table 2.2 includes site quality scores for the impact area at the airport site and the 'current', 'future with offset' and 'future without offset' quality scores for the Orchard Hills offset site. Values in the table that relate to these various inputs to the offsets assessment guide calculations for the project are indicated in bold, along with a description of the attributes that define the given values at the airport site or at Orchard Hills and references to source documents. This confirms the consistency of the approach to scoring site quality between the impact and offset areas. Descriptions of the relevant attribute values for the range of site quality scores are provided for context.

The above values have been entered into the offsets assessment guide calculations for offset proposals for the Grey-headed Flying-fox included in this BODP and will be used to confirm the quantum of offset provided by longer term offsets.

Table 2.2 Offsets assessment guide site quality score values for the Grey-headed Flying-fox

Score	Site condition values 60% of site quality score	Site context values 20% of site quality score	Species stocking rate 20% of site quality score
10	Undisturbed old growth patches of habitat including abundant mature food trees. Food tree species that are productive throughout the year.[1] Healthy vegetation with high productivity of food tree species.	Part of a continuous remnant patch of native vegetation greater than 500ha in area. Minimal clearing and fragmentation of habitat in the surrounding region.	Continuously occupied roost camp on site and/or individuals foraging on site throughout the year and multiple occupied roost camps within the region.

Score	Site condition values 60% of site quality score	Site context values 20% of site quality score	Species stocking rate 20% of site quality score
9	A mix of mature regrowth and old growth patches of habitat, including abundant mature food trees. Food tree species that are productive during multiple key foraging periods.[2] Healthy vegetation with high productivity of food tree species.	Part of a near-continuous remnant patch of native vegetation greater than 500ha in area. Widespread clearing and fragmentation of habitat in the surrounding region.	Individuals foraging on site throughout the year and multiple occupied roost camps within the region.
8	**Orchard Hills future condition with offset score** – a mix of regrowth and mature patches of habitat including moderate abundance of mature food trees. Food tree species that are productive during at least one key foraging period.[2] Healthy vegetation with high productivity of food tree species.[3]	**Orchard Hills future context with offset score** – part of a near-continuous remnant patch of native vegetation greater than 100ha in area. Occasional 10 to 100m wide gaps in habitat associated with localised clearing of vegetation, access tracks, fence lines, etc.	Individuals foraging on site in multiple seasons during any given year and multiple occupied roost camps within the region.
7	**The airport site condition score and the Orchard Hills start condition score** – a mix of regrowth and mature patches of habitat including moderate abundance of mature food trees. Food tree species that are productive during at least one key foraging period2. Moderately healthy vegetation with moderate productivity of food tree species. Health and productivity affected by observed threats such as weed infestation, pest fauna, inappropriate fire regimes etc.[4, 5]	**The Orchard Hills start context score** – part of a near-continuous remnant patch of native vegetation greater than 100ha in area. Frequent 10 to 100m wide gaps in habitat associated with less mature regrowth, access tracks, fence lines, etc.	**The airport site quality score and the Orchard Hills start and future with offset and without offset species stocking rate scores** – individuals foraging on site in at least one season during any given year and multiple occupied roost camps within the region. No increase with offset entered because of uncertainty about whether the improvements in condition and context with offset at Orchard Hills would achieve an increase in species stocking rate score.

Score	Site condition values 60% of site quality score	Site context values 20% of site quality score	Species stocking rate 20% of site quality score
6	**The Orchard Hills future condition without offset score** – a mix of regrowth and mature patches of habitat including moderate abundance of mature food trees. Food tree species that are productive during at least one key foraging period.[2] Moderately healthy vegetation with low-moderate productivity of food tree species. Health and productivity substantially affected by threats such as weed infestation, pest fauna, inappropriate fire regimes etc.[4]	**The airport site context score and the Orchard Hills future context without offset score** – part of remnant patch of native vegetation 5 to 100ha in area. Fragmented by frequent greater than 100m wide gaps in habitat associated with extensive clearing of vegetation, sealed roads etc.	Individuals foraging on site in at least one season during any given year and at least one occupied roost camp within the region.
5	Regrowth patches of habitat including occasional mature food trees. Food tree species that are productive during at least one key foraging period[2]. Moderately healthy vegetation but with low productivity of food tree species. Health and productivity severely affected by threats such as weed infestation, pest fauna, and inappropriate fire regimes etc.	Remnant patches of vegetation 5 to 100ha in area. Fragmented by frequent greater than 100m wide gaps in habitat associated with extensive clearing of vegetation, sealed roads etc.	Individuals foraging on site on occasion and at least one occupied roost camp within the region.
4 to 2	Occasional mature food trees. Score varies with abundance, productivity and/or seasonal productivity of tree species. Health and productivity affected to varying degrees by observed threats such as weed infestation, pest fauna and inappropriate fire regimes etc.	Extensively fragmented landscape. Score varies with width of gaps between areas of habitat and presence of risks in gaps between patches of habitat.	Few and/or occasionally occupied roost camps in the region. Score varies with number and permanency of camps and distance from camps.

Score	Site condition values 60% of site quality score	Site context values 20% of site quality score	Species stocking rate 20% of site quality score
1	No food tree species or habitat at the site.	No native vegetation cover or habitat at the site or the surrounding area.	No occupied roost camps in the region. Occasional vagrant individuals only.

Notes: 1) Tree species that are recognised as significant species in the blossom or fruit diet of the Grey-headed flying-fox in Eby and Law (2008). 2) Food trees that are productive during food bottlenecks or productive during the final weeks of gestation, and during the weeks of birth, lactation and conception (September to May), and qualifies as foraging habitat critical to the survival of the species, as defined in the draft recovery plan (DECCW 2009). 3) Based on likely improvements in site condition along with active management outlined in Section 6.1.4 when compared with baseline condition recorded in plot/transects, habitat assessments completed in the site inspection of Orchard Hills and biodiversity monitoring data from the site (SKM 2014) as documented in sections 6.1.2 and 6.1.7 of the BODP. 4) As recorded in recorded in plot/transects, habitat assessments completed in the site inspection of Orchard Hills and biodiversity monitoring data from the site (SKM 2014) as documented in sections 6.1.2 and 6.1.7 of the BODP. 5) As recorded in plot/transects and habitat assessments completed at the airport site as documented in Section 4.3.2, Section 4.5.3 and Appendix A of the Stage 1 BAR (GHD 2017).

2.2.3 Swift Parrot foraging habitat

Area of habitat in the impact zone

The Swift Parrot (*Lathamus discolor*) is a migratory bird species that breeds in Tasmania and migrates to mainland Australia each autumn. During winter, Swift Parrots disperse across a broad non-breeding range mainly in Victoria and New South Wales, foraging on nectar and lerps in eucalypts (Saunders and Tzaros 2011). The Swift Parrot may occur in the Stage 1 CIZ on occasion during its winter migration, but was not detected during targeted surveys. This species is listed as a critically endangered species under the EPBC Act and an endangered species under the TSC Act. All native woodland and forest in the airport site provides potential foraging habitat for this species.

The single, migratory population of the Swift Parrot may use foraging habitat at the airport site on an occasional basis as part of its occupation of winter foraging habitat. Winter flowering trees in the Myrtaceae family such as Swamp Mahogany (*Eucalyptus robusta*), Spotted Gum (*Corymbia maculata*) and Red Bloodwood (*Corymbia gummifera*) are important nectar sources in coastal parts of the Swift Parrot's non-breeding range (Saunders and Tzaros 2011). Commonly used lerp-infested trees include Inland Grey Box (*Eucalyptus microcarpa)*, and Blackbutt (*Eucalyptus pilularis)* (OEH 2018b). Forest Red Gum is also identified as a key food tree in the Sydney Metro and Hawkesbury-Nepean areas within the non-breeding range of the species (Saunders and Tzaros 2011). Each of the vegetation zones at the airport site with a forest or woodland structure contains Forest Red Gum and/or Grey Box as dominant canopy species and is potential Swift Parrot foraging habitat. Therefore construction of the airport would remove 187.8 hectares of foraging habitat associated with the native woodland and forest shown in Figure 7. 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 by 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 Swift Parrot arising from the airport. Therefore an area of habitat of 187.8 hectares has been entered in the 'Impact calculator' section of offsets assessment guide calculations for the Swift Parrot.

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 Swift Parrot 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 Chapter 28 of the airport EIS (GHD 2016c), the airport is unlikely to tangibly decrease the extent or quality of habitat outside of the airport site. Therefore, no additional areas of habitat for the Swift Parrot 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 based on the presence of Forest Red Gum and Grey Box as dominant canopy species.

Environment and Energy'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 Swift Parrot population with respect to the airport site was defined as follows:

- Site condition – 40% 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% 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. This factor was given less weighting because the species is highly mobile and movement pathways used by Swift Parrots throughout their range are not well understood (Saunders and Tzaros 2011).
- Species stocking rate – 40% comprising an assessment of the usage or density of the species at the site. The Swift Parrot is a highly mobile species, which regularly travels between Tasmania and mainland Australia during its annual migrations. However the recovery plan for the species emphasises the importance of habitat that is used by large proportions of the Swift Parrot population or repeatedly between seasons (ie site fidelity) (Saunders and Tzaros 2011).

Each characteristic was then scored based on the results of field surveys conducted in accordance with the FBA (GHD 2016a; GHD 2017) and supplementary desktop assessments conducted for this BODP.

Site condition was scored as 6/10 based on:

- the presence of Forest Red Gum as a dominant canopy species across the airport site. As described above, Forest Red Gum is recognised as a key species in Hawkesbury-Nepean region in the draft recovery plan (DECCW 2009) (GHD 2016a)
- the health and condition of the vegetation zones that comprise Swift Parrot habitat based on plot/transects, the size and abundance of food tree species and other field survey data. The majority of the habitat in the Stage 1 CIZ is Cumberland Plain Woodland (around 141 out of 187.8 hectares), which is in moderate condition as described above. Forest Red Gum – Rough-barked Apple grassy woodland (the remaining 35.9 out of 187.8 hectares) is also in moderate condition, comprising remnant or regrowth native vegetation with near-intact over storey that was slightly below benchmark values in the four plot/transects sampled

- the abundance of Noisy Miners (*Manorina melanocephala*) and, to a lesser extent, Rainbow Lorikeets (*Trichoglossus haematodus*) at the airport site. Significant negative associations with Swift Parrot occurrence were found for the Rainbow Lorikeet in coastal habitats and the Noisy Miner throughout the species' range (Saunders and Heinsohn 2008). The majority of woodland and forest at the airport site occurs as fragmented patches in an agricultural landscape and is more likely to be dominated by these aggressive bird species than patches of continuous vegetation.

Site context was scored as 6/10 given habitat at the airport site is in a highly fragmented, rural landscape. The Swift Parrot is a highly mobile species, 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 4/10, comprising an area of potentially productive foraging habitat within the broad range of this highly mobile species but with no evidence of use by large numbers of individuals or of site fidelity. There are no previous records (last 30 years) of the Swift Parrot from within the airport site or immediate surrounds despite multiple rounds of targeted survey for the airport (Biosis 1999; GHD 2016a). There are eight records of the Swift Parrot in the locality and scattered records across the Cumberland Plain, but limited evidence of any concentration of records at any locations and very few records of the species in south-western Sydney (OEH 2018a). A broad-scale habitat map prepared for the Greater Southern Sydney Region identifies the largest area of habitat for the Swift Parrot within the Burragorang Valley (approximately 30km to the southwest of the Stage 1 CIZ), with smaller patches around Glenmore, west of Liverpool, and around Wedderburn (DECC 2007).

Based on the inputs described above, 'Impact calculator – quantum of impact – quality' (ie the quality of habitat in the airport disturbance footprint) was scored as 5/10 overall (rounded to the nearest whole number).

The link between the qualitative assessment provided above and the quantitative site quality scores is summarised in Table 2.3. Table 2.3 includes site quality scores for the impact area at the airport site and the 'current', 'future with offset' and 'future without offset' quality scores for the Orchard Hills offset site. Values in the table that relate to these various inputs to the offsets assessment guide calculations for the project are indicated in bold, along with a description of the attributes that define the given values at the airport site or at Orchard Hills and references to source documents. This confirms the consistency of the approach to scoring site quality between the impact and offset areas. Descriptions of the relevant attribute values for the range of site quality scores are provided for context.

The above values have been entered in offsets assessment guide calculations for offset proposals for the Swift Parrot included in this BODP and will be used to confirm the quantum of offset provided by longer term offsets.

Table 2.3 Offsets assessment guide site quality score values for Swift Parrot foraging habitat

Site quality score	Site condition values 40% of site quality score	Site context values 20% of site quality score	Species stocking rate 40% of site quality score
10	Undisturbed old growth patches of habitat including abundant mature food trees. Food tree species that are productive throughout the year.[1] Healthy vegetation with high productivity of food tree species.	Part of a continuous remnant patch of native vegetation greater than 500ha in area. Minimal clearing and fragmentation of habitat in the surrounding region.	High site fidelity as confirmed by annual use of foraging habitat by large numbers of individuals.
9	A mix of mature regrowth and old growth patches of habitat, including mature food trees.[1] Score varies with health, abundance and productivity of food tree species.	Part of a near-continuous remnant patch of native vegetation greater than 500ha in area. Some clearing and fragmentation of habitat in the surrounding region.	High site fidelity as confirmed by frequent use of foraging habitat by large numbers of individuals. Score varies with frequency of use and number of individuals.
8	**The Orchard Hills future condition with offset score** – a mix of regrowth and mature patches of habitat including moderate abundance of mature food trees. Healthy vegetation with high productivity of food tree species. Low abundance of aggressive bird species due to large patch sizes and maturity of vegetation. [2]	**The Orchard Hills future context with offset score** – part of a near-continuous remnant patch of native vegetation greater than 100 to 500ha in area. Some clearing and fragmentation of habitat in the surrounding region.	High site fidelity as confirmed by use of foraging habitat by large numbers of individuals. Score varies with frequency of use and number of individuals.

Site quality score	Site condition values 40% of site quality score	Site context values 20% of site quality score	Species stocking rate 40% of site quality score
7	**The Orchard Hills start condition score** – a mix of regrowth and mature patches of habitat including moderate abundance of mature food trees1. Moderately healthy vegetation with moderate productivity of food tree species. Health and productivity affected by observed threats such as moderately abundant aggressive bird species, weed infestation, pest fauna, inappropriate fire regimes etc.[3]	**The Orchard Hills start context score** – part of a near-continuous remnant patch of native vegetation greater than 100ha in area. Frequent 10 to 100m wide gaps in habitat associated with less mature regrowth, access tracks, fence lines, etc.	Site fidelity as confirmed by repeated use of foraging habitat. Score varies with frequency of use and number of individuals.
6	**The airport site condition score and Orchard Hills future condition without offset score** – a mix of regrowth and mature patches of habitat including moderate abundance of mature food trees. Moderately healthy vegetation with moderate productivity of food tree species. Health and productivity substantially affected by threats such as abundant aggressive bird species, weed infestation, pest fauna, inappropriate fire regimes etc.[3,4]	**The airport site context score and Orchard Hills future context without offset score** – part of remnant patch of native vegetation 5 to 100ha in area. Fragmented by frequent greater then 100m wide gaps in habitat associated with extensive clearing of vegetation, sealed roads etc.	Site fidelity as confirmed by repeated use of foraging habitat. Score varies with frequency of use and number of individuals.
5	Regrowth patches of habitat including low abundance of mature food trees. Moderately healthy vegetation but with low productivity of food tree species and/or substantially affected by threats such as abundant aggressive bird species etc.	Remnant patches of vegetation 5 to 100ha in area. Fragmented by frequent greater than 100m wide gaps in habitat associated with extensive clearing of vegetation, sealed roads etc. Barriers or risks associated with gaps in habitat.	Low site fidelity as indicated by infrequent use of foraging habitat. Records of the species in the local area surrounding the site.

Site quality score	Site condition values 40% of site quality score	Site context values 20% of site quality score	Species stocking rate 40% of site quality score
4	Regrowth patches of habitat including occasional mature food trees. Moderately healthy vegetation but with low productivity of food tree species and/or substantially affected by threats such as abundant aggressive bird species etc.	Remnant patches of vegetation 5 to 100ha in area. Fragmented by frequent greater than 100m wide gaps in habitat associated with extensive clearing of vegetation, sealed roads etc. Significant barriers or risks associated with gaps in habitat.	**The airport site species stocking rate score and Orchard Hills start and future species stocking rate with and without offset score** – no evidence of site fidelity. No confirmed use of foraging habitat. Records of the species in the local area surrounding the site. No increase with offset entered because of uncertainty about whether the improvements in condition and context with offset at Orchard Hills would achieve an increase in species stocking rate score.
3 to 2	Occasional mature food trees. Score varies with abundance, and/or productivity of tree species. Health and productivity affected to varying degrees by abundant aggressive bird species etc.	Extensively fragmented landscape. Score varies with width of gaps between areas of habitat and significance of barriers and risks in gaps between patches of habitat.	No evidence of site fidelity as indicated. No confirmed use of foraging habitat. Records of the species in the region surrounding the site. Score varies with number and frequency of individuals recorded in the region.
1	No food tree species or habitat at the site.	No native vegetation cover or habitat at the site or the surrounding area.	No records of the species in the region.

Notes: 1) Winter flowering or lerp-infested tree species that are recognised as key species in the Hawkesbury-Nepean region in the draft recovery plan (DECCW 2009). 2) Based on likely improvements in site condition along with active management outlined in Section 6.1.4 when compared with baseline condition recorded in plot/transects, habitat assessments completed in the site inspection of Orchard Hills and biodiversity monitoring data from the site (SKM 2014) as documented in sections 6.1.2 and 6.1.7 of the BODP. 3) As recorded in plot/transects, habitat assessments completed in the site inspection of Orchard Hills and biodiversity monitoring data from the site (SKM 2014) as documented in sections 6.1.2 and 6.1.7 of the BODP. 4) As recorded in plot/transects and habitat assessments completed at the airport site as documented in Section 4.3.2, Section 4.5.3 and Appendix A of the Stage 1 BAR (GHD 2017).

2.2.4 Pimelea spicata

Area of habitat in impact zone

The Stage 1 CIZ includes the entire population of at least 4118 *Pimelea spicata* at the airport site. This population occurs within 2.94 hectares of occupied habitat.

The population of *Pimelea spicata* is located at five locations in the north-western portion of the Stage 1 CIZ (see Figure 6e). A total of 4118 clumps of *Pimelea spicata* were recorded, including many flowering plants. *Pimelea spicata* is listed as an endangered species under the TSC and EPBC Acts. *Pimelea spicata* is a cryptic species that is very hard to detect when not flowering. A population at a site may consist only of underground tubers and the soil seed bank during droughts or because of excessive grazing or weed infestation. The species is known to grow rapidly and flower in response to fire and/or favourable rainfall. The heavy summer and autumn rainfall in early 2017 combined with the exclusion of grazing and slashing since the properties were vacated in 2015-2016 is likely to have contributed to the abundance of the species as observed in March-April 2017 (GHD 2017). Conversely, ongoing monitoring of the population and attempts to collect seed and viable cuttings of the species through mid to late 2017 noted a decline to around 400 above-ground *Pimelea spicata* individuals in the local population by December 2017.

The observed clumps of *Pimelea spicata* are located within an area of 2.94 hectares of occupied habitat (see Figure 6e). The extent of occupied habitat was mapped using GIS as a 20-metre wide buffer around recorded clumps of *Pimelea spicata* where the buffer area contained areas of suitable grassland or grassy woodland habitat. The buffer area was modified to exclude clearly unsuitable habitat such as gravel tracks, water, fill or rubbish. Therefore an area of habitat of 2.94 hectares has been entered in the 'impact calculator' section of the offsets assessment guide calculations for *Pimelea spicata.* The same approach will be used at *Pimelea spicata* offset sites (ie a targeted survey to identify *Pimelea spicata* clumps followed by a habitat assessment and mapping of the extent and quality of occupied habitat as inputs to offsets assessment guide calculations).

Quality of habitat in the impact zone

Environment and Energy'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 *Pimelea spicata* population with respect to the airport site was defined as follows:

- Site condition – 20% comprising an assessment of the condition of the habitat at the airport site in relation to the ecological requirements of the species and based on vegetation condition and degree of disturbance.
- Site context – 20% comprising an assessment of the relative importance of habitat at the airport site in terms of its position in the landscape based on patch size, connectivity and proximity to threats. This factor was given minor weighting because important elements in the life history of the species such as pollination, seed fall and recruitment typically happen over short distances and within populations (DEC 2005b).

- Species stocking rate – 60% comprising an assessment of the usage or density of the species at the site. This factor was given greater weighting because the size and abundance of individuals within a population are recognised as being critical to the maintenance of populations of the species as well as being the best indicator of the quality of habitat given uncertainty about the key microhabitat, pollinator and disturbance regime requirements for the species (DEC 2005b).

Each characteristic was then scored based on the results of the Stage 1 BAR (GHD 2017).

Site condition was scored as 8/10 based on the health and condition of the vegetation zones that comprise *Pimelea spicata* habitat, given plot/transects, general observations of the health and condition of native vegetation and evidence of degradation by threatening processes such as clearing, weed infestation and grazing. The majority of the *Pimelea spicata* population at the airport site is in an area of derived native grassland that would have formerly supported Grey Box – Forest Red Gum grassy woodland on flats (Figure 6). This area was sampled with plot/transect 78 (see Figure 5), which confirmed that this area was in good condition (other than the absence of over-storey and mid-storey plants) with moderate native species richness, high native grass and herb cover and low exotic plant cover. It should be noted that this attribute is scored differently with respect to the site quality for *Pimelea spicata* than for EPBC Act Cumberland Plain Woodland because of its specific ecological requirements. Notably the lower cover of tree and shrub species within the area of occupied *Pimelea spicata* habitat means that there is less competition for light, moisture and other resources.

Site context was scored as 7/10 given the broad area of potential *Pimelea spicata* habitat at the airport site is in a highly fragmented, rural landscape. The area of occupied *Pimelea spicata* habitat is also fragmented at a fine scale with observed clumps of plants separated by tracks, building pads, dumped fill and dense African Olive *(Olea europea* subsp. *cuspidata)* infestations. The mechanism of *Pimelea spicata* seed dispersal, if any, are unknown and observations of seedling emergence following fire suggest seed dispersal is likely to be very low, with the majority of seedlings being within 30cm of adult plants (DEC 2005b).

Species stocking rate was scored as 10/10 given the presence of at least 4118 *Pimelea spicata* within 2.94 hectares of occupied habitat in March–April 2017.

Based on the inputs described above, ‘Impact calculator – quantum of impact – quality’ (ie the quality of habitat in the airport disturbance footprint) was scored as 9/10 overall (rounded to the nearest whole number) comprising highly suitable habitat with a substantial population of the species and some evidence of degradation by clearing, weed infestation and grazing.

The link between the qualitative assessment provided above and the quantitative site quality scores is summarised in Table 2.4.Table 2.4 includes site quality scores for the impact area at the airport site and the ‘current’, ‘future with offset’ and ‘future without offset’ quality scores for the Orchard Hills offset site. Values in the table that relate to these various inputs to the offsets assessment guide calculations for the project are indicated in bold, along with a description of the attributes that define the given values at the airport site or at Orchard Hills and references to source documents. This confirms the consistency of the approach to scoring site quality between the impact and offset areas. Descriptions of the relevant attribute values for the range of site quality scores are provided for context.

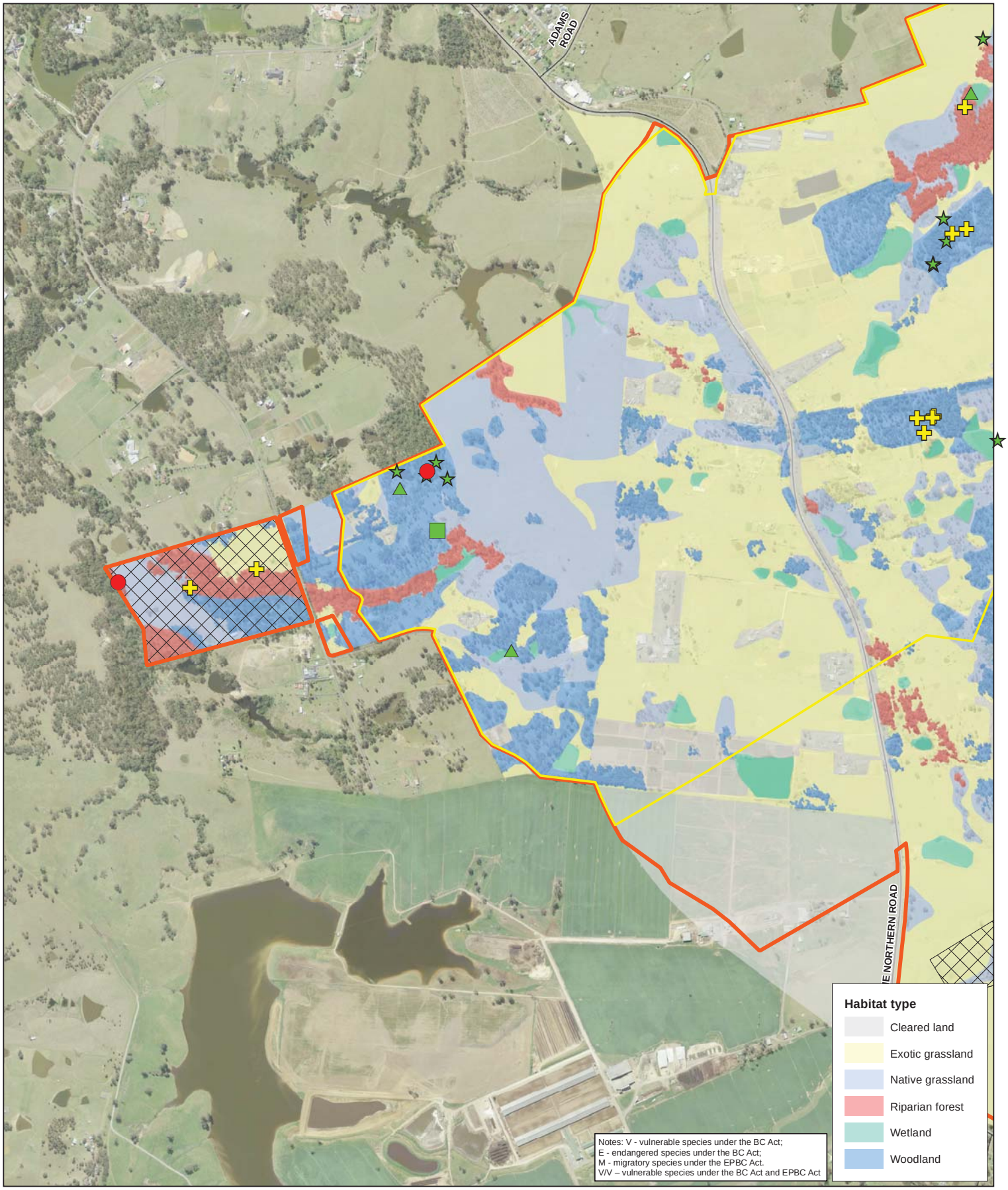
These values have been entered in offsets assessment guide calculations for offset proposals for *Pimelea spicata* included in this BODP and will be used to confirm the quantum of offset provided by longer term offsets.

Table 2.4 Offsets assessment guide site quality score values for Pimelea spicata

Site quality score	Site condition values 20% of site quality score	Site context values 20% of site quality score	Species stocking rate 60% of site quality score
10	Undisturbed old growth patches of habitat with a natural fire and disturbance regime. A variety of successional stages of vegetation providing opportunities for recruitment and establishment of the species.[1] Healthy vegetation with very low to nil exotic plant cover.	Part of a continuous remnant patch of native vegetation greater than 500ha in area. Minimal clearing and fragmentation of habitat in the surrounding region.	**The airport site species stocking rate score** – an abundant local population comprising greater than 1000 individuals per hectare under favourable survey conditions.[2]
9	Occupied habitat containing a mix of remnant and disturbed vegetation with high native species richness and cover and very low exotic plant cover. A favourable fire and disturbance regime with a variety of successional stages of vegetation providing opportunities for recruitment and establishment of the species.	Part of a near-continuous remnant patch of native vegetation greater than 500ha in area. Some clearing and fragmentation of habitat in the surrounding region.	An abundant local population comprising 500 to 1000 individuals per hectare under favourable survey conditions.
8	**The airport site condition score** – occupied habitat containing a mix of remnant and disturbed vegetation with moderate to high native species richness and cover and low to moderate exotic plant cover. A favourable fire and disturbance regime with a variety of vegetation successional stages providing opportunities for recruitment and establishment of the species.[3]	Part of a near-continuous remnant patch of native vegetation greater than 100 to 500ha in area. Some clearing and fragmentation of habitat in the surrounding region.	An abundant local population comprising 100 to 500 individuals per hectare under favourable survey conditions.

Site quality score	Site condition values 20% of site quality score	Site context values 20% of site quality score	Species stocking rate 60% of site quality score
7	Occupied habitat containing a mix of remnant and disturbed vegetation with moderate native species richness and cover and low exotic plant cover. A suitable fire and disturbance regime with a variety of vegetation successional stages providing opportunities for recruitment and establishment of the species.	**The airport site context score** – part of a near-continuous remnant patch of native vegetation greater than 100ha in area. Frequent 10 to 100m wide gaps in habitat within the site associated with less tracks, building pads, dumped fill and dense exotic plant growth etc. Widespread clearing and fragmentation of habitat in the surrounding region.	A local population comprising 20 to 100 individuals per hectare under favourable survey conditions.
6	Occupied habitat containing a mix of remnant and disturbed vegetation with moderate native species richness and cover and low to moderate exotic plant cover. A suitable fire and disturbance regime with some opportunities for recruitment and establishment of the species.	Part of remnant patch of native vegetation 5 to 100 hectares in area. Fragmented by frequent greater than 100m wide gaps in habitat within the site associated with extensive clearing of vegetation, sealed roads etc. Widespread clearing and fragmentation of habitat in the surrounding region.	A local population comprising up to 20 individuals per hectare under favourable survey conditions.
5 to 2	Potential habitat based on landscape position, substrate and vegetation associations. Site quality varies with vegetation condition, exotic plant cover and the fire and disturbance regime.	Remnant patches of vegetation in a fragmented landscape. Score varies with patch size, width of gaps and degree of weed infestation or other threats in gaps between areas of suitable habitat.	No recent records of the species on site. Score varies with number and proximity of records of the species in the local area and/or number and currency of previous records on site.
1	No potential habitat based on landscape position, substrate and vegetation associations.	No native vegetation cover or habitat at the site or the surrounding area.	No records of the species in the local area.

Notes: 1) As described in the recovery plan for the species (DEC 2005b). 2) Based on targeted surveys conducted under apparently ideal survey conditions in March/April 2017 (GHD 2017) and as documented in Section 2.2.4 of the BODP. 4) As recorded in plot/transects and habitat assessments completed at the airport site as documented in Section 4.3.1, Section 4.5.3 and Appendix A of the Stage 1 BAR (GHD 2017).



LEGEND

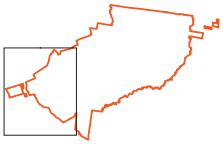
- Airport site
- Stage 1 Construction Impact Zone
- Environmental conservation
- Roads
- Habitat tree

Threatened species

- Blue-billed Duck (V)
- Black Bittern (V)
- Cumberland Plain Land Snail (E) (present)
- East Coast Freetail Bat (V)
- Grey-headed Flying-fox (V/V)
- Large-footed Myotis (V)
- Little Eagle (V)
- Scarlet Robin (V)
- Varied Sittella (V)
- Little Lorikeet (V)
- Dusky Woodswallow (V)

Migratory species

- Latham's Snipe
- Rufous Fantail
- White-throated Needletail



Paper Size A3

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Metres

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

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Western Sydney Airport
Biodiversity Offset Delivery Plan

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Threatened fauna and habitat features

Figure 7A

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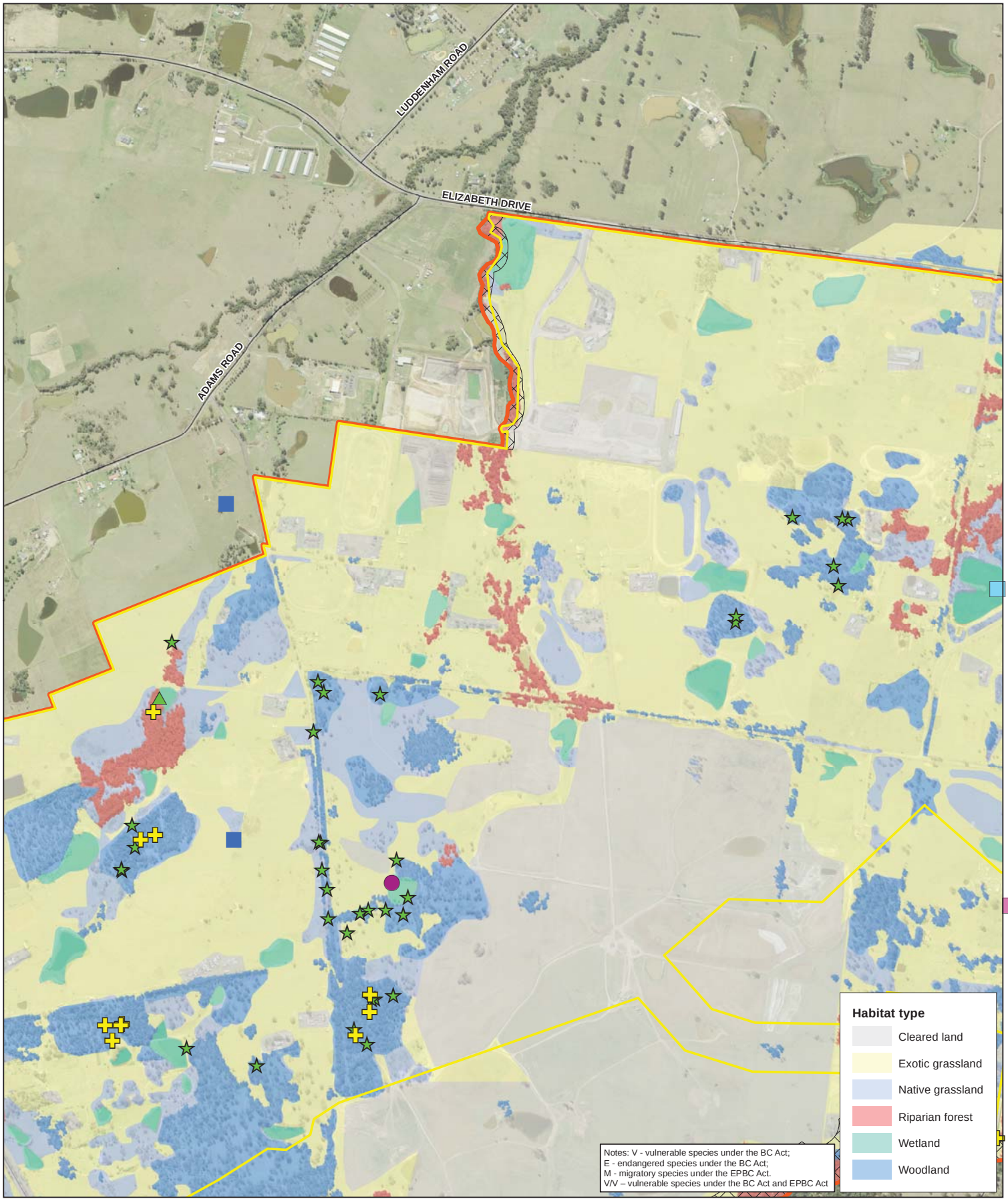
Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data source: Topographic Features - NSW LPI DTDB 2015, Airport layout data - WSU 2016, Aerial imagery - NSW LPI 2013, Vegetation mapping - OEH & GHD 2017, Ecological survey data - GHD 2017, Threatened & migratory species mapping - GHD 2017. Created by:jrprice



LEGEND

- Airport site
- Stage 1 Construction Impact Zone
- Environmental conservation
- Roads
- Habitat tree

Threatened species

- Blue-billed Duck (V)
- Black Bittern (V)
- Cumberland Plain Land Snail (E) (present)
- East Coast Freetail Bat (V)
- Grey-headed Flying-fox (V/V)
- Large-footed Myotis (V)
- Little Eagle (V)
- Scarlet Robin (V)
- Varied Sittella (V)
- Little Lorikeet (V)
- Dusky Woodswallow (V)

Migratory species

- Latham's Snipe
- Rufous Fantail
- White-throated Needletail

Paper Size A3
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Metres

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

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Threatened fauna and habitat features

Figure 7B

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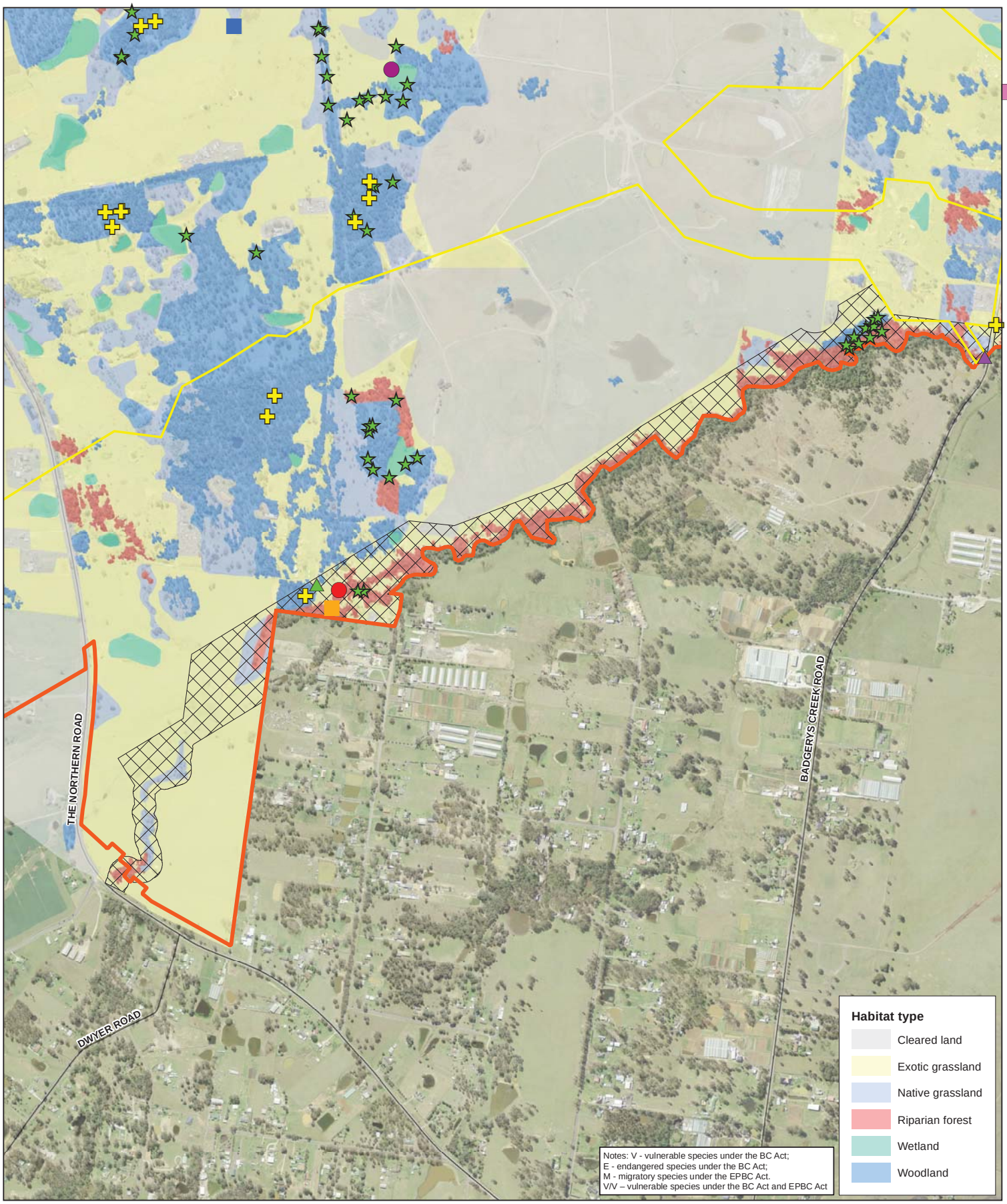
Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data source: Topographic Features - NSW LPI DTDB 2015, Airport layout data - WSU 2016, Aerial imagery - NSW LPI 2013, Vegetation mapping - OEH & GHD 2017, Ecological survey data - GHD 2017, Threatened & migratory species mapping - GHD 2017. Created by:jrprice



LEGEND

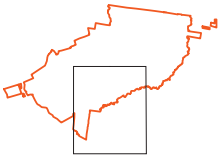
- Airport site
- Stage 1 Construction Impact Zone
- Environmental conservation
- Roads
- Habitat tree

Threatened species

- Blue-billed Duck (V)
- Black Bittern (V)
- Cumberland Plain Land Snail (E) (present)
- East Coast Freetail Bat (V)
- Grey-headed Flying-fox (V/V)
- Large-footed Myotis (V)
- Little Eagle (V)
- Scarlet Robin (V)
- Varied Sittella (V)
- Little Lorikeet (V)
- Dusky Woodswallow (V)

Migratory species

- Latham's Snipe
- Rufous Fantail
- White-throated Needletail



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Metres

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

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Threatened fauna and habitat features

Figure 7C

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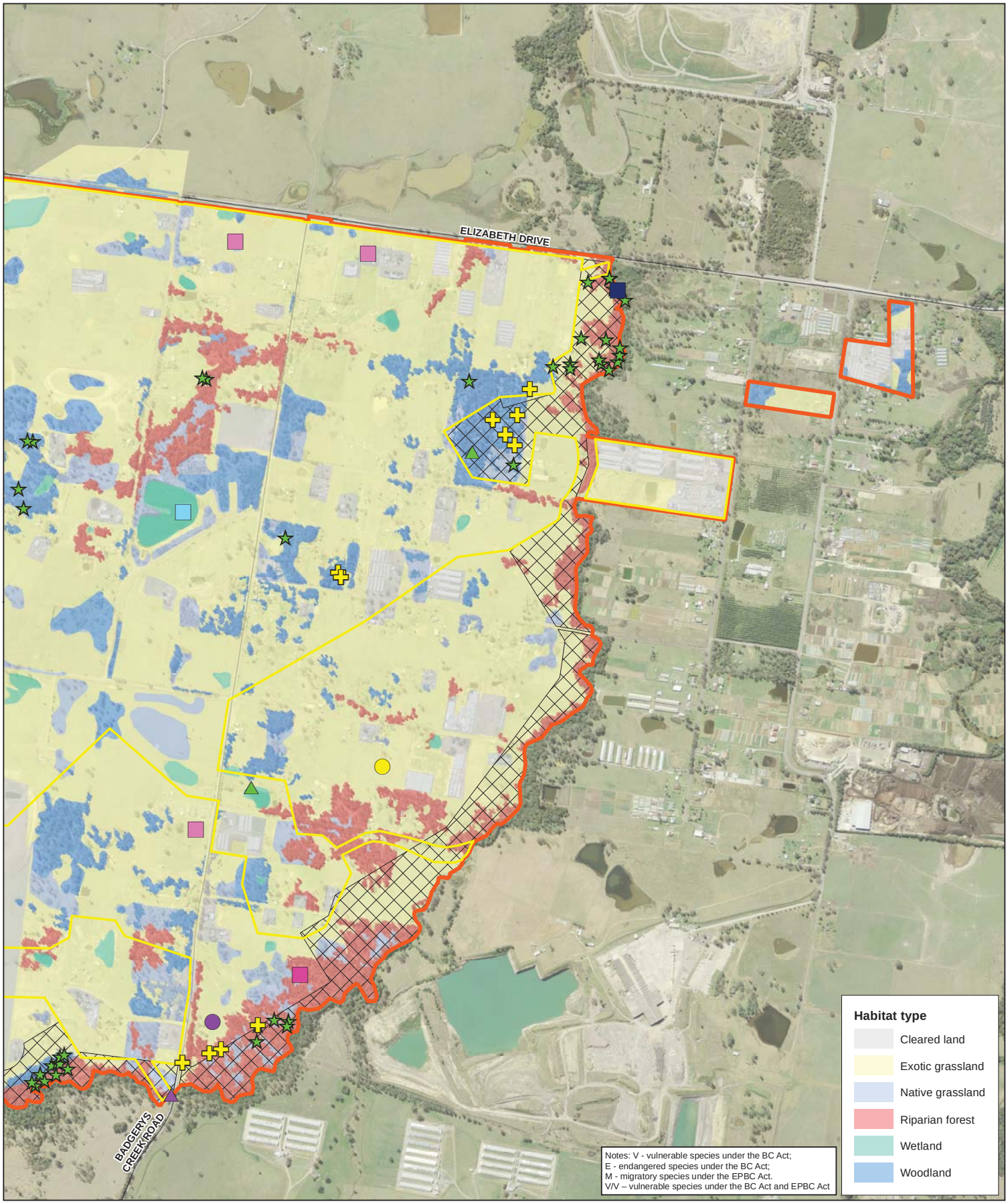
Data source: Topographic Features - NSW LPI DTDB 2015, Airport layout data - WSU 2016, Aerial imagery - NSW LPI 2013, Vegetation mapping - OEH & GHD 2017, Ecological survey data - GHD 2017, Threatened & migratory species mapping - GHD 2017. Created by:jrprice



LEGEND

- Airport site
- Stage 1 Construction Impact Zone
- Environmental conservation
- Roads
- Habitat tree

Threatened species

- Blue-billed Duck (V)
- Black Bittern (V)
- Cumberland Plain Land Snail (E) (present)
- East Coast Freetail Bat (V)
- Grey-headed Flying-fox (V/V)
- Large-footed Myotis (V)
- Little Eagle (V)
- Scarlet Robin (V)
- Varied Sittella (V)
- Little Lorikeet (V)
- Dusky Woodswallow (V)

Migratory species

- Latham's Snipe
- Rufous Fantail
- White-throated Needletail

Paper Size A3

0 100 200 400

Metres

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

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Threatened fauna and habitat features

Figure 7D

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Data source: Topographic Features - NSW LPI DTDB 2015, Airport layout data - WSU 2016, Aerial imagery - NSW LPI 2013, Vegetation mapping - OEH & GHD 2017, Ecological survey data - GHD 2017, Threatened & migratory species mapping - GHD 2017. Created by:jrprice

3 Offset requirements for plants, animals and their habitat

3.1 Overview

The following section presents the quantum of offset required for significant impacts on plants, animals and their habitats affected by the Stage 1 development with reference to the NSW FBA methodology and associated credit calculator. Assessments of the likely significance of impact on the environment on Commonwealth land arising from the airport were prepared in accordance with the *Matters of National Environmental Significance: Significant impact guidelines 1.2 Environment Protection and Biodiversity Conservation Act 1999* (DoE 2013b) (see: GHD 2016b and the Stage 1 BAR, GHD 2017). The following assessment is based on the biodiversity survey and assessment results presented in the GHD Biodiversity Assessment (GHD 2016b), the Stage 1 BAR (GHD 2017) and the Stage 1 BAR addendum (GHD 2018). Offset calculations were completed with reference to the FBA and based on field surveys conducted in accordance with the FBA (OEH 2014, 2016). The Stage 1 BAR addendum has been independently verified in accordance with Condition 30(4)(c) of the Airport Plan (see Appendix B of GHD 2018).

3.2 Removal of vegetation and habitat

The Stage 1 Construction Impact Zone (CIZ) includes the area of bulk earthworks in the northern half of the airport site, which would facilitate the development of the runway, terminal and aviation support facilities, as well as areas of disturbance outside the bulk earthworks boundary that would be used for ancillary infrastructure such as drainage controls, detention ponds, perimeter roads, security fencing and site services. No significant construction will occur outside the Stage 1 CIZ.

All vegetation and habitat resources will eventually be removed within the Stage 1 CIZ shown on Figure 5. The boundary of this area depicts the extent of vegetation clearing and grubbing, earthworks, permanent detention basins and the permanent infrastructure that will be constructed for Stage 1 of the airport. Construction of the Stage 1 development results in direct impacts within a 1199.1-hectare disturbance footprint, including 359 hectares of native vegetation as shown on Figure 5. One vegetation zone was created for each NSW vegetation type and broad condition state in the Stage 1 CIZ. The area of each zone was calculated using GIS. Vegetation zones within the impact area are summarised in Table 3.1.

Development impacts are expected to be restricted to the Stage 1 CIZ. Given the mitigation measures specified in Chapter 28 of the airport EIS (GHD 2016c), 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 3.1 Vegetation zones

Veg Zone ID	Vegetation Zone	Condition	BC Act status[1]	EPBC Act status[1]	Area	Plot/transects required	Plot/transects completed
1	Good condition Grey Box – Forest Red Gum grassy woodland on flats (HN528)	Moderate/good to high	CEEC	CEEC (part[2]), foraging habitat[3]	104.8	6	10 (Plot/transects 2, 5, 6, 11, 12, 22, 23, 25, 31, 35)
2	Poor condition Grey Box – Forest Red Gum grassy woodland on flats (HN528)	Moderate/good to poor	CEEC		113.2	6	10 (Plot/transects 3, 24, 28, 30, 37, 42, 57, 59, 60, 78)
3	Good condition Grey Box – Forest Red Gum grassy woodland on hills (HN529)	Moderate/good	CEEC	CEEC (part[2]), foraging habitat[3]	35.5	4	4 (Plot/transects 20, 21, 36, 38)
4	Poor condition Grey Box – Forest Red Gum grassy woodland on hills (HN529)	Moderate/good to poor	CEEC		13.2	3	4 (Plot/transects 39, 41, 71, 75)
5	Good condition Forest Red Gum – Rough-barked Apple grassy woodland (HN526)	Moderate/good	EEC	Foraging habitat[3]	35.9	4	4 (Plot/transects 17, 26, 29, 33)
6	Poor condition Forest Red Gum – Rough-barked Apple grassy woodland (HN526)	Moderate/good to poor	EEC		11.7	3	3 (Plot/transects 27, 67, 79)
7	Good condition Broad-leaved Ironbark – Grey Box – *Melaleuca decora* grassy open forest (HN512)	Moderate/good	EEC	CEEC (part[2]), foraging habitat[3]	5.5	3	3 (Plot/transects 51, 63, 64)
8	Poor condition Broad-leaved Ironbark – Grey Box – *Melaleuca decora* grassy open forest (HN512)	Moderate/good to poor	EEC		0.4	1	1[4] (Plot/transect 43)[5]

Veg Zone ID	Vegetation Zone	Condition	BC Act status[1]	EPBC Act status[1]	Area	Plot/transects required	Plot/transects completed
9	Good condition artificial freshwater wetland on floodplain (HN630)	Moderate/good			32.7	4	4 (Plot/transects 65, 77, 80 ,81)
10	Low condition Grey Box – Forest Red Gum grassy woodland on flats (HN528)	Low			542.2	5	9 (Plot/transects 4, 50, 52, 54, 56, 58, 61 ,62, 76)
11	Low condition Grey Box – Forest Red Gum grassy woodland on hills (HN529)	Low			41.9	3	4 (Plot/transects 70, 72, 73, 74)
12	Low condition Forest Red Gum – Rough-barked Apple grassy woodland (HN526)	Low			52	3	4 (Plot/transects 55, 66, 68, 69)
13	Medium condition Grey Box – Forest Red Gum grassy woodland on flats (HN528)	Moderate/good to medium	CEEC	Foraging habitat[3]	6.1	3	3 (Plot/transect 53, rapid plot/transects 2 and 3)[6]
	Total vegetation				**995.1**		
	Cleared land or cropland				204		n/a
	Total Revised CIZ				**1199.1**		

Notes: 1) CEEC – critically endangered ecological community; EEC – endangered ecological community. 2) part of this vegetation zone, comprising patches that meet the condition criteria for a local occurrence of EPBC Act Cumberland Plain Woodland as defined in the listing advice for the community (TSSC 2008) and associated guidelines (DEWHA 2010). 3) foraging habitat for the Swift Parrot and Grey-headed Flying-fox based on the presence of recognised food trees as described in Section 2. 4) The number of plot/transects that must be sampled according to the FBA, based on the vegetation zone area: 0 to 4 ha / 1 per 2 ha or 1 if low; greater than 4 to 20 ha / 3 plots or 2 if low; greater than 20 to 50 ha/ 4 plots or 3 if low; greater than 50 to 100 ha / 5 plots or 3 if low; greater than 100 to 250 ha / 6 plots or 4 if low; greater than 250 to 1000 ha / 7 plots or 5 if low (OEH 2014a). 5) Data from plot/transect 43 outside the Stage 1 CIZ was entered because it is in adjacent and floristically similar vegetation. 6) Benchmark plant species richness data was entered for rapid plot/transects.

Site value data was collected using the plot/transect methodology and was entered for each plot/transect field in each vegetation zone. Vegetation zone 13 was created as a result of independent verifier review after the updated field surveys had been completed and so there was no opportunity to purposefully stratify survey effort across this vegetation zone and ensure that the required number of plot/transects was sampled. As a result, two of the three vegetation survey points in this new vegetation zone were only rapid plot/transects and only the dominant plant species were recorded. To avoid potential underestimation of the site value score in these areas, benchmark plant species richness data was entered for rapid plot/transects 2 and 3.

Vegetation zone 8 did not occur in the indicative Stage 1 CIZ and as such was not sampled directly with plot/transects for the Stage 1 BAR. There is 0.4 hectares of vegetation zone 8 in the Revised CIZ. Data from plot/transect 43 outside the Stage 1 CIZ was entered because it is in adjacent and floristically similar vegetation.

3.3 Impacts on threatened species

3.3.1 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 Stage 1 CIZ. 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 3.2. There is known or potential habitat for each of these threatened species in the Stage 1 CIZ and so the threatened species multipliers have not been adjusted. This list is equivalent to the list for the original Stage 1 CIZ (see Table 41 of the Stage 1 BAR, GHD 2017).

Table 3.2 Predicted threatened species (ecosystem credit species)

Common name	Scientific name	Threatened species multiplier	On site [1]
Australian Painted Snipe	*Rostratula australis*	1.3	Yes
Barking Owl	*Ninox connivens*	3.0	Yes
Black Bittern	*Ixobrychus flavicollis*	1.3	Yes[2]
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

Common name	Scientific name	Threatened species multiplier	On site [1]
Bush Stone-curlew	*Burhinus grallarius*	2.6	Yes
Diamond Firetail	*Stagonopleura guttata*	1.3	Yes
Eastern False Pipistrelle	*Falsistrellus tasmaniensis*	2.2	Yes[2]
Eastern Freetail-bat	*Mormopterus norfolkensis*	2.2	Yes[2]
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[3]
Hooded Robin (south-eastern form)	*Melanodryas cucullata* subsp. *cucullata*	1.7	Yes
Little Eagle	*Hieraaetus morphnoides*	1.4	Yes[2]
Little Lorikeet	*Glossopsitta pusilla*	1.8	Yes[2]
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[2]
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

Notes: 1) habitat resources for the species are present at the site and the species is likely to occur on site at least from time to time. 2) directly observed on site during surveys conducted for the airport EIS or the Stage 1 BAR (GHD 2017). 3) potentially present on site based on possible call identifications made from Anabat recordings (GHD 2017).

3.3.2 Species credits

Species-credit species cannot be reliably predicted to use an area of land based on habitat surrogates according to the FBA. 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.

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. This list has been expanded and modified to include threatened species previously recorded in the locality based on BioNet data (OEH 2018a).

A table of potential candidate threatened species prepared in accordance with the FBA is included in Appendix A of the Stage 1 BAR (GHD 2017). This table includes the Threatened species survey / time matrix and survey effort table generated by the FBA credit calculator along with a summary of BioNet records of each species and the survey effort completed. Appendix A of the Stage 1 BAR also includes a summary of the specific techniques and timing of survey effort employed for each species.

The majority of the species-credit type species predicted to occur have been reliably excluded from occurring at the airport site or being affected by the airport based on field survey effort undertaken in accordance with the survey time matrix (see Section 4.5 and Appendix A of the Stage 1 BAR (GHD 2017)). The existing environment of the Stage 1 CIZ and the type of habitats present is equivalent to the indicative Stage 1 CIZ and so the survey time matrix does not require any update.

The species-credit type threatened species that are present at the airport site are summarised in Table 3.3 along with the extent of impacts. For plants, impacts were calculated based on the number of individuals in the Stage 1 CIZ. For animals, impacts were calculated based on the extent of habitat for the species in the Stage 1 CIZ as described below.

Table 3.3 Impacts on species-credit type threatened species

Common name	Scientific name	TSC Act Status	Likelihood of occurrence	Quantum of impact
Dillwynia tenuifolia	*Dillwynia tenuifolia*	Vulnerable	Present. 30 individuals were recorded in the Stage 1 CIZ.	30 individuals
Pultenaea parviflora	*Pultenaea parviflora*	Endangered	Present. 4 individuals were recorded in the Stage 1 CIZ.	4 individuals
Pimelea spicata	Spiked Rice-flower	Endangered	Present. 4118 clumps were recorded in the Stage 1 CIZ.	4118 clumps
Marsdenia viridiflora subsp. *viridiflora*	*Marsdenia viridiflora* subsp. *viridiflora*	Endangered population	Present. 145 stems were recorded in the Stage 1 CIZ.	145 stems
Cumberland Plain Land Snail	*Meridolum corneovirens*	Endangered	Present in the Stage 1 CIZ. Generally occurs in larger remnant patches of Cumberland Plain Woodland with deep leaf litter.	183.2ha

Common name	Scientific name	TSC Act Status	Likelihood of occurrence	Quantum of impact
Southern Myotis roosting habitat	*Myotis macropus* 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. Habitat present in the Stage 1 CIZ.	71.7ha

Cumberland Plain Land Snail

The Cumberland Plain Land Snail was recorded at multiple locations across the Stage 1 CIZ and airport site. Species credits were calculated for the species by preparing a Cumberland Plain Land Snail species polygon, consistent with Section 6.5.1 of the FBA (OEH 2014a). The area of known and potential habitat for the Cumberland Plain Land Snail was mapped based on the location of the individuals found within the Stage 1 CIZ and areas of suitable habitat identified during the GHD field surveys (see Figure 8). The species polygon is more extensive than the area of known habitat confirmed by field surveys because the Cumberland Plain Land Snail may burrow during hot, dry weather and not be detected. Habitat was defined based on the presence of native over storey and predominantly native groundcover species, dense moist leaf litter, friable topsoil, woody debris or other shelter substrate and known vegetation associations as described in the threatened species profile for the species (OEH 2018b).

Based on the approach described above, a 183.2-hectare Cumberland Plain Land Snail species polygon was mapped at the airport site as shown on Figure 8.

Southern Myotis roosting habitat

Probable calls of the Southern Myotis were recorded at a number of locations in the Stage 1 CIZ. A small colony of bats were recorded roosting under the bridge over Badgerys Creek and a large number of calls probably attributable to the Southern Myotis were also recorded at this location. Farm dams and creeks would provide foraging habitat for this species. It may roost in tree hollows, culverts and old buildings in the Stage 1 CIZ where they are located close to suitable foraging habitat.

Species credits were calculated for the species, by preparing a Southern Myotis roosting habitat species polygon consistent with the FBA. The area of roosting habitat for the species was mapped, based on the presence of woodland or forest with hollow-bearing trees or other roost sites within the vicinity of third and fourth-order drainage lines or freshwater wetlands. This was achieved with GIS by buffering water bodies by 100 metres and then clipping out areas that did not contain suitable roost sites such as tree hollows. The draft species polygons were checked against habitat assessments completed during field surveys and at selected locations and ground-truthed during the updated 2017 field surveys.

Based on the approach described above, a 71.7-hectare Southern Myotis species polygon was mapped at the airport site as shown on Figure 8.

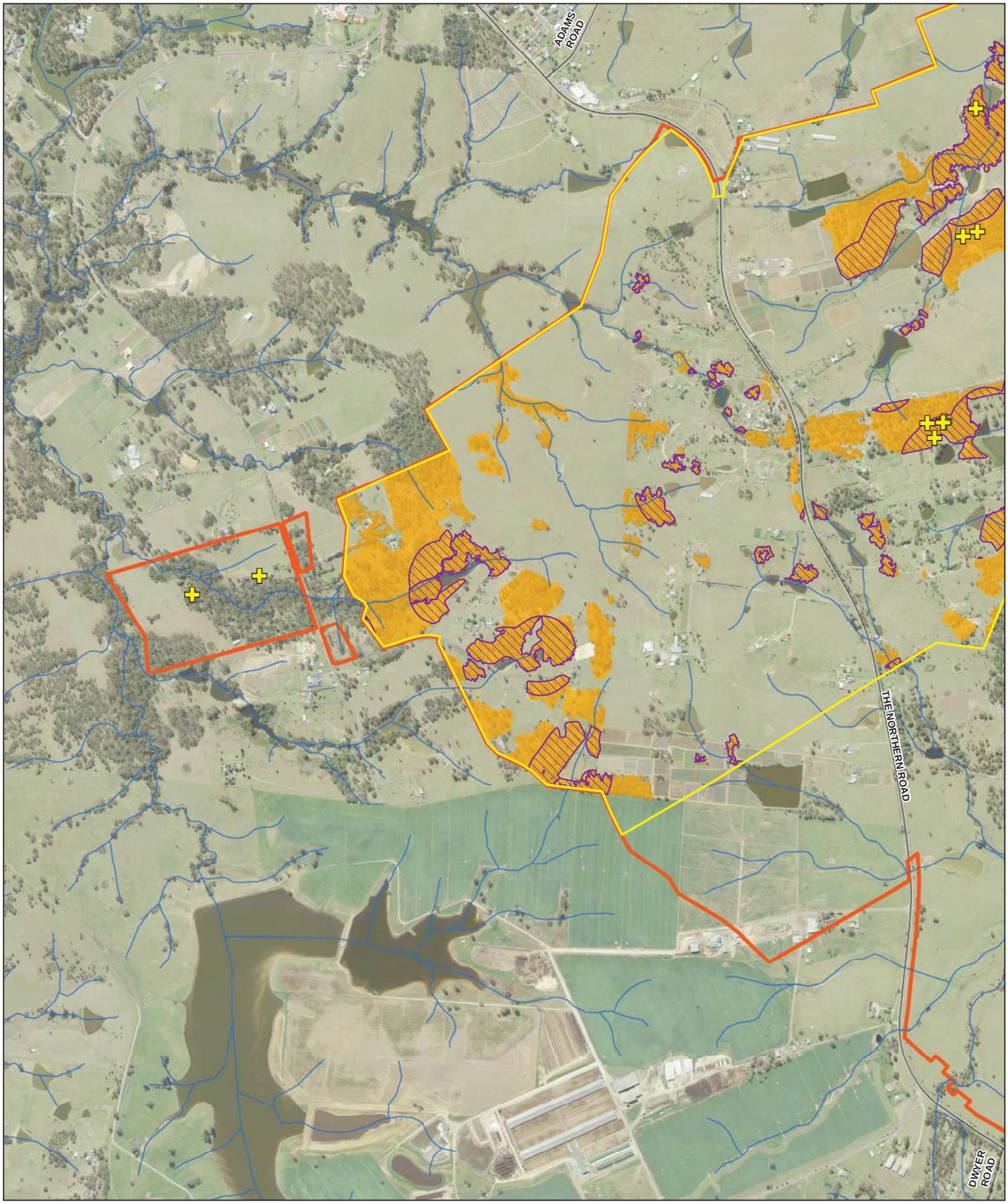
Black Bittern

The Black Bittern was a species-credit species in 2017 and assessed as such in the Stage 1 BAR (GHD 2017). A Black Bittern was recorded roosting in dense riparian vegetation in the Badgerys Creek riparian corridor outside of the Stage 1 CIZ. Larger, more densely vegetated dams and permanent creeks in the Stage 1 CIZ would provide foraging habitat for this species. It may roost and potentially nest in reed beds and riparian forest in the Stage 1 CIZ where they are located close to suitable foraging habitat. A Black Bittern species polygon was mapped to encompass 17.2 hectares of occupied habitat in the indicative CIZ (GHD 2017).

The Black Bittern was changed to a predicted threatened species (ie an ecosystem-credit type species for the purposes of credit calculations) by the OEH in early 2018 'because its presence can be predicted based on vegetation and it is difficult to survey' (OEH 2018a). Therefore Black Bittern species-credit calculations have not been included in this Stage 1 BAR addendum. Appropriate like-for-like offsets for the removal of occupied Black Bittern habitat will be provided through the purchase and retirement of Forest Red Gum – Rough-barked Apple grassy woodland (HN526) and or *Typha orientalis/Phragmites australis* freshwater wetland on floodplain (HN630) ecosystem credits from BSA sites or delivery of offsets equivalent to these credit types.

The threatened species profile database attached to the credit calculator has not yet been updated to reflect the Black Bittern becoming a predicted threatened species (though the change is reflected in the BAM credit calculator). Therefore, to avoid the generation of an invalid species-credit requirement, the Black Bittern data on the Threatened species survey results form of the credit calculator was entered as: 'Impacted by development?' = 'No'; 'ID method' = 'Survey; and 'Loss' = '0'.

It should also be noted the Black Bittern has a threatened species offset multiplier of 1.3, which is less than the offset multipliers for the threatened species with the highest multipliers that are an input to the ecosystem credit calculations (Black-tailed Godwit with a multiplier of 2.6 for freshwater wetland/HN630; and Barking Owl or Masked Owl with a multiplier of 3.0 for forest and woodland ecosystem credit types/HN528, HN529, HN526 and HN512).



LEGEND

- The airport site
- Stage 1 Construction Impact Zone
- Environmental conservation
- Watercourses
- Roads

Species credit species

- Cumberland Plain Land Snail (E)
- Southern Myotis (V)

- Cumberland Plain Land Snail species polygon
- Southern Myotis species polygon

Notes: V - vulnerable species under the BC Act;
E - endangered species under the BC Act.

Paper Size A3

0 100 200 400

Metres

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

N

Department of Infrastructure, Regional Development and Cities
Western Sydney Airport
Biodiversity Offset Delivery Plan

Job Number 21-26204
Revision A
Date 13 Jul 2018

Species polygons

Figure 8A

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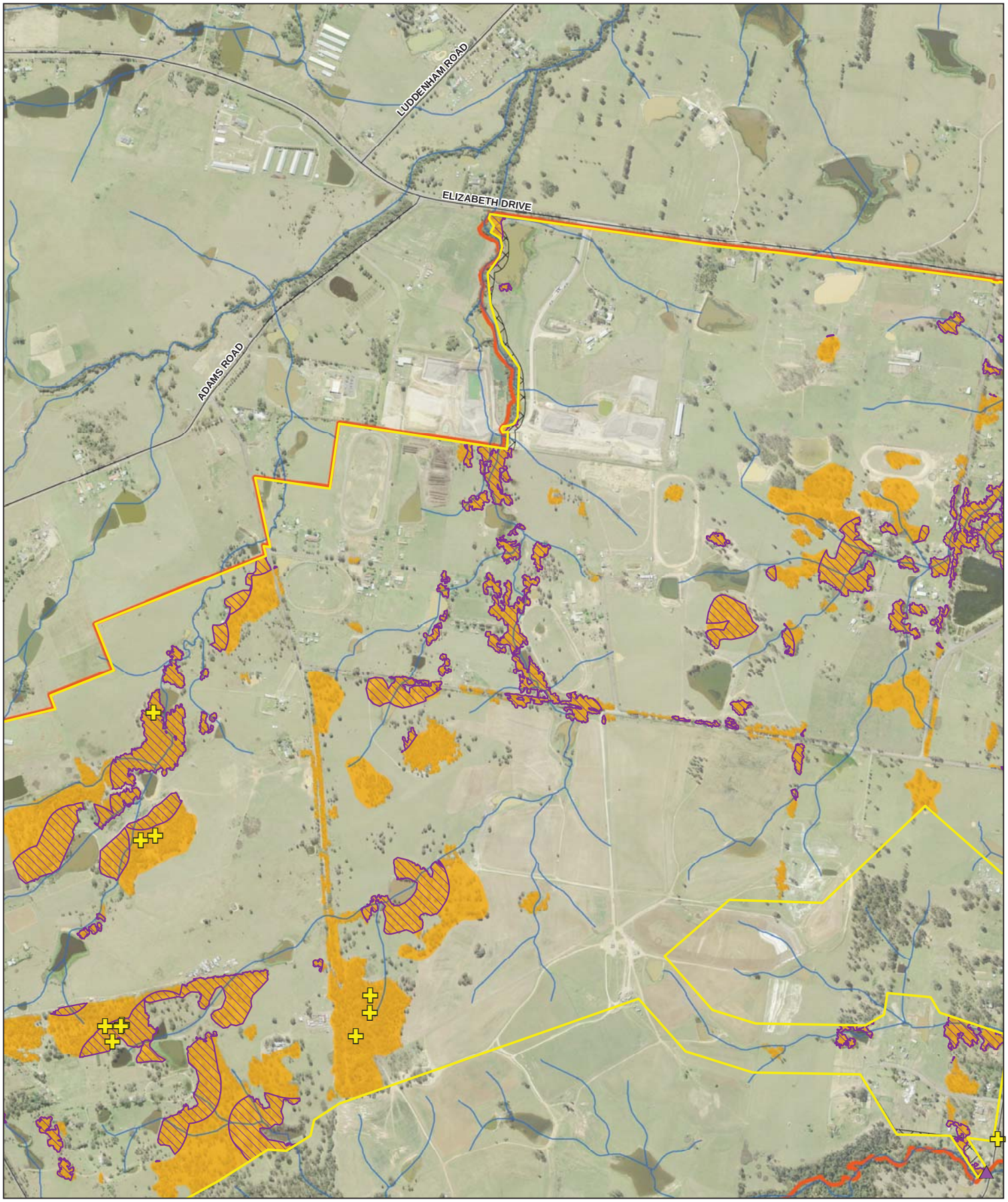
Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data source: Topographic Features - NSW LPI DTDB 2015, Airport layout data - WSU 2016, Aerial imagery - NSW LPI 2013, Vegetation mapping - OEH & GHD 2017, Ecological survey data - GHD 2017, Threatened species mapping - GHD 2017. Created by:jrprice



LEGEND

- The airport site
- Stage 1 Construction Impact Zone
- Environmental conservation
- Watercourses
- Roads

Species credit species

- Cumberland Plain Land Snail (E)
- Southern Myotis (V)

- Cumberland Plain Land Snail species polygon
- Southern Myotis species polygon

Notes: V - vulnerable species under the BC Act;
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Paper Size A3

0 100 200 400

Metres

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

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Department of Infrastructure, Regional Development and Cities
Western Sydney Airport
Biodiversity Offset Delivery Plan

Job Number 21-26204
Revision A
Date 13 Jul 2018

Species polygons

Figure 8B

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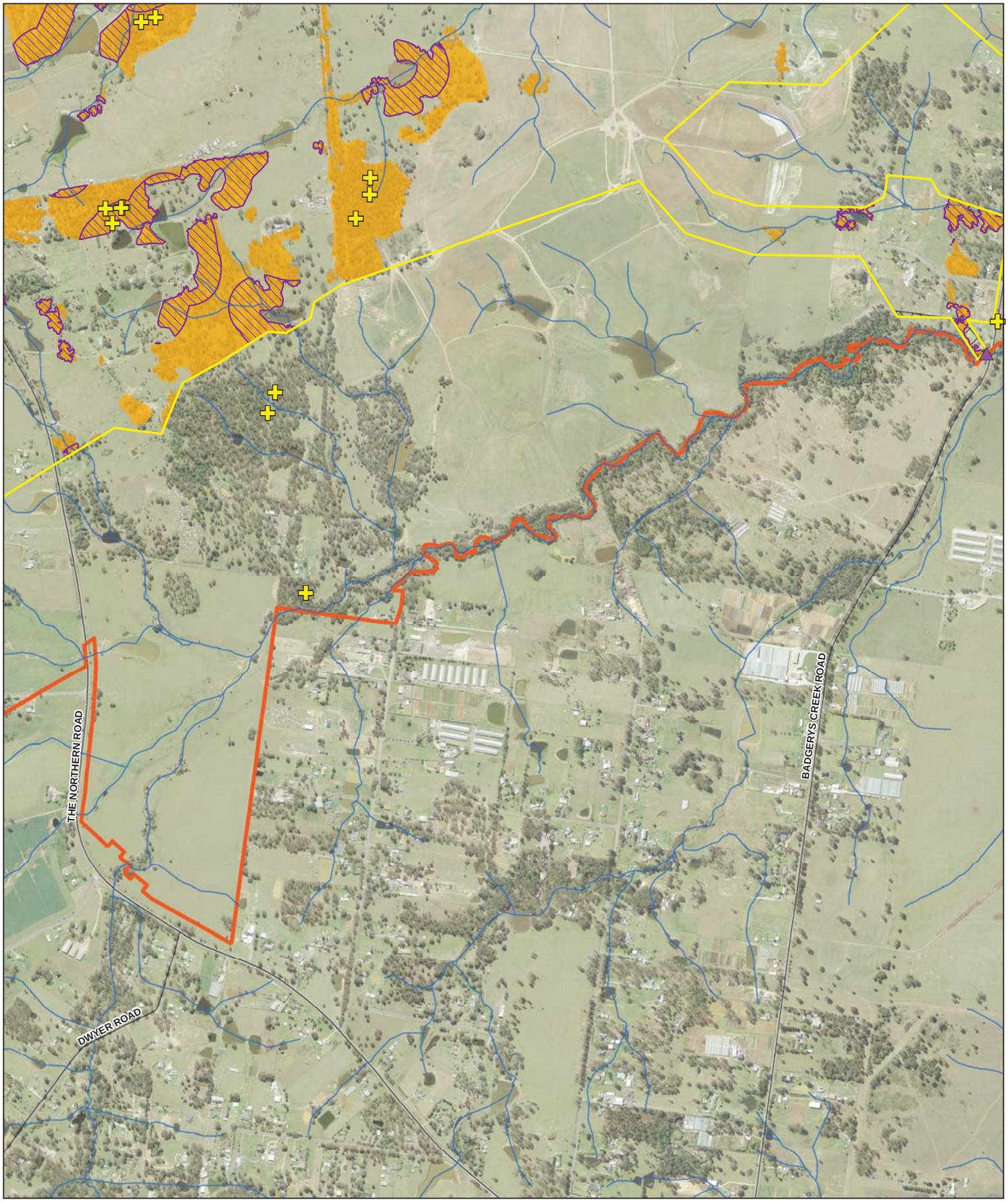
Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data source: Topographic Features - NSW LPI DTDB 2015, Airport layout data - WSU 2016, Aerial imagery - NSW LPI 2013, Vegetation mapping - OEH & GHD 2017, Ecological survey data - GHD 2017, Threatened species mapping - GHD 2017. Created by:jrprice



LEGEND

- The airport site
- Stage 1 Construction Impact Zone
- Environmental conservation
- Watercourses
- Roads

Species credit species

- Cumberland Plain Land Snail (E)
- Southern Myotis (V)

- Cumberland Plain Land Snail species polygon
- Southern Myotis species polygon

Notes: V - vulnerable species under the BC Act;
E - endangered species under the BC Act.

Paper Size A3

0 100 200 400

Metres

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

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Department of Infrastructure, Regional Development and Cities
Western Sydney Airport
Biodiversity Offset Delivery Plan

Job Number 21-26204
Revision A
Date 13 Jul 2018

Species polygons

Figure 8C

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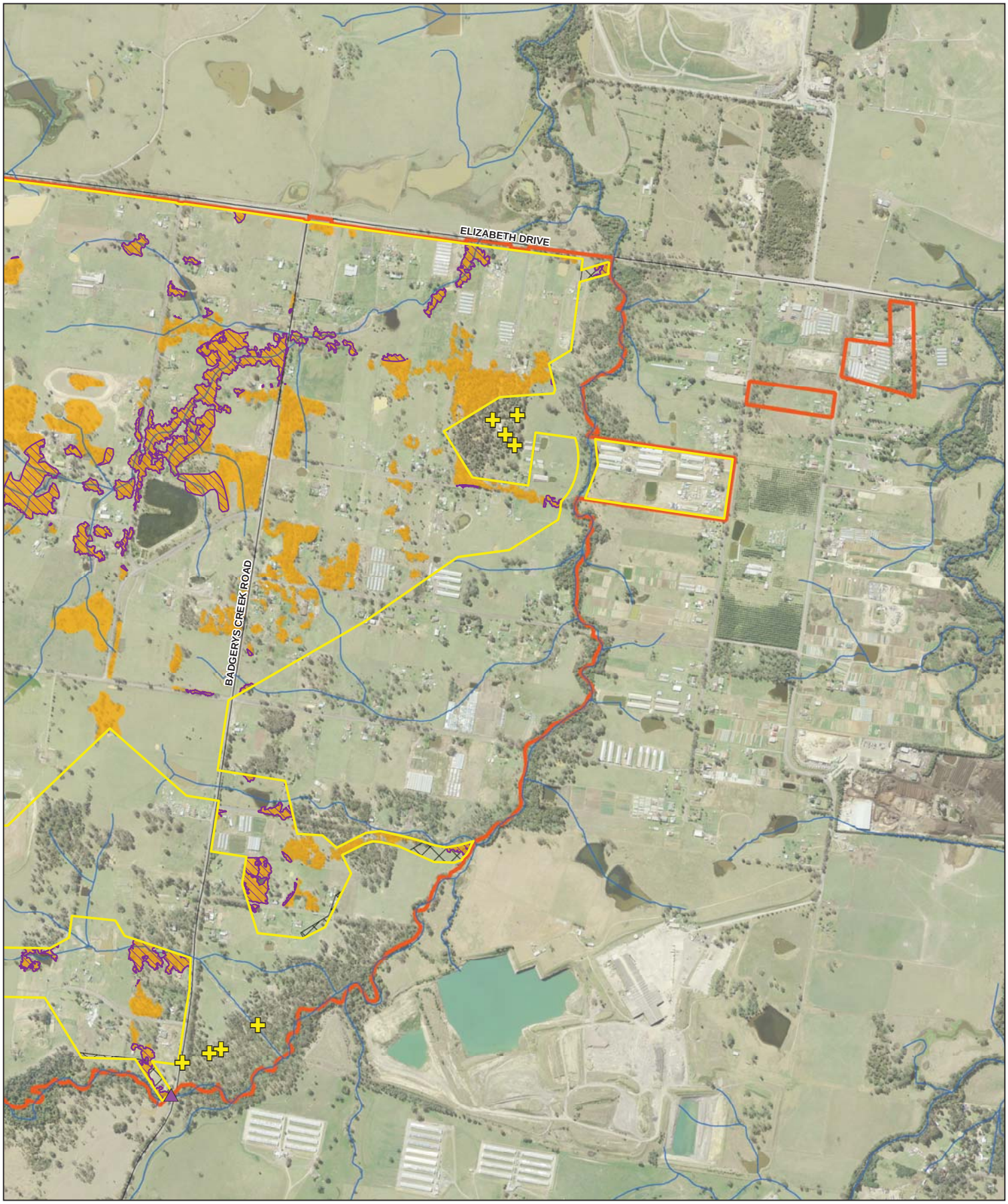
Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data source: Topographic Features - NSW LPI DTDB 2015, Airport layout data - WSU 2016, Aerial imagery - NSW LPI 2013, Vegetation mapping - OEH & GHD 2017, Ecological survey data - GHD 2017, Threatened species mapping - GHD 2017. Created by:jrprice



LEGEND

- The airport site
- Stage 1 Construction Impact Zone
- Environmental conservation
- Watercourses
- Roads

Species credit species

- Cumberland Plain Land Snail (E)
- Southern Myotis (V)

- Cumberland Plain Land Snail species polygon
- Southern Myotis species polygon

Notes: V - vulnerable species under the BC Act;
E - endangered species under the BC Act.

Paper Size A3

0 100 200 400

Metres

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

N

Department of Infrastructure, Regional Development and Cities
Western Sydney Airport
Biodiversity Offset Delivery Plan

Job Number 21-26204
Revision A
Date 13 Jul 2018

Species polygons

Figure 8D

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

3.4 Impacts requiring biodiversity offsets

Vegetation zones 1 to 9 and also 13 in Table 3.1 are native vegetation and threatened species habitat and each have a current site value score of greater than 17. Therefore, impacts on these vegetation zones require the calculation of biodiversity offsets. There is a total of 359 hectares of native vegetation and threatened species habitat requiring biodiversity offsets in the Stage 1 CIZ.

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 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 CIZ will eventually be removed. The default decrease in site value was entered in the credit calculator for all management zones (ie the site values for all vegetation and habitat attributes were reduced to zero). Management zones in the Stage 1 CIZ are summarised in Table 3.4.

The results of the biodiversity offset calculations are presented in Section 3.7.

Table 3.4 Management zones

Management zone	Veg zone ID	Vegetation zone	Condition	Area (ha)	Site value score	Management / site attribute scores
MZ1	1	Good condition Grey Box – Forest Red Gum grassy woodland on flats (HN528)	Moderate/good	104.8	74.4	Full removal / Default decrease in site value
MZ2	2	Poor condition Grey Box – Forest Red Gum grassy woodland on flats (HN528)	Moderate/good to poor	113.2	36.23	Full removal / Default decrease in site value
MZ3	3	Good condition Grey Box – Forest Red Gum grassy woodland on hills (HN529)	Moderate/good	35.5	53.14	Full removal / Default decrease in site value
MZ4	4	Poor condition Grey Box – Forest Red Gum grassy woodland on hills (HN529)	Moderate/good to poor	13.2	42.75	Full removal / Default decrease in site value
MZ5	5	Good condition Forest Red Gum – Rough-barked Apple grassy woodland (HN526)	Moderate/good	35.9	70.83	Full removal / Default decrease in site value

Management zone	Veg zone ID	Vegetation zone	Condition	Area (ha)	Site value score	Management / site attribute scores
MZ6	6	Poor condition Forest Red Gum – Rough-barked Apple grassy woodland (HN526)	Moderate/good to poor	11.7	49.83	Full removal / Default decrease in site value
MZ7	7	Good condition Broad-leaved Ironbark – Grey Box – *Melaleuca decora* grassy open forest (HN512)	Moderate/good	5.5	73.19	Full removal / Default decrease in site value
MZ8	8	Poor condition Broad-leaved Ironbark – Grey Box – *Melaleuca decora* grassy open forest (HN512)	Moderate/good to poor	0.4	62.32	Full removal / Default decrease in site value
MZ9	9	Good condition artificial freshwater wetland on floodplain (HN630)	Moderate/good	32.7	33.33	Full removal / Default decrease in site value
MZ10	10	Low condition Grey Box – Forest Red Gum grassy woodland on hills (HN528)	Low	542.2	11.59	Full removal / Default decrease in site value
MZ11	11	Low condition Grey Box – Forest Red Gum grassy woodland on hills (HN529)	Low	41.9	13.77	Full removal / Default decrease in site value
MZ12	12	Low condition Forest Red Gum – Rough-barked Apple grassy woodland (HN526)	Low	52	8.33	Full removal / Default decrease in site value
MZ13	13	Medium condition Grey Box – Forest Red Gum grassy woodland on flats (HN528)	Moderate/good to medium	6.1	36.96	Full removal / Default decrease in site value

3.5 Areas not requiring offset determination

Vegetation zones 10 to 12 in Table 3.1 are predominantly exotic vegetation. They have been mapped as low-condition forms of the native vegetation types that are most likely to have occurred previously for the purposes of site stratification and sampling with plot/transects. These vegetation zones comprise potential habitat for some threatened species and feature some native over-storey and mid-storey cover but minimal native groundcover, no hollow-bearing trees, no woody debris, minimal natural regeneration and very low species richness. Each of these vegetation zones have a site value score calculated by the credit calculator of less than 17, which is below the threshold for which offsets must be calculated for impacts on potential threatened species habitat.

None of this vegetation comprises a local occurrence of a Threatened Ecological Community (TEC) or contains species-credit type threatened species or their habitats. Therefore impacts on vegetation zones 10 to 12 in the project area do not require the calculation of offsets according to the FBA.

A more detailed description of this vegetation and justification for the decision to not provide offsets under the FBA is provided in Section 4.2.2 of the Stage 1 BAR (GHD 2017).

3.6 Areas not requiring assessment

An assessor is not required to assess areas in a project area without native vegetation unless the Secretary's Environmental Assessment Requirements (SEARs) for the project specifically require it.

The mapped area of cleared land or cropland does not comprise native vegetation within the meaning of the FBA. These areas comprise the condition class 'cleared land' according to the FBA (OEH 2014a) because they contain no native over-storey or mid-storey vegetation and greater than 50% exotic groundcover or greater than 90% bare earth. This area includes gravel tracks, hardstand areas and other infrastructure with occasional plants associated with cracks or shallow soil deposits that clearly do not comprise native vegetation within the meaning of the FBA and do not require assessment.

These areas do not comprise native vegetation or threatened species habitat according to the FBA and so were not sampled with plot/transects. A more detailed description of these areas and justification for the decision for no further assessment under the FBA is provided in Section 4.2.2 of the Stage 1 BAR (GHD 2017).

3.7 Biodiversity credits

The data summarised above were entered into Version 4.0 of the credit calculator (Proposal ID 073/2015/2144MP; Version 3) to determine the number of biodiversity credits that would be required to offset the removal of vegetation and habitat in the Stage 1 CIZ. The calculations have been independently verified. The Biodiversity credit report is included in Appendix A of the Stage 1 BAR addendum (GHD 2018) and is summarised below.

3.7.1 Ecosystem credits

The ecosystem credits that would be required to offset the impacts of the airport on plants, animals and their habitat are shown in Table 3-5, along with potential offset options (ie the PCTs that can be used to offset these impacts according to the FBA/BioBanking credit trading rules).

Table 3.5 Ecosystem credits required to offset impacts of the airport

Plant community type name	Condition	BC Act status	EPBC Act status	Management zone area (ha)	Ecosystem credit requirement	Offset options – Plant community types
Areas requiring offset						
Good condition Grey Box – Forest Red Gum grassy woodland on flats (HN528)	Moderate/good to high	CEEC	CEEC	104.8	6545	HN528
Poor condition Grey Box – Forest Red Gum grassy woodland on flats (HN528)	Moderate/good to poor	CEEC		113.2	3829	HN528
Medium condition Grey Box – Forest Red Gum grassy woodland on flats (HN528)	Moderate/good to medium	CEEC		6.1	210	HN528
Good condition Grey Box – Forest Red Gum grassy woodland on shale (HN529)	Moderate/good	CEEC	CEEC	35.5	1651	HN529, HN528
Poor condition Grey Box – Forest Red Gum grassy woodland on shale (HN529)	Moderate/good to poor	CEEC		13.2	511	HN529, HN528
Good condition Forest Red Gum – Rough-barked Apple grassy woodland (HN526)	Moderate/good	EEC		35.9	2146	HN526
Poor condition Forest Red Gum – Rough-barked Apple grassy woodland (HN526)	Moderate/good to poor	EEC		11.7	515	HN526

Plant community type name	Condition	BC Act status	EPBC Act status	Management zone area (ha)	Ecosystem credit requirement	Offset options – Plant community types
Good condition Broad-leaved Ironbark – Grey Box – *Melaleuca decora* grassy open forest (HN512)	Moderate/good	EEC	CEEC	5.5	338	HN512, HN513, HN604, HN556
Poor condition Broad-leaved Ironbark – Grey Box – *Melaleuca decora* grassy open forest (HN512)	Moderate/good to poor	EEC		0.4	21	HN512, HN513, HN604, HN556
Good condition artificial freshwater wetland on floodplain (HN630)	Moderate/good			32.7	926	HN630, HN520
Areas not requiring offset						
Low condition Grey Box – Forest Red Gum grassy woodland on flats (HN528)	Low			542.2	0	n/a
Low condition Grey Box – Forest Red Gum grassy woodland on shale (HN529)	Low			41.9	0	n/a
Low condition Forest Red Gum – Rough-barked Apple grassy woodland (HN526)	Low			52	0	n/a

3.7.2 Species credits

The species credits that would be required to offset the impacts of the Stage 1 development on plants, animals and their habitat are shown in Table 3.6.

Table 3.6 Species credits required to offset impacts of the airport

Common name	Scientific name	Threatened species multiplier	Species credits required
Cumberland Plain Land Snail	*Meridolum corneovirens*	1.3	2441
Dillwynia tenuifolia	*Dillwynia tenuifolia*	1.8	540
Marsdenia viridiflora subsp. *viridiflora* in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	*Marsdenia viridiflora* subsp. *viridiflora* endangered population	4.0	5800
Pultenaea parviflora	*Pultenaea parviflora*	1.5	60
Southern Myotis roosting habitat	*Myotis macropus* roosting habitat	2.2	1617
Spiked Rice-flower	*Pimelea spicata*	2.6	107,068

4 Consultation Activities

This chapter outlines the consultation activities undertaken throughout the preparation of the BODP for Stage 1 of the Western Sydney Airport. Advice on biodiversity offsets and complementary outcomes was sought from a variety of stakeholders, including the Australian Government, the NSW Government, local councils, conservation groups, community groups, local Aboriginal Land Councils and other Aboriginal groups, as well as other individuals and organisations with relevant expertise.

In line with the Airport Plan conditions, the Department established an Experts Group and consulted with the Experts Group on the development of the BODP and the offset measures to be included. The Department also consulted with local Aboriginal Land Councils and Aboriginal groups and individuals in Western Sydney to identify complementary outcomes for Aboriginal cultural heritage on the Cumberland Plain within the conservation activities proposed in the BODP.

4.1 Biodiversity Experts Group

Under Condition 31 of the Airport Plan, the Department was required to establish an Experts Group consisting of appropriately qualified and experienced experts in fields relevant to the BODP. The Experts Group had to be consulted on the development of the BODP and any proposed biodiversity offsets and other compensatory measures secured or implemented before the approval of the BODP. The preparation of the BODP also had to be informed by the advice of the Experts Group, specifically on whether and how conservation outcomes improve or maintain the viability of the biodiversity values to be offset. Condition 31(5) states that, when published, the BODP must include or be accompanied by the advice of the Experts Group.

4.1.1 Membership of the Biodiversity Experts Group

In considering the membership of the group, the Department consulted with an Approver in Environment and Energy about the proposed membership of the Experts Group as required by Condition 31(3) of the Airport Plan. Environment and Energy was also consulted on the Terms of Reference for the Experts Group.

Prior to establishing the Experts Group, the Department consulted with the Cumberland Conservation Corridor Reference Group (the CCC Reference Group) during the CCC Reference Group's regular meetings on 17 November 2016 and 2 March 2017. The CCC Reference Group was established by the Biodiversity Conservation Division in Environment and Energy to support the delivery of a 2013 election commitment, which provided $15 million towards a Cumberland Conservation Corridor (CCC) program. This program aimed to protect and regenerate threatened bushland on the Cumberland Plain in Western Sydney by establishing a corridor to connect patches of remnant Cumberland Plain Woodland to improve the resilience of this critically endangered community and to support the movement of species through the landscape. The role of CCC Reference Group members has been to provide advice to Environment and Energy on suitable lands for acquisition and permanent protection within the corridor, with a focus on parcels that contain Cumberland Plain Woodland. The Department invited CCC Reference Group members to express their interest in being part of the Experts Group and nominations were discussed with Environment and Energy. After calling for nominations and consulting with the Approver, the Department resolved the membership of the Experts Group in April 2017.

The Experts Group comprised:

- two representatives from the NSW Government Office of Environment and Heritage (OEH)
- one representative from the NSW Government Local Land Services (reporting to the NSW Department of Primary Industries)
- four local government officers from four local councils in the vicinity of the project and within the Cumberland Plain
- three representatives from local Aboriginal Land Councils and/or other local Aboriginal stakeholder groups in Western Sydney
- one academic or representative from a university, with expertise on biodiversity offsets and processes
- three representatives from other community or conservation groups

In addition, officers from Environment and Energy attended meetings in an advisory capacity. See Attachment A for a list of Biodiversity Experts Group members.

Many of the members of the Experts Group are also members of the CCC Reference Group and, as such, have significant experience with, and knowledge of, the conservation and restoration of the Cumberland Plain and biodiversity values of the Western Sydney region. Members also appropriately represent the range of stakeholders and communities that will be impacted by the Stage 1 development.

4.1.2 Terms of Reference

The Terms of Reference for the Experts Group set out the role and objectives of the Experts Group in providing advice to the Department, the role of the Department in chairing and convening the group, the role and obligations of members of the Experts Group, and particulars of Experts Group meetings. As outlined in the Terms of Reference (see Attachment B), the Experts Group's role was to provide advice to the Department in relation to:

- the preparation and development by the Department's technical consultant of the BODP
- the identification and conservation outcome of securing direct biodiversity offsets for the BODP, including through supporting and facilitating consultation with local landowners and other relevant stakeholders
- the identification and conservation outcome of securing other compensatory offset measures for the BODP, including opportunities to provide funding to existing bush regeneration or revegetation programmes
- proposed direct offsets and other compensatory offset measures that are secured or implemented prior to approval of the BODP
- feedback received by members from the wider community on biodiversity offsets for Stage 1 of the airport development and consideration of this feedback in developing the BODP.

4.1.3 Meetings of the Biodiversity Experts Group

The Experts Group was established in April 2017 and held five meetings in Western Sydney, on 12 May 2017, 11 August 2017, 9 November 2017, 9 February 2018 and 8 March 2018. Each meeting agenda was generally five hours long.

Outside of discussions on the BODP and potential offsets for inclusion in the plan, the Department provided members at the meetings with updates on the Western Sydney Airport project and the biodiversity activities being undertaken on the airport site and in accordance with the Airport Plan conditions. Members were also provided with an updated biodiversity offset register at each meeting. The register was a comprehensive list of currently available and potential biodiversity offset sites relevant for offsetting Stage 1 of the Western Sydney Airport. Members were asked to provide advice on the register and details for any additional sites they were aware of.

Out of session consultation also occurred on an as needs basis between the Department (including its technical consultant) and the Experts Group on potential offsets and other related matters.

4.1.4 Advice of the Experts Group

Experts Group members were asked to provide advice at several key points during the drafting of the BODP. Experts Group members have provided:

- advice on, and endorsement of, the criteria to be applied to the consideration and identification of potential direct offsets and other compensatory measures
- information on potential sites where biodiversity offsets could be sought
- potential options for biodiversity offsets delivering direct offsets or other compensatory measures to be considered by the Experts Group in its discussions
- written and verbal feedback on, and in some cases priority ranking of, the range of offsetting options presented to the Experts Group, from the potential purchase of credits through the NSW Biodiversity Offsets Scheme to the various concepts and ideas brought by members of the group. This advice from Experts Group members supported the Department in considering the merits of each concept
- further comments on the consolidated member advice on the range of offsetting options
- comments and advice on the draft structure of the BODP and proposed composition of offset measures to be delivered under the BODP.

Details of the advice of the Experts Group on the proposed offset measures to be delivered under the BODP can be found in the Member Advice Report following this section.

4.2 Consultation with local Aboriginal Land Councils and Aboriginal groups

In accordance with Condition 30(8) of the Airport Plan, the Department, in preparing the BODP, consulted with local Aboriginal Land Councils and Aboriginal groups in Western Sydney, to identify complementary outcomes for biodiversity conservation and Aboriginal cultural heritage on the Cumberland Plain.

4.2.1 Consultation activities

The Department has engaged with Aboriginal stakeholders in a number of ways. For example, on 15 August 2017, a briefing session was held with local Aboriginal Land Councils and Aboriginal groups that have landholdings within the Cumberland Plain. The briefing session involved discussion about the opportunities for biodiversity offsetting, including information about the potential for generating biodiversity credits on land held by the groups attending.

Follow-up meetings or further information has been shared with groups that were interested in further discussion or unable to attend the information briefing. These groups have included:

- Gandangara Local Aboriginal Land Council
- Tharawal Local Aboriginal Land Council
- Deerubbin Local Aboriginal Land Council
- Darug Tribal Aboriginal Corporation
- Darug Aboriginal Cultural Heritage Assessments.

Three Aboriginal groups are members of the Experts Group and were closely engaged in the development of the BODP: Deerubbin Local Aboriginal Land Council, Gandangara Local Aboriginal Land Council and Muru Mittigar.

The Department and Deerubbin Local Aboriginal Land Council have entered into a Memorandum of Understanding (MOU) to work together on biodiversity offsetting opportunities on Deerubbin lands with relevant environmental characteristics. Consultation with Gandangara Local Aboriginal Land Council has mainly revolved around complementary outcomes, noting that the airport site is located in the Gandangara area. Muru Mittigar, an Aboriginal Cultural and Education Centre located on Darug lands near Penrith, has focused on the educational, training, and employment outcomes for Aboriginal peoples in biodiversity offsetting.

The Department continues to consult with several Aboriginal stakeholders on biodiversity offsetting and complementary outcomes as well as Aboriginal cultural heritage conservation.

5 Member Advice Report of the Biodiversity Experts Group

The Experts Group represented a broad range of organisations, and members held a variety of perspectives on the preferred approach for an offsets package. Throughout the meetings and from written feedback, members have provided advice on a range of issues including on the development of the Offset Assessment Criteria, the conservation outcomes of the overall offsets package and on potential direct and other compensatory measures. This advice was then taken into account in the development of the BODP. A summary of this advice is provided below.

5.1 Offset Assessment Criteria

Experts Group members were asked to provide feedback on the Offset Assessment Criteria to be applied to the identification and consideration of potential offset sites as well as offset measures more broadly. In addition to the Experts Group, the criteria were developed in consultation with legal advisers from Australian Government Solicitor and Clayton Utz, the Department's technical consultant, and Environment and Energy. The finalised criteria are listed below:

a) The extent to which offset actions correlate to, and adequately compensate for the impacts of the development.

b) The conservation gain to be achieved by the offset (the offsets collectively must deliver an overall conservation outcome that improves or maintains the viability of the protected matter).

c) The current land tenure and management history (if any) of the offset and the proposed method of securing and managing the offset for the life of the impact.

d) For offsets other than available biodiversity credits, the time it will take to achieve the proposed conservation gain.

e) For offsets other than available biodiversity credits, the level of certainty that the proposed offset will be successful.

f) The suitability of the location of the offset site – in most cases this will be as close to the impact site as possible but may not be if it can be shown that a greater conservation benefit can be achieved by providing an offset further away.

g) The extent to which the location of the offset improves connectivity or contributes to Australian, state or local government initiatives and Australian Government commitments to secure offsets with strategic value.

h) The extent to which the offset will achieve complementary outcomes for biodiversity conservation and Aboriginal cultural heritage on the Cumberland Plain.

i) How efficient the process of creating and acquiring credits and negotiating and settling any other relevant matters is and whether the volume of offsets available will be sufficient to make an efficient transaction.

j) What risks are associated with the arrangements for acquiring the offsets versus the risks of purchasing other offsets.

k) What the likely relative cost of these offsets is versus other similar offsets.

Member advice

The draft criteria were presented to Experts Group members over several meetings. Members discussed and were supportive of the criteria. One member raised the importance of the historical land use of offset sites and how this can better inform decision making regarding selection of offset sites. In light of this, historical land use was incorporated into criterion (c) addressing land tenure. Another member noted the importance of coordinating any proposed offset measures, specifically making reference to commitments by the Australian Government to secure offsets with strategic value. In response to this feedback, 'Australian Government commitments' was included in criterion (g).

5.2 Conservation outcomes of the overall offsets package

Under condition 31 of the Airport Plan, the BODP must be informed by the advice of the Experts Group and in particular, advice must be sought on whether and how conservation outcomes improve or maintain the viability of the biodiversity values to be offset.

Member advice

Experts Group members generally supported the overall offsets package and felt the conservation outcomes would improve or maintain the viability of the biodiversity values lost as a consequence of the construction of the Western Sydney Airport, provided certain conditions were met.

There was strong support for a package with a diverse range of measures. The main objective should be to improve management of biodiversity to safeguard Western Sydney's unique ecosystems.

Several members were supportive of other compensatory measures contributing more than 10% of the offset package, provided that this could be demonstrated to achieve a greater benefit to the relevant protected matters. In stating this, members identified that the EPBC Act Offsets Policy allows a deviation from the 90% direct offset requirement, where it can be demonstrated that a greater benefit can be achieved through increasing the proportion of other compensatory measures in an offsets package. To this end, several members stated that the BODP should consider a range of other compensatory measures, such as Aboriginal land management, certain restoration and rewilding activities, and research. As stated by one member, a combination of direct and other compensatory measures, would provide 'greater conservation gains for Western Sydney than would be possible from purchase of biodiversity credits alone'. Based on this advice, the Department has identified a range of other compensatory measures in Chapter 7.

Within that diverse range of desired outcomes, members highlighted different priorities. Measures that delivered conservation in perpetuity and secured mature habitat and foraging habitat that was not yet secured for conservation were seen as a priority. Members identified the purchase of credits through the NSW Biodiversity Offsets Scheme and the acquisition of new properties for conservation as methods for doing this. The Department has included both of these measures in this Biodiversity Offset Package, at sections 6.2.1 and 6.2.2 respectively. Members also generally felt that offset measures should, where possible, seek to support connectivity in order to maximise the impact of any investment. As one member wrote:

'*The proposed biodiversity offsetting measures will improve the viability of the biodiversity values to be offset, especially the Cumberland Plain Woodlands and associated species. The key outcomes (NSW Biodiversity Offset Credits and Acquisition of Land) will avert future habitat loss, building a larger and better connected network of conservation managed lands across the region.*'

Together with direct offsets, members viewed other compensatory measures and complementary outcomes as valuable components of the package. Depending on the situation, these measures could lead to direct or indirect outcomes. As one member wrote, 'key infrastructure, research and capacity building will create long-term benefits for the improvement and maintenance of biodiversity in Western Sydney.' Another member felt that restoration and rewilding programs, Aboriginal land management and research, capacity building and training will strategically address current threats to biodiversity values. A further member felt that other compensatory measures 'will allow for the improved management (regeneration and rewilding), improved application of knowledge (research) and improved Indigenous engagement (Aboriginal training programs) in ensuring the viability of existing and new conservation areas.' In line with this advice, the Department has included restoration and rewilding in Section 6.2.3, and Aboriginal land management, research, capacity building and training in Section 7.4 as measured in this Biodiversity Offset Package.

The contribution of an offset site at Defence Establishment Orchard Hills (Orchard Hills) to the overall offset package drew a variety of responses from members. Members noted that an offset site at Orchard Hills would be a large part of both the cost and biodiversity offsets of the BODP, and this informed their responses. All members agreed that the Orchard Hills site location provides a highly valuable east-west connection at the juncture of two north-south corridors on the Cumberland Plain. There was also strong consensus on expanding environmental protection for the Orchard Hills site. Beyond that general support, some members felt that there was still insufficient detail to comment comprehensively on an Orchard Hills offset site as part of an overall package of offsets. Some members questioned whether this measure would maintain or improve the biodiversity values from the airport site, and whether the Orchard Hills land was already conserved.

In their own words, one member felt that the BODP package appears to strike a balance between 'protecting/conserving strategically located remnant vegetation and undertaking supporting management actions to increase the extent and connectivity of the impacted matters.' There was also general support for collaboration between the different elements in the package, with one member advocating for 'partnerships between government, not for profit, and Aboriginal organisations to deliver direct and complementary biodiversity offset measures.'

The Department acknowledged to Experts Group members that they were being asked to provide advice on an offset package that did not yet have all details finalised. For example, once the BODP is approved, the Department will enter into several contractual processes and through them set price and delivery outcomes; these details are therefore not yet known to the Department or to Experts Group members. Members identified that, in many cases, because funding has not been allocated to specific offset measures, it is not possible to determine the full outcomes nor make detailed comments regarding cost and potential value for money.

Summary of advice that informed the preparation of the BODP

To ensure enduring conservation gain, a biodiversity offset package for Stage 1 of the Western Sydney Airport should prioritise the securing of perpetual biodiversity conservation. A range of direct and other compensatory measures, as presented in chapters 6 and 7 of this BODP, could strategically address biodiversity impacts and provide additional long-term benefits for the improvement and maintenance of biodiversity in Western Sydney. In some cases, other compensatory measures may represent greater biodiversity and conservation value than direct offsets. There are also benefits to collaborative approaches. Any offset site at Orchard Hills should have enduring environmental protection, be fully funded over the long term, and give measureable improvements in conservation outcomes, with management plans in place. Further advice on specific measures is outlined below.

5.3 Advice on specific measures

5.3.1 Offset site at Defence Establishment Orchard Hills

Member advice

A proposed offset site at Orchard Hills elicited a range of different views from members. Some Experts Group members strongly supported the proposal. This support centred on the size, strategic location and like-for-like environmental characteristics of the site and the potential to further protect and enhance an important biodiversity connectivity corridor for Western Sydney. There was strong agreement from members on the high conservation value of the woodland at Orchard Hills, as well as the importance of large sites to the preservation of the unique Cumberland Plain Woodland ecology.

One member felt that, notwithstanding some concerns, securing Orchard Hills was an important outcome for conservation in Western Sydney. The site was also seen to have the potential to support complementary offset measures including research and Aboriginal management of land. Another member felt that the proposal provided a unique opportunity to create direct biodiversity offsets outside of the NSW Biodiversity Offset Scheme, thereby releasing offset credits for other developments and prolonging like-for-like offsets within Western Sydney.

While there was in-principle support from the majority of members for an offset site at Orchard Hills, members provided advice on several aspects of this offset measure, including identifying some areas of concern. One member outlined strong opposition to the proposal. An overview of feedback is detailed below.

- *Conservation status*

Some members felt that Orchard Hills was already conserved because it had been placed on the Commonwealth Heritage List and is zoned as E2 Environmental Conservation on Penrith City Council's Local Environment Plan. These members also noted that part of the site had been the subject of conservation commitments by the two major parties at the 2007 federal election. In light of this, these members were of the opinion that the site did not meet the EPBC Act Offset Policy. By not meeting this requirement, they considered that an offset site at Orchard Hills would not secure any additional conservation lands and the outcomes for biodiversity would neither be maintained nor improved. For other members, the existing Commonwealth Heritage Listing did not exclude Orchard Hills from being an offset site, but those members noted that the averted risk of loss should not be high, and that this would in turn impact on the calculation of the impact of the offset.

- *Conservation in perpetuity*

Several members, while generally supportive of the proposal, were concerned about ensuring the Orchard Hills arrangements provided conservation in perpetuity. In particular, there was strong feeling that the proposed 20-year agreement or management plan would need to be supplemented by a plan for the offset site over the very long term, with one member questioning whether a 20-year timeframe satisfied the long-term security requirements of the conditions of approval and the EPBC Act Offsets Policy. A number of members felt it was warranted and appropriate to ensure the appropriate use and security of the site after the proposed 20-year term. One member noted that they agreed that stronger protections for Orchard Hills were warranted, and even stronger measures such as those required under the NSW Biodiversity Offsets Scheme could be considered. Another member suggested the creation of an investment fund to ensure money is available for longer term management actions.

- *Value for money*

Some members stated that any proposed budget for the offset site should exclude payment to Defence for any loss of opportunity as the site already had protection under the Commonwealth Heritage Listing, environmental zoning and prior conservation declarations made by political parties. A number of members also felt that the upper end of the potential budget was high, relative to Biodiversity Stewardship Agreements (BSAs) and that there may have been an over-estimation of what was needed for management actions over 20 years. One member felt that, based on their knowledge of the site, it was hard to understand how that much work would be required. This member had previously visited the site and felt that, at that time, despite overgrazing during the dry summer period, the site was generally in good condition. A member suggested that money for ongoing management actions be paid into an ongoing trust (akin to the situation with the NSW Biodiversity Offsets Scheme) so that management actions could be funded in perpetuity from the interest received.

Members were clear that funding should not be used for measures that were not related to biodiversity conservation or for actions that are already the responsibility of Defence. This could include high security fencing and the removal of waste from Defence operations. Any work undertaken with the allocated funding should be in support of conservation, and not used as a means to remediate operational areas or demarcate the site beyond what is required to achieve a conservation gain. One member stated that expenditure on the Orchard Hills offset site could potentially reduce funding that could be used in the package to effect positive outcomes through other supporting measures.

- *Boundaries of the offset site*

One member was concerned about the areas of Orchard Hills that are not included in the Commonwealth Heritage Listing, and which would not be part of the proposed offset site. This included questions around how these areas would be protected from future developments such as transport corridors. The potential addition of land along Blaxland Creek, between the north and south buffer zones, was seen as a positive outcome worth pursuing.

- *Management*

A number of management issues were raised by members. One issue was that areas of derived grasslands, with high diversity of grasses, herbs and groundcover, should not necessarily be revegetated to canopy, as this would bring changes to the ecology, particularly for certain birds. There were also concerns about the building of internal fencing that would restrict the movement of macropods, particularly if the fencing prevents fauna from accessing Blaxland Creek.

- *Governance*

Members felt that there should be a governance structure in place, including oversight from external organisations in addition to the standard reporting requirements under the EPBC Act. Suggestions included the appointment of a panel or advisory committee, including community conservation representatives to ensure independent oversight of the management of the area. Their role could include commenting on or recommending management actions and monitoring biodiversity gains. One member suggested that periodic access should be given to local experts, potentially through the proposed advisory committee, to ensure the conservation and biodiversity objectives.

Summary of advice that informed the preparation of the BODP

An offset site at Orchard Hills would include land with high biodiversity value, in a strategic location, that would be like-for-like vegetation for the impacts on the airport site. It is important that the mechanism used to secure the land for conservation is fully funded, robust and enduring. Management plans and measures should be additional to the status quo and consider options for securing conservation in perpetuity. Costs should be appropriate for the additional management actions undertaken. Annual reports on the Orchard Hills offset site will be made public as part of the Department's reporting requirement under condition 39(3) of the Airport Plan.

The Department has taken this advice into account in the Orchard Hills offset proposal in Section 6.1.

5.3.2 Purchase of biodiversity credits through the NSW Biodiversity Offsets Scheme

Member advice

Members' views regarding the suitability of biodiversity credits as an offset mechanism can be broadly divided into three categories. The largest group of members considered biodiversity credits to be a very high priority for the offset package. For these members, purchasing credits through the NSW Biodiversity Offsets Scheme (BOS) should be the primary offset mechanism. This approach was favoured by some due to the scheme ensuring additionality, direct offsetting and outcomes that correlate to the same timescale as the impacts (ie impacts occurring now or in the near future and lasting in perpetuity). Other benefits identified included the scheme's transparency, the certainty and efficiency provided by an established legislative and administrative framework, and the established reporting and monitoring requirements.

The second group of members supported the use of the BOS as the primary mechanism for securing offsets, but identified that this approach was not without risks in terms of conservation gain. Concerns included that, while the method for securing offsets is thorough, the method of managing offsets can have mixed outcomes. These members argued that the purchase of biodiversity credits needs to be complemented by additional activities such as strategic land conservation, research, biodiversity infrastructure and training.

A third group of members did not support a package that consisted predominantly of the purchase of biodiversity credits through the BOS and saw this as a lost opportunity for real conservation gain in the Cumberland Plain. These members raised the following issues about the use of the BOS in relation to the Western Sydney Airport offsets package:

- *Variable conservation outcomes*

Some members stated that there was a variability in conservation outcomes, with some biodiversity stewardship sites demonstrating optimal management with strong biodiversity recovery, yet other sites exhibiting a decline in biodiversity values. Examples raised include clearing by landowners, stock grazing, the use of trail bikes and ineffective weed management on stewardship sites.

- *Ecological quality*

Some members highlighted the challenge of obtaining well-established stands of ecological community not infested by weeds. In particular, members identified African Olive as a key issue that requires substantial funds to control. Other members supported including land that required restoration work, provided high standards of work were applied to achieve high quality ecosystems.

- *Location and connectivity*

Some members felt that some of the sites identified in the biodiversity offsets register compiled by the Department were too far away and too spread out from the airport site. Likewise, some members felt that some of the proposed sites did not reflect a commitment to securing vital links in the Cumberland Conservation Corridor (CCC). To ensure maximum biodiversity gains, members stated that sites selected should be as close as possible to the airport site and the location of sites should enhance connectivity.

- *Availability and cost*

Some members had concerns about the availability and high costs of credits in the current market, with increased demand in Western Sydney, driven by high land prices, likely to make credits even more expensive.

Summary of advice that informed the preparation of the BODP

The Biodiversity Offsets Scheme provides a clear and established framework for obtaining biodiversity offsets. However, key factors such as connectivity, existing ecological quality, proximity to the airport, and ongoing management practices must be taken into account when assessing potential BOS sites and ensuring a conservation gain that maintains or increases the viability of the protected matter.

The Department has taken this advice into account in the proposal to purchase credits through the NSW Biodiversity Offsets Scheme in Section 6.2.1.

5.3.3 Acquisition of land to be managed for conservation in perpetuity

Member advice

There was general support amongst members for the acquisition of land not currently set aside for conservation to be managed for conservation in perpetuity by a third party such as a not-for-profit organisation, outside of the BOS. Members felt that this measure strongly supported offset assessment criteria, including the potential to achieve a conservation outcome that improves or maintains the viability of the protected matter, and that the purchase of strategic parcels of land could improve connectivity. Members noted that this offset measure would correlate with the impacts of the development, provided the appropriate biodiversity is present on the relevant sites. Members also felt that the method of securing the sites through purchase, covenant and ownership by a third party was a well-established mechanism and with proven results in the region. Members identified that such an arrangement could achieve complementary outcomes in community and volunteer engagement, Aboriginal participation, research, training and education. The following particular issues were raised:

- *Biodiversity value*

The sites acquired should be of high biodiversity value and contain or must once have contained the vegetation communities (plant and animal), or threatened species impacted at the Western Sydney Airport site. One member felt that land acquisition could consider degraded or cleared land where it adds connectivity value and could be restored to a high standard. Land acquired should not include land otherwise unable to be developed as this represents a false gain.

- *Location*

The strategic location of the land was identified as a key issue if it is to improve connectivity and contribute to the CCC. One member supported this measure if the parcels of land acquired are contiguous or relevant to other parcels of land secured through the BODP such as the Orchard Hills offset site or land secured for conservation under the NSW Biodiversity Offsets Scheme. One member stated that it was not clear how this particular measure differs from a process of purchasing credits through the NSW Biodiversity Offsets Scheme; however, other members felt that a key strength of this approach was the focus on acquiring strategic parcels of land with conservation value, containing high biodiversity and landscape connectivity, to be conserved through a conservation covenant and managed for biodiversity, and specifically not be part of the NSW BOS (thereby the biodiversity credits cannot be acquired).

- *Site availability and cost*

Members felt that the certainty of success of this offset measure was reasonably high, provided relevant sites could be identified and purchased. Some members raised concerns regarding the availability of appropriate sites and the time taken to acquire the sites. The increasing cost of land in Western Sydney was also identified as a risk and some members had concerns that value may not be able to be achieved within proximity of the airport site, based on current and projected land prices. One member felt that high land rates may negate the cost and social benefits of a volunteer run program of biodiversity stewardship and mean that only small parcels of land can be secured. Some members suggested that it could be more effective to enter into commercial agreements with existing land holders, including local Aboriginal Land Councils.

- *Ongoing management and governance*

While management in perpetuity was identified as a necessary aspect of this offset measure, some members raised concerns about ongoing funding and the organisations' ability to manage the sites in perpetuity. One member felt that the expertise to undertake conservation management needs to be assured and could be informed through NSW Government authorities charged with conservation of biodiversity or an advisory committee to ensure conservation management actions and monitoring of biodiversity gains. Other members stated that the arrangements between the CCC Reference Group and the National Conservation Trust (now Biodiversity Conservation Trust) had demonstrated success and that a continuation of such arrangements would be beneficial. It was also suggested that integrating this offset measure with other aspects of the BODP would achieve the best biodiversity gains.

Summary of advice that informed the preparation of the BODP

Securing additional and strategic parcels of land connecting existing conserved sites, for management by not-for-profit organisations outside of the BOS, can lead to strong conservation outcomes. Such an approach needs time and flexibility to secure appropriate land parcels and strong governance and resources to ensure the ongoing maintenance of the acquired sites.

The Department has taken this advice into account in the proposal to acquire land in Section 6.2.2.

5.3.4 Restoration activities

Member advice

Members expressed a variety of views regarding the inclusion of restoration projects into the offset package. In general, most members felt that restoration projects could make a valuable contribution to conservation outcomes and that it was possible to achieve gains for both flora and fauna, including the protection of individually listed threatened species and their habitat. Members also raised the potential to improve connectivity through the choice of strategic sites and the removal of barriers to species movement, as well as the potential for complementary outcomes including education, community engagement and training for land managers.

Some members, however, were concerned that the conservation gain from restoration works has more risk than securing land for conservation under the NSW Biodiversity Offsets Scheme, can be harder to measure, and can lack reporting frameworks. One member questioned how a long-term revegetation project could provide a successful offset for the mature habitat and foraging habitat lost through construction of the airport, as neither revegetation nor regeneration would provide immediate replacement. This member felt that revegetation does not compare favourably to securing land for conservation in perpetuity, which already has intact ecological communities and has demonstrated resilience to weeds or is located away from weed seed sources.

There was also a range of different views from members as to whether restoration could be considered as a direct offset. One member felt that it was not possible to consider restoration as a direct offset, as it comprised revegetation and regeneration works most likely undertaken on already conserved land. Other members felt that restoration and rewilding programs can act as direct offsets only if the criteria for perpetual security and funding for management actions are also met. Where the offset is not secured, a discount should apply to the offsets generated. Another member felt that, for the measure to be a direct offset, the land tenure needs to be under a conservation covenant agreement (or similar agreement providing long-term conservation), and management actions need to improve or maintain biodiversity. A further member was supportive of restoration and rewilding programs directed at land that will be added to the biodiversity conservation estate under the BODP and noted this should be prioritised over potential restoration and rewilding programs directed at land that is already within the biodiversity conservation estate. Land already within the biodiversity conservation estate should have access to such programs from other, established public and private resources. Restoration programs can also be other compensatory measures where they can improve and maintain biodiversity across Western Sydney. The maximum biodiversity gains for restoration and rewilding activities will come through integration of the activities in the BODP.

The following further key issues regarding restoration programs were discussed:

- *Land tenure*

A number of members stressed that any sites undergoing restoration need to be secured for conservation in perpetuity, otherwise conservation gains would not be realised over the long term. Members also identified that there could be risks surrounding what seemed to be secure tenure, for example, the rezoning of land or changing land managers. One member felt alternative land ownership, stewardship and reporting regimes may be required.

- *Long-term viability of restoration efforts*

Members noted that restoration of native vegetation requires long-term management and support. Some members raised that projects would require higher management inputs for an indefinite period after the life of the project and would need funding or sufficient mechanisms to secure the long-term investment needed to maintain these sites.

- *Maintenance and weed control*

Members raised that outcomes from regeneration projects can be variable and require regular follow up. Some members saw African olive control and the recurrence of weeds as key issues affecting success, especially along creek lines or flood plains. One member argued that further development on the Cumberland Plain would exacerbate this issue.

- *Location of sites*

Some members felt there were benefits in being able to be flexible and target a range of different sites, for example land adjacent to the airport, larger areas, land along connectivity corridors and also specifically sites not subject to BSAs. Other members stated that emphasis should be placed on sites with biodiversity priority rather than any selection process being driven by vacant land and simple availability. Some members felt it was hard to measure the benefits of a project when sites are not confirmed.

- *Size of the sites*

One member was of the opinion that targeting larger areas would be beneficial in redefining degraded landscapes into structured woodlands and minimising the risk of edge effects. Another member stated that the integration of a large number of small to medium size sites, with high conservation value, into the urban environment has broad benefits for landscape connectivity along with ecosystem function and resilience.

- *Costs*

Members were divided over the potential costs of restoration projects. Some felt that restoration offered good benefits at a low cost, while others felt that the costs for revegetation and restoration would be much higher than for the management of relatively intact vegetation. It was identified that projects would also need to take into account any future tenure and management costs.

- *Research and partnerships*

One member raised the importance of ensuring engagement with adequate research and that an adaptive management framework should be developed whereby alternative and new management practices can be assessed for relative conservation gains. Another member felt the ability to deliver restoration and rewilding measures will be enhanced through strategic partnerships and governance from an advisory committee. Several members supported links between restoration activities and Aboriginal land management, research, government initiatives, on-ground conservation practitioners and land managers.

- *Additionality*

Some members raised concerns about including land already secured for conservation by government (for example through the National Parks and Wildlife Service, local government and the Western Sydney Parklands). In summary, the concern was that these sites were already zoned to preclude being built upon and thus were in the 'conservation estate'. Another additionality concern was 'double dipping' by landowners already in the BOS and that restoration training for these land managers should come out of stewardship payments and existing NSW funding sources. Some members also argued that work should not duplicate or replace works that local government, NSW Roads and Maritime Services in particular, or the NSW Government more broadly are already obliged to undertake as part of their core services. On the other hand, where restoration measures go above and beyond the existing management plans, the restoration and rewilding activity would still provide additional biodiversity gains.

- *Risks*

Risks identified by members included difficultly getting permission from landowners for works; changing climatic conditions with increased variability; and potential changing priorities of government bodies and other organisations causing any projects to be under resourced and incurring delays.

- *Standard of work*

One member noted that, irrespective of whether specific restoration activity is classified as a direct offset or as an other compensatory measure, the activity should be assessed in accordance with relevant guidelines for restoration and that any work must be of a high standard.

- *Rewilding*

Members also provided targeted advice on rewilding. There was strong support for a rewilding project from several members who saw it as an innovative approach that could significantly shift how environmental management is undertaken. Some members considered that rewilding would be best undertaken at a key conservation area for Western Sydney. There were mixed responses to the potential conservation gain, with some members feeling that the quantification of the gain over the long term remains unclear. However, other members felt there was potential for high conservation gain, with considerable flow-through improvements for biodiversity from the exclusion of predators and introduction of certain fauna species. Securing suitable land and land tenure were identified as the key issue that needed to be factored into a successful rewilding proposal. Members noted that, if rewilding was to take place on land already secured for conservation in perpetuity, the direct offset would be through the additional land management practices or, alternatively, the rewilding project could be classed as an other compensatory measure.

Summary of advice that informed the preparation of the BODP

Restoration projects can make a valuable contribution to conservation outcomes. Restoration activities should only occur on land demonstrated to provide a high likelihood of enduring outcomes. Land tenure is a key issue that needs to be addressed and securing conservation in perpetuity is important to the realisation of conservation gains over the long term. However, there will also be sites with complex tenure arrangements where a covenant is not possible but which nevertheless provide significant restoration opportunities.

Projects should secure additionality and not merely replace works that others are already required to do. Long-term management objectives and funding sources also need to be built into projects to ensure the long-term viability of restoration efforts, along with ongoing evaluation and reporting. Restoration work can be enhanced through strategic partnerships, connection to research and adequate governance.

The Department has taken this advice into account in the proposal to fund restoration and rewilding programs in Section 6.2.3.

5.3.5 Aboriginal land management

Member advice

Members raised that there was potential for a comprehensive component involving Aboriginal peoples in the offsets package, but that how this would fit together conceptually and in terms of implementation would need further work. A key theme raised by Experts Group representatives from local Aboriginal Land Councils and other Aboriginal groups was the importance of Aboriginal peoples 'doing and speaking' for themselves and that Aboriginal peoples need to be driving the process.

One member queried how the term 'Aboriginal land management' was being used in relation to the BODP. They commented that, if the phrase refers to land management being carried out by Aboriginal people, it is important that any biodiversity offsetting measures are designed and implemented by Aboriginal people with relevant knowledge and experience. If the phrase refers to Aboriginal cultural land management practices, the member cautioned against adopting such practices without broad discussions with Aboriginal peoples in the airport catchment, as there are many views about what this may mean.

Members noted the potential to 'value add' by developing and implementing long-term Aboriginal land management practices on land that will be added to the biodiversity conservation estate under the BODP. It was noted that such sites have the potential to create long-term and permanent employment for Aboriginal peoples in land management, often on their own land. This member raised that biodiversity stewardship sites pursuant to the *NSW Biodiversity Conservation Act 2016* provide a sound legal framework for biodiversity conservation and its proper integration with Aboriginal cultural practices.

One potential model put forward by an Experts Group member was an Indigenous Ranger Training and Education program (Indigenous Ranger program). Members felt that this type of model had a high level of complementary outcomes for Aboriginal cultural heritage and employment. It was also seen to have alignment with the broader aims of the EPBC Act Offsets Policy, in that it embeds capacity building and social and economic co-benefits with the management of offsets. A further member also commented that such an Indigenous Ranger program would align with broader strategic objectives such as Closing the Gap, the Indigenous Health Strategy, and the Western Sydney City Deal commitment to job opportunities for Aboriginal peoples.

There were some different views about the type of offset measure an Indigenous Ranger program would comprise. Some members strongly supported such a proposal as either a component of a direct offset or other compensatory measure, acknowledging that the actions performed by an Indigenous Ranger team on-ground may provide direct offsets. Other members saw it as an other compensatory measure that could be complementary to and support other offset measures in the package. Another group of members raised concerns that a measure focused on Aboriginal land management that was largely about training or employment schemes for Aboriginal peoples could not be seen as a long-term biodiversity offsetting measure and should be seen solely as a complementary outcome.

The other key issues raised were:

- *Conservation gain*

Many of the issues raised in terms of conservation gain and successful outcomes were similar to those raised for restoration projects. Some members felt that while there would be clear training and employment outcomes, similar to other revegetation and management projects, the on-ground outcomes could be harder to quantify. Likewise, members noted potential issues regarding any sites chosen for activities, such as land tenure and ongoing management. One member noted that programs or management actions should be relevant to appropriate ecological communities and species in order to meet offsetting requirements. A concern was also raised that if on-ground works are undertaken on land already secured for conservation then there are questions about additionality.

- *Long-term viability*

The main risks identified by members included the long-term commercial viability of an Indigenous Ranger program or other type of program, namely the uncertainty of securing future work in a competitive market with other parties undertaking restoration. One member also commented that initiatives should seek to include long-term employment outcomes.

- *Co-design and partnership approach*

It was identified that a co-design process would be important to ensure strong partnerships with Aboriginal stakeholders including local Aboriginal Land Councils. Members also highlighted the potential for partnerships and making links with other restoration and research activities under the offset package and that an Aboriginal scholarship component could link with broader research activities.

Summary of advice that informed the preparation of the BODP

Aboriginal land management should involve leadership from local Aboriginal groups. An Indigenous Ranger or similar type of initiative should employ a co-design and partnership approach. The time needed for any project development needs to be taken into account in considering such a component of the package. Ideally, any initiatives would become self-sustaining over time in order to have long-term benefits for the region.

The Department has taken this advice into account in the proposal for research and capacity building and training opportunities, including Aboriginal land management, in Section 7.4.

5.3.6 Research

Member advice

There was a variety of views with regard to the inclusion of research as an other compensatory measure. Research was strongly supported by some members who felt that it could provide long-term benefits for the broader regional management of Cumberland Plain Woodland. It was also felt that research could achieve long-term conservation gains through an increase in the capacity to restore and manage Cumberland Plain Woodland and could add value to the offsetting measures implemented as part of the overall offset package. Other members felt that conservation outcomes were less tangible with pure research measures and there was some uncertainty about how research would transition into real-world change. Some members also felt that it would be better for conservation outcomes to occur closer to the time of impact. These members were of the opinion that the training of site owners would provide a much greater and quicker improvement in biodiversity in Western Sydney than the outcomes of research programs. For this reason they were of the view that securing land for conservation should be a higher priority and remain the focus of the offsets package. Several other research-related issues were discussed by members as summarised below:

- *Scope of research*

One member suggested that a research program should include the assessment of biodiversity; ecosystem function and resilience in Western Sydney to establish critical targets for restoration projects; a measure of the biodiversity gains through past and current management actions, and where to source material for ecological restoration programs; characterisation of seed production facilities to ensure genetic integrity, and the development and enhancement of soil microbiome and plant-associates for ecological restoration; and experimental manipulation of above and below ground diversity to determine the biodiversity gains, along with ecosystem function and resilience to stressors (including climate and weeds), to improve the cost-benefit of restoration practices and secure Western Sydney biodiversity over the long term. Another member identified that research proposals should also align with Research Priorities in the Commonwealth Conservation Advice and Recovery Objective 4 of the Cumberland Plain Recovery Plan.

- *Translating research into action*

While some members felt that research, including an increased understanding of restoration, could play a key role in directly informing on-ground work, other members identified the translation of research into action as containing a significant amount of risk. One member had concerns that there could be up to a 10-year time lag before research findings influence on-ground measures. Members highlighted that there needs to be a high level of engagement with practitioners to focus the research in ways that are meaningful for those with the capacity to implement the findings. The potential for adaptive management approaches was also raised, whereby research would contribute to ongoing evaluation and decision making within much shorter timeframes.

- *Integration with other measures in the offsets package*

Members noted that research could be shaped to be complementary to, and contribute to, on-ground works undertaken as part of the Western Sydney Airport offsets package. Some members saw research as adding value to offsetting measures, including the Orchard Hills offset site, acquisition of land, restoration and rewilding programs and Aboriginal management of land. A consortium approach was suggested to ensure that research is focused, relevant and adds longer term value. Members were generally very supportive of collaboration between different offset measures.

Summary of advice that informed the preparation of the BODP

Research projects should have strong engagement with on-ground projects and clear strategies for engaging and feeding back findings to land managers and policy makers. There is the potential for research projects to be complementary to activities undertaken as part of the offsets package and contribute to their ongoing monitoring, evaluation and adaptive management practices. This could help to achieve conservation gains within shorter timeframes and support the delivery of other restoration and management activities. The Department has taken this advice into account in the proposal for research and capacity building and training opportunities, including Aboriginal land management, in Section 7.4.

5.3.7 Education, training and community engagement

Member advice

There was some support for education and community engagement programs as an other compensatory measure; however, this approach was generally viewed as less of a priority than direct offset measures. Some members felt that community outreach programs were not as related to the Department's responsibility for securing and funding offsets for Western Sydney Airport and it was hard to compare their cost to direct offset measures where the impacts are more easily quantifiable.

Training and capacity building of land managers was viewed favourably by some members with the potential to lead to good conservation outcomes; however, it was felt that training of biobank site landowners should be happening anyway and any training should be restricted to sites that are not subject to a BSA.

Summary of advice that informed the preparation of the BODP

Education and community engagement are not seen as a priority other compensatory measure for this offsets package. There was some support for training and capacity building of landowners and managers; however, funding for training should not extend to those with existing obligations under BSAs.

The Department has taken this advice into account in the proposal for research and capacity building and training opportunities, including Aboriginal land management, in Section 7.4.

6 Direct offsets

6.1 Orchard Hills offset site

6.1.1 Overview of the proposal

The Department is in discussions with Defence regarding arrangements for establishing an offset site at the Defence Establishment Orchard Hills (Orchard Hills). Orchard Hills is an explosive ordnance depot located approximately 50 kilometres west of central Sydney that is owned, used and managed by Defence. Orchard Hills is managed for Defence capability purposes, Defence training activities and the use and safe storage of explosives. Approximately 1370 hectares of Orchard Hills is recorded on the Commonwealth Heritage List as a Commonwealth Heritage Place for its natural heritage values, including remnants and regenerating areas of the TEC Cumberland Plain Woodland and River Flat Forest Eucalypt Forest on Coastal Floodplains. The offset site would be established under an MOU to be entered into between Defence and the Department.

The Orchard Hills offset site would make a substantial direct offset contribution, especially through the conservation and restoration of Cumberland Plain Woodland and the endangered population of *Marsdenia viridiflora* subsp. *viridiflora.* The Department would provide funds for the intensive management of the site for biodiversity conservation and restoration for a period expected to take up to 20 years. Management actions would be performed in accordance with an Offset Plan prepared under the MOU and would aim to achieve an increase in the quality of habitat for the affected threatened biota.

The following sections comprise a preliminary biodiversity assessment of the Orchard Hills offset site (indicatively shown in Figure 1) and are presented as a guide to the quantum of biodiversity offset that would be delivered by conservation and management of the site based on the MOU. This preliminary biodiversity assessment is based on:

- desktop assessment, including:
  - review of various biodiversity assessment and monitoring reports for the site and especially GIS analysis of vegetation community and threatened plant mapping prepared by Sinclair Knight Mertz (SKM 2007)
  - conversion of vegetation map units to likely vegetation zones according to the BioBanking Assessment Methodology (BBAM), including land that was not mapped by SKM (2007) but which is likely to be derived native grassland or shrubland.
- a two-day, preliminary site survey conducted by two GHD ecologists accompanied by a Defence ecologist, including:
  - ground-truthing and refinement of the draft vegetation zones map using walked and driven transects across the site and observation of vegetation structure, species composition, soil type and landscape position
  - sampling of a small number of plot/transects within vegetation zones to allow confirmation of plant community type with reference to Tozer et al (2010) diagnostic species lists for equivalent vegetation map units

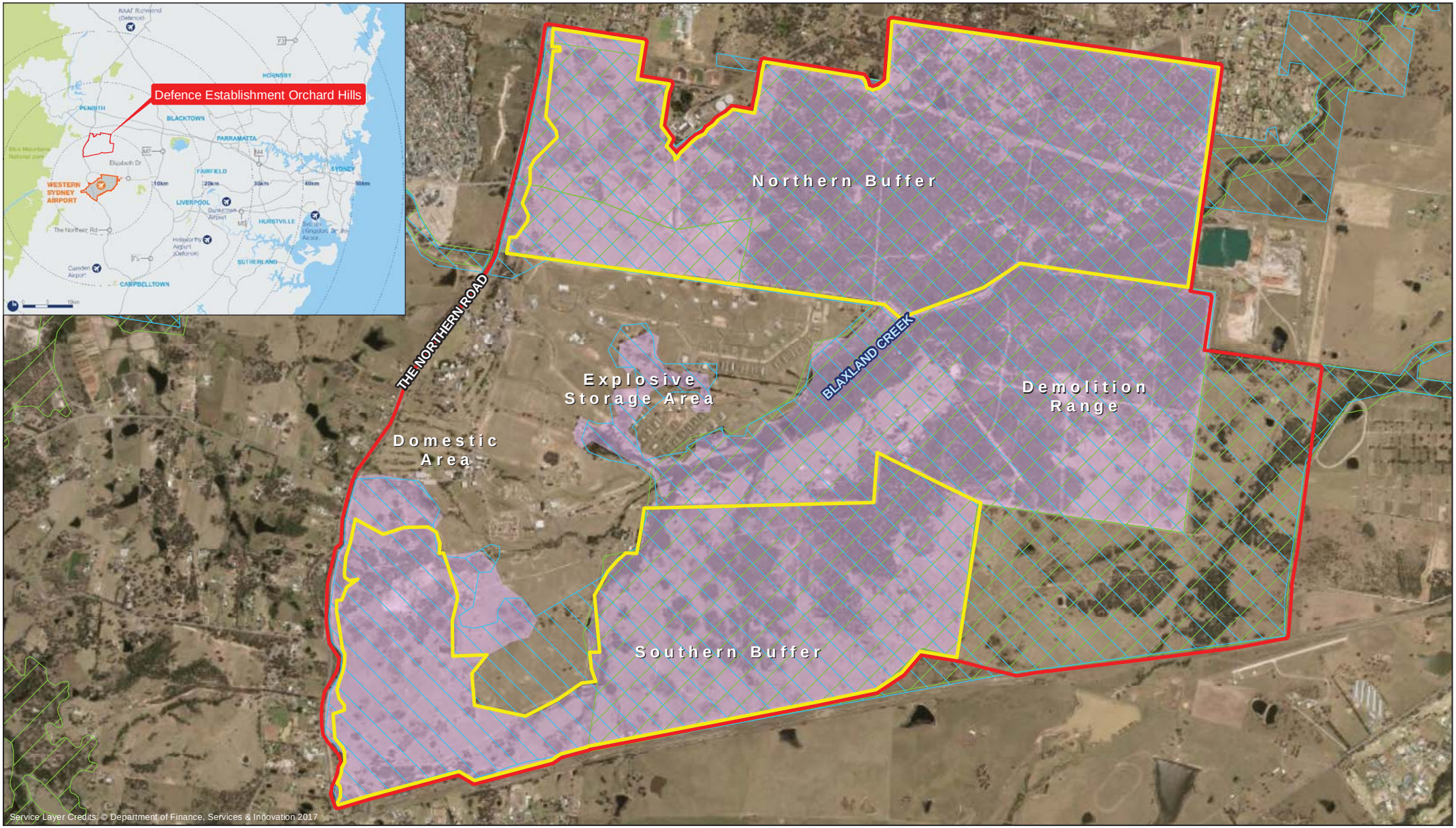
  - inspection and mapping of patches of Cumberland Plain Woodland with specific reference to the key diagnostic characteristics and condition thresholds for the EPBC Act-listed form of the community
  - confirmation of the presence and approximate extent of threatened plant populations mapped by SKM (2007) and additional targeted searches for threatened plants
  - habitat assessments to record the extent and quality of habitat resources for the affected threatened biota (ie Cumberland Plain Woodland, the Grey-headed Flying-fox and Swift Parrot foraging habitat) in accordance with the EPBC Act Offsets Policy
  - targeted searches for the Cumberland Plain Land Snail and opportunistic fauna observations.
- preparation of updated vegetation and threatened biota maps informed by the field survey
- preliminary EPBC Act offsets assessment guide calculations based on observations of the extent and quality of habitat for the affected threatened biota and the anticipated improvements in site quality with management under the Offset Plan
- an estimate of the number and type of biodiversity credits that could be generated at the site, based on the rate of generation of credits in similar vegetation zones at biobank sites in Western Sydney and comparison with the credits required to offset the impacts of the airport as documented in the *Western Sydney Airport Stage 1 Biodiversity Assessment Report* (GHD 2017) and the *Western Sydney Airport Stage 1 Biodiversity Assessment Report Addendum* (GHD 2018).

The boundaries of the site and the biodiversity values of the Orchard Hills offset site will be confirmed in a biodiversity assessment report (Initial Ecological Survey) which:

- demonstrates that the offset site would help deliver an overall conservation outcome that improves or maintains the viability of the EPBC Act protected matters consistent with the EPBC Act Offsets Policy (2012)
- has had regard to the key diagnostic characteristics and condition thresholds specified in the Commonwealth Listing Advice on Cumberland Plain Woodland and Shale-Gravel Transition Forest (TSSC 2008)
- identifies the equivalent biodiversity credits that would help to offset the impacts of the Stage 1 development on biodiversity, determined in accordance with the Airport Plan conditions and relevant policies.

The biodiversity credit value of the species and habitats at the Orchard Hills offset site would be confirmed using the BBAM as the preferred means of quantifying offset contributions. This approach allows direct comparison with the NSW FBA methodology credit calculations included in Section 3 of this BODP.

The Orchard Hills offset site biodiversity assessment report, including the assessment of the quantum of direct offset delivered by the Orchard Hills offset site, will be independently verified. In addition, an independent audit will be conducted of the Department's implementation of the BODP 12 months after the approval of the BODP and for each subsequent 18-month period.



Paper Size A4

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Metres

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

N

LEGEND

- Defence Establishment Orchard Hills
- Orchard Hills offset area
- Priority conservation lands (BIO Map) (OEH 2015)
- Cumberland Conservation Corridor
- Commonwealth Heritage List Area

Department of Infrastructure, Regional Development and Cities
Western Sydney Airport
Biodiversity Offset Delivery Plan

Job Number 21-26204
Revision A
Date 25 Jul 2018

Orchard Hills offset site location

Figure 9

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

Data source: Aerial Imagery - SIX Maps 2018 & ESRI 2018, Offset sites - GHD 2017, Cumberland Plain Conservation - OEH 2016, Airport layout data - WSU 2016. Created by:jrprice Created by:jrprice

6.1.2 Existing environment of the offset site

Landscape features and context

The Orchard Hills offset site boundary has been indicatively defined based on biodiversity values and current and proposed land uses (see Figure 9). This boundary was developed in consultation with Defence ecologists and GHD staff who have previously prepared bushfire and biosecurity management reports for Orchard Hills and have a detailed understanding of the site. The potential offset site includes a core area of no less than 900 hectares and the potential for additional suitable areas to be agreed. Throughout this chapter, references to the offset site are references to the core offset area, as shown in the figures in this chapter. The core offset area lies within the Commonwealth Heritage List area within the northern buffer area and southern buffer area at Orchard Hills, also known as Sector B and Sector H in the Defence site plan. The potential offset site contains species and communities that would provide appropriate like-for-like offsets for the Stage 1 development of the airport.

The majority of the site is drained by Blaxland Creek, which flows in a generally south-west to north-easterly direction through the central portion of the site. Blaxland Creek is a third order stream in its upper reaches in the south-west of the site, is fed by an unnamed third order stream in the central portion of the site and is a fourth order stream downstream of this point until it discharges at the eastern boundary of the site. It is fed by numerous first and second order tributaries along its length.

The north-west portion of the site is drained by an unnamed tributary of Surveyors Creek, which discharges to the north through a culvert beneath The Northern Road.

The majority of the Orchard Hills site contains the Blacktown soil landscape, which comprises gently undulating low hills and flats on Wianamatta Group shales. Local relief is 10 to 30m with slopes generally less than 5% but occasionally up to 10%. Crests and ridges are broad (200 to 600m) and rounded with convex upper slopes grading into concave lower slopes. Soils are deep, moderately fertile clay loams and clays (Bannerman and Hazelton 1990).

The lower slopes and alluvial flats adjoining Blaxland Creek contain the South Creek soil landscape, which comprises floodplains, valley flats and drainage depressions of the channels on the Cumberland Plain. This landscape is made up of Quaternary alluvium derived from Wianamatta Group shales and Hawkesbury Sandstone. It is flat apart from incised channels and occasional terraces or levees providing low relief. Soils are deep, moderately fertile sandy clay loams and clay loams over clays (Bannerman and Hazelton 1990).

As shown on Figure 9, the Orchard Hills offset site is located within CCC, which is a community-developed, government-recognised proposal to help address the conservation of biodiversity values and especially connectivity of habitat on the Cumberland Plain. The CCC aims to secure and connect approximately 7000 hectares of land under conservation management in Western Sydney. The majority of the Orchard Hills offset site is also mapped as priority conservation lands in the *Biodiversity Investment Opportunities Map, Mapping Priority Investment Areas for the Cumberland Subregion* (BIO Map) (OEH 2015). As such the conservation of the Orchard Hills offset site would realise an opportunity to improve connectivity and contribute to Australian Government and state government initiatives to secure offsets with strategic value in accordance with Airport Plan Condition 30(7).

At a local scale the conservation and management of the Orchard Hills offset site would help to conserve an important riparian corridor surrounding Blaxlands Creek and maintain connectivity between terrestrial and aquatic environments. The proposal would also increase the extent of woodland and forest habitat and improve connectivity between vegetated remnants through regeneration of woodland in areas of derived grassland.

Plant species and communities

The site inspection confirmed the presence and distribution of three Plant Community Types (PCTs). Stands of these PCTs include near-intact vegetation in 'moderate/good to high' condition, partially cleared or regrowth vegetation in 'moderate/good to poor' condition and extensively modified areas in 'low' condition (according to BBAM). Vegetation zones are shown on Figure 10. The condition of these PCTs varies across the site as a result of previous land uses and grazing intensity. Areas that have been historically cleared and/or heavily grazed now contain regrowth vegetation in poorer condition. The Orchard Hills site has never been extensively ploughed or sown with exotic pasture and contains predominantly native vegetation. There is slight to moderate weed infestation throughout the site, with linear remnants along roads being the most severely affected. There are occasional patches of more severe weed infestation associated with areas of dumped fill or previous more intensive land uses such as firing ranges.

Grey Box – Forest Red Gum grassy woodland on flats is associated with mid and lower slopes, on shale-derived soils across Orchard Hills and is the most extensive native PCT. It comprises an open forest or woodland of Forest Red Gum and Grey Box with a grassy understorey and extensive dense patches of the shrub species Native Blackthorn. Vegetation zone 2, 'Poor condition Grey Box – Forest Red Gum grassy woodland on flats', comprises a derived Swamp Oak scrub, Native Blackthorn shrubland or grassland form of this PCT.

There is an isolated patch of tertiary gravel influenced soils in the southern buffer area that supports Broad-leaved Ironbark – Grey Box – *Melaleuca decora* grassy open forest with a canopy of Broad-leaved Ironbark (*Eucalyptus fibrosa*) and Grey Box along with a characteristic mid storey of Honey Myrtle (*Melaleuca decora*) and a shrub and grass understorey. Vegetation zone 8, 'Poor condition Broad-leaved Ironbark – *Melaleuca decora* grassy open forest', comprises a derived scrub or shrubland form of this plant community type (Figure 10).

The above PCTs grade into Forest Red Gum – Rough-barked Apple grassy woodland along the riparian corridors of Blaxland Creek and other drainage lines through the site. This community is a closed woodland or forest of Forest Red Gum, Grey Box and Cabbage Gum (E*ucalyptus amplifolia)* along with Swamp Oak (*Casuarina glauca*), Broad-leaved Apple (*Angophora subvelutina)* and paperbarks (*Melaleuca* spp.). Understorey vegetation is similar to Grey Box – Forest Red Gum grassy woodland on flats along with additional moisture loving species such as rushes and sedges. Vegetation zone 6, 'Poor condition Forest Red Gum – Rough-barked Apple grassy woodland', comprises a derived Swamp Oak scrub or grassland form of this plant community type (Figure 10).

There are a large number of dams and flooded depressions throughout the site formed by the construction of barriers across small drainage lines. These water bodies contain a moderate diversity and abundance of native wetland plants. They are not natural features; however they contain native wetland and aquatic plant species, and the PCT of '*Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin' is the best fit for this vegetation zone.

Vegetation zones shown on Figure 10 include notable revisions to previous vegetation mapping at the site (see SKM 2014), which appeared to have been based on air photo interpretation and modelling, and is probably originally attributable to the regional scale *Native Vegetation of the Cumberland Plain, Western Sydney* (NPWS 2006).

The following notable changes were made to the vegetation mapping at the site:

- Around 118 hectares formerly mapped as 'Shale Hills Woodland' (SKM 2014), equivalent to 'Grey Box – Forest Red Gum grassy woodland on shale' were re-mapped as 'Grey Box – Forest Red Gum grassy woodland on flats' based on the low elevation of the site (greater than 90m AHD), low local relief and gentle slopes, proximity to alluvial flats, location in the central (rather than southern) Cumberland Plain and 'Blacktown' rather than 'Luddenham' soil landscape (Bannerman and Hazelton 1990).
- Around 27 hectares formerly mapped as 'Castlereagh Ironbark Forest' (SKM 2014), equivalent to 'Broad-leaved Ironbark – Grey Box – *Melaleuca decora* forest on' were re-mapped as 'Broad-leaved Ironbark – Grey Box – *Melaleuca decora* grassy open forest on clay/gravel soils' based on topographic position (mid-slopes and crests rather than alluvial flats), proximity to Cumberland Plain Woodland communities on shale-derived soils rather than Castlereagh vegetation on Tertiary alluvium and 'Blacktown' rather than 'Berkshire Park' soil landscape (Bannerman and Hazelton 1990).
- Areas that had not been mapped as native vegetation because of the absence of trees were mapped as follows:
  - 409.2 hectares of derived native grassland or scrub were mapped as moderate/good to poor condition patches of the PCT most likely to be present based on landscape position
  - 16.9 hectares of exotic grassland or bare earth was mapped as low condition patches of the PCT most likely to be present based on landscape position.

Regarding the re-mapping of Shale Hills Woodland and Castlereagh Ironbark Forest, vegetation structure and dominant plant species do not provide a clear distinction between either set of candidate PCTs at the site because they are so closely related. The four plot/transects sampled in January 2018 had low plant species richness and did not clearly discriminate between PCTs. The vegetation zones shown on Figure 10 represent the 'assessor's use of judgement' according to the BBAM and based on the evidence available at the time of preparation of this BODP.

The scale and consequences of the revisions made by GHD in the preliminary assessment and potential future changes are as follows:

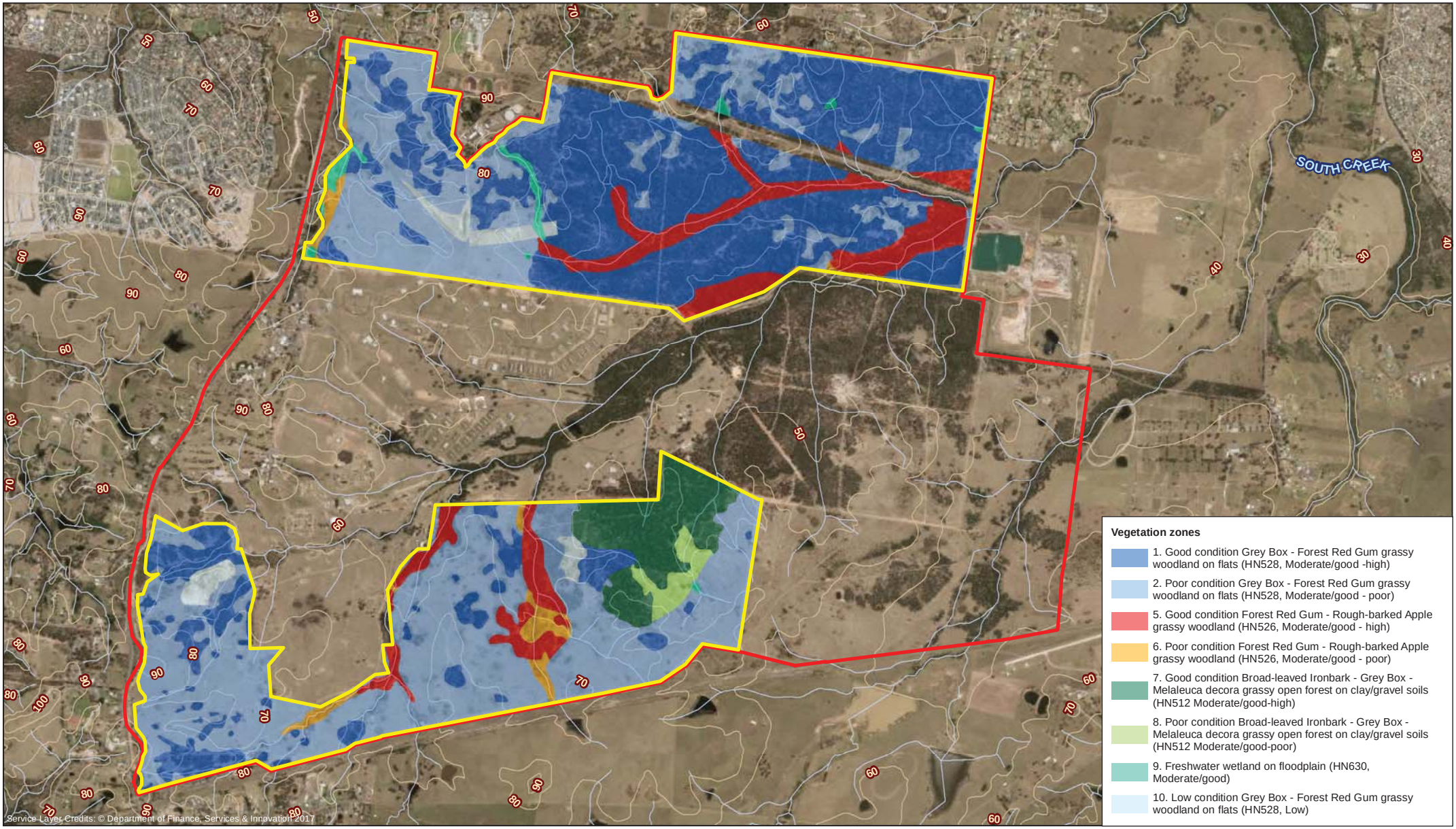
- Re-mapping of areas of 'Shale Hills Woodland' (SKM 2014), equivalent to 'Grey Box – Forest Red Gum grassy woodland on shale' as 'Grey Box – Forest Red Gum grassy woodland on flats' makes little difference to offset calculations since both PCTs comprise EPBC Act Cumberland Plain Woodland and would help meet the direct offset requirements for plants, animals and their habitats.

- Re-mapping of areas of ‘Castlereagh Ironbark Forest’ (SKM 2014), equivalent to ‘Broad-leaved Ironbark – Grey Box – *Melaleuca decora* forest on clay’ as ‘Broad-leaved Ironbark – Grey Box – *Melaleuca decora* grassy open forest on clay/gravel soils’ has resulted in around 27 hectares of additional EPBC Act Cumberland Plain Woodland because the latter PCT is consistent with the community as defined in the listing advice (TSSC 2009). However this change makes little difference to the offset calculations for impacts on plants, animals and their habitats because these PCTs can be traded according to the FBA.
- Mapping of derived native grassland and scrub resulted in 398.1 hectares of poorer condition Cumberland Plain Woodland that contributed to the offset requirement for the EPBC Act-listed form of the community within a total of 426 hectares of poorer condition vegetation that would generate biodiversity credits that would contribute to the offset requirement for plants, animals and their habitats.

Vegetation zones at the site may be revised further during the preparation of the Orchard Hills offset site biodiversity assessment report based on additional survey effort and especially sampling of additional plot/transects under better conditions.

The majority of the site was severely drought affected and heavily grazed by macropods and pest herbivores such as rabbits and deer at the time of the site inspection. Understorey vegetation cover was very low across the site, particularly in grassland areas, making it difficult to confidently identify plant species and to confirm the relative cover of native and exotic species. The majority of the grassland at the site is assumed to comprise poor condition forms of the native PCTs described above (ie derived native grassland) and to comprise occurrences of related threatened ecological communities. These areas are assumed to contain predominantly native groundcover, mainly comprising native grasses such as Kangaroo Grass (*Themeda triandra*) that could be readily regenerated with increased rainfall and especially with reduced grazing pressure. The evidence used to support the mapping of native grassland across the site includes:

- the presence of species-rich and predominantly native grassland vegetation in fenced portions of the site with equivalent landscape positions and disturbance histories but without enclosed macropod populations
- personal communications from Defence ecologists and GHD bushfire and biosecurity management specialists who have observed the site over the last five years
- the results of biodiversity monitoring (SKM 2014) and macropod monitoring (Cumberland Ecology 2014) conducted at the site between 2008 and 2013
- the NSW Scientific Committee (2009) determination for Cumberland Plain Woodland, which notes ‘some areas of the community now devoid of woody plant species may retain a substantial suite of native grasses and herbs in the ground layer. Orchard Hills includes outstanding examples of this phenomenon’.



Paper Size A4

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Metres

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

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LEGEND

- Defence Establishment Orchard Hills
- Orchard Hills offset area
- Waterways
- Contours (10m)

Department of Infrastructure, Regional Development and Cities
Western Sydney Airport
Biodiversity Offset Delivery Plan

Job Number	21-26204
Revision	A
Date	25 Jul 2018

Orchard Hills vegetation zones

Figure 10

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

Data source: Aerial Imagery - SIX Maps 2018, Offset sites - GHD 2017, Cumberland Plain Conservation - OEH 2016, Airport layout data - WSU 2016. Created by:jrprice

Fauna species and habitats

The Orchard Hills offset site contains substantial areas of habitat for native fauna associated with woodland, riparian forest and derived native grassland and scrub. There is a relatively extensive area of wetland and aquatic habitat associated with the riparian corridor of Blaxland Creek, a network of smaller drainage lines and a number of artificial wetlands. There are also areas of exotic grassland and cleared land associated with previous, more intensive land uses and dumped fill. These fauna habitat types are shown on Figure 12.

Native woodland at the Orchard Hills offset site comprises an extensive and regionally significant area of fauna habitat. Habitat resources include: mature canopy trees (ie trees between 20 to 80% of their life expectancy) and associated nectar, fruits and leaves as well as foraging substrate; a range of fruiting and flowering small trees and shrubs; and connectivity with wetland and aquatic habitat. Woodland and forest at the site occurs as extensive patches (see Figure 12) of particular value given the generally fragmented nature of similar habitat on the Cumberland Plain. The Orchard Hills offset site contains relatively good quantities of pre-European occupation age trees and associated habitat resources, such as tree hollows and stags. These trees include hollows with a range of sizes, orientations and landscape positions and both living and dead trees.

Canopy tree species in woodland provide foraging and shelter resources for a range of birds and mammals. Foraging resources include seasonal nectar resources, seeds and insects. Winter-flowering acacias and Native Blackthorn would help provide year-round foraging resources for a range of native birds, bats and mammals.

Riparian forest is a closed woodland or forest of eucalypts with Swamp Oak present along the margins of the creeks. This species also occurs on the associated flats. A range of paperbarks (*Melaleuca* spp.) are also present. Understorey vegetation is similar to the adjacent native woodland along with additional moisture-loving species, such rushes and sedges. Riparian forest at the site contains large, hollow-bearing trees as well as foraging and shelter resources for a range of birds and mammals.

There are extensive areas of grassland at the Orchard Hills offset site that would have historically supported native woodland vegetation but have been extensively modified by previous clearing and agriculture. Notably, the majority of these areas have never been cropped or sown with exotic pasture and contain derived native grassland. Native grasslands are recognised as having particular value for many native fauna species, particular grain-feeding woodland birds such as parrots and finches. Open areas of native grassland are also recognised as contributing to habitat complexity and overall fauna species richness on the Cumberland Plain. A matrix of open forest, grassy woodland and grassland is recognised as being the likely vegetation structure of the Cumberland Plain prior to European occupation (DEC 2005a, DECCW 2010). Occasional paddock trees and shrubs such as Native Blackthorn and *Hakea sericea* also occur in these areas and would provide shelter and foraging habitat for native woodland birds.

The areas of exotic grassland and cleared land contain few habitat resources of relevance to most native species due to low structural and floristic diversity. Exotic grasses and herbs would provide foraging resources for relatively mobile and opportunistic native fauna species.

There is a relatively extensive network of drainage lines and waterbodies across the Orchard Hills offset site. Most drainage lines feature moderate geomorphic condition, generally contain good instream and riparian vegetation but moderate to severe weed infestation and some evidence of degradation, such as bank erosion, increased turbidity and interrupted flow. Drainage lines provide habitat for native fish and aquatic invertebrates and breeding habitat for a number of stream-breeding frogs.

There are a number of dams and flooded depressions at the site with varying growth of native wetland and aquatic plants, including some water bodies with extensive reed beds. These range in habitat value for native fauna depending on their size, presence of emergent or aquatic vegetation. The majority of these dams contain a variety of aquatic vegetation, including *Typha orientalis, Eleocharis cylindrostachys* and *Eleocharis sphacelata* and have been mapped as a native freshwater wetland vegetation zone (see Figure 10).

A total of 68 bird species have been recorded at Orchard Hills, including birds of open country, woodland, riparian forest and wetlands (SKM 2014).

A total of 10 reptile species have been recorded at Orchard Hills with the Fence Skink (*Cryptoblepharus virgatus*) and Grass Skink (*Lamprophoils guichenoti*) the most commonly recorded (SKM 2014).

Orchard Hills is entirely and securely fenced and contains several large, discrete regions each with their own enclosed macropod populations, including Eastern Grey Kangaroos (*Macropus giganteus*), Swamp Wallabies (*Wallabia bicolor*) and Common Wallaroos (*Macropus robustus*). Any large, enclosed area with a resident kangaroo population poses a long-term management challenge, as macropods are fast breeders in suitable conditions and can exert significant grazing pressure. Orchard Hills contains an abundant enclosed macropod population that is having a significant effect on the ecology of the site and has been the subject of monitoring and management since 2005 (Cumberland Ecology 2014).

Conservation significance

Better condition patches of Grey Box – Forest Red Gum grassy woodland on flats and Broad-leaved Ironbark – Grey Box – *Melaleuca decora* grassy open forest at the site comprise occurrences of 'Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest' (Cumberland Plain Woodland). Cumberland Plain Woodland is listed as a CEEC under the EPBC Act. EPBC Act Cumberland Plain Woodland was identified according to the criteria in the listing advice for the community (TSSC 2008).

As described above, the Broad-leaved Ironbark – Grey Box – *Melaleuca decora* grassy open forest on clay/gravel soils was formerly mapped as Castlereagh Ironbark Forest and an occurrence of the related TEC (SKM 2014) rather than Cumberland Plain Woodland. As described above, there are several factors that support a revision to the vegetation mapping that also apply to the related TEC.

Patches of woodland at the site that comprise an occurrence of EPBC Act Cumberland Plain Woodland are shown on Figure 11. A patch is defined as a discrete and continuous area that comprises the ecological community. A patch may include small-scale disturbances such as tracks or breaks or other small-scale variations in native vegetation that do not significantly alter the overall functionality of the ecological community – for instance the easy movement of wildlife or dispersal of plant spores and seeds (DEWHA 2010).

Derived native grassland and other moderate/good to poor condition vegetation at the site does not meet the condition criteria for a local occurrence of EPBC Act Cumberland Plain Woodland as defined in the listing advice for the community (TSSC 2008) and associated guidelines (DEWHA 2010). This vegetation does not qualify because native tree species are not present with a minimum projected foliage cover of greater than 10% (DEWHA 2010). The low project foliage cover in these areas was confirmed through a combination of aerial photo interpretation and walked traverses.

The majority of the native vegetation at the site, including derived native grasslands, comprises local occurrences of TECs listed under the NSW BC Act (as detailed on Figure 11), as follows:

- Both good and poor condition patches of Grey Box – Forest Red Gum grassy woodland on flats and Grey Box – Forest Red Gum grassy woodland on hills comprise the CEEC 'Cumberland Plain Woodland in the Sydney Basin Bioregion'.
- Both good and poor condition patches of Broad-leaved Ironbark – Grey Box – *Melaleuca decora* grassy open forest comprise the EEC 'Shale-Gravel Transition Forest in the Sydney Basin Bioregion'.
- Both good and poor condition patches of Forest Red Gum – Rough-barked Apple grassy woodland comprise the EEC 'River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner' bioregions.
- Wetlands at the site feature predominantly native plant species but are associated with dams and flooded depressions that have been formed by the construction of barriers across small drainage lines. They are clearly not natural geomorphic features. They do not comprise a local occurrence of the TEC 'Freshwater wetlands on coastal floodplains' because artificial wetlands created on previously dry land for purposes such as sewerage treatment, stormwater management and farm production are not regarded as part of this community (DECC 2008).

Orchard Hills contains known populations of the following threatened flora species:

- *Pultenaea parviflora*, which is listed as a vulnerable species under the EPBC Act and an endangered species under the BC Act
- *Dillwynia tenuifolia,* which is listed as a vulnerable species under the BC Act
- *Grevillea juniperina* subsp*. juniperina,* which is listed as a vulnerable species under the BC Act
- individuals within the endangered *Marsdenia viridiflora* R. Br. subsp. *viridiflora* population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas listed under the BC Act (SKM 2014).

Threatened flora populations at the site are shown on Figure 11. The locations of the threatened flora shown on Figure 11 should be considered indicative of occupied habitat only at this stage of the biodiversity offset assessment, particularly the polygons indicating areas of *Pultenaea parviflora* and *Dillwynia tenuifolia.* Biodiversity monitoring indicated significant fluctuations in the abundance of these species between 2008 and 2013 (SKM 2014) and just one individual *Pultenaea parviflora* and no *Dillwynia tenuifolia* were recorded during the January 2018 site inspection. This is probably because of the prolonged dry weather and intensity of grazing over the last 12 months. In contrast, the majority of the *Grevillea juniperina* subsp*. juniperina* patches and *Marsdenia viridiflora viridiflora* individuals could be readily located in January 2018 and some additional individuals were observed. Additional targeted surveys will be required to obtain a more accurate census of threatened flora populations.

All native woodland and forest at Orchard Hills provides foraging habitat for the Grey-headed Flying-fox. Dominant canopy species, including Forest Red Gum, Grey Box and Broad-leaved Ironbark are recognised as significant species in the blossom diet of the Grey-headed Flying-fox (Eby and Law 2008).

The Swift Parrot may occur at the Orchard Hills site on occasion during its winter migration. Dominant canopy species at the site, including Grey Box and Forest Red Gum would provide nectar and lerp foraging resources for the Swift Parrot.

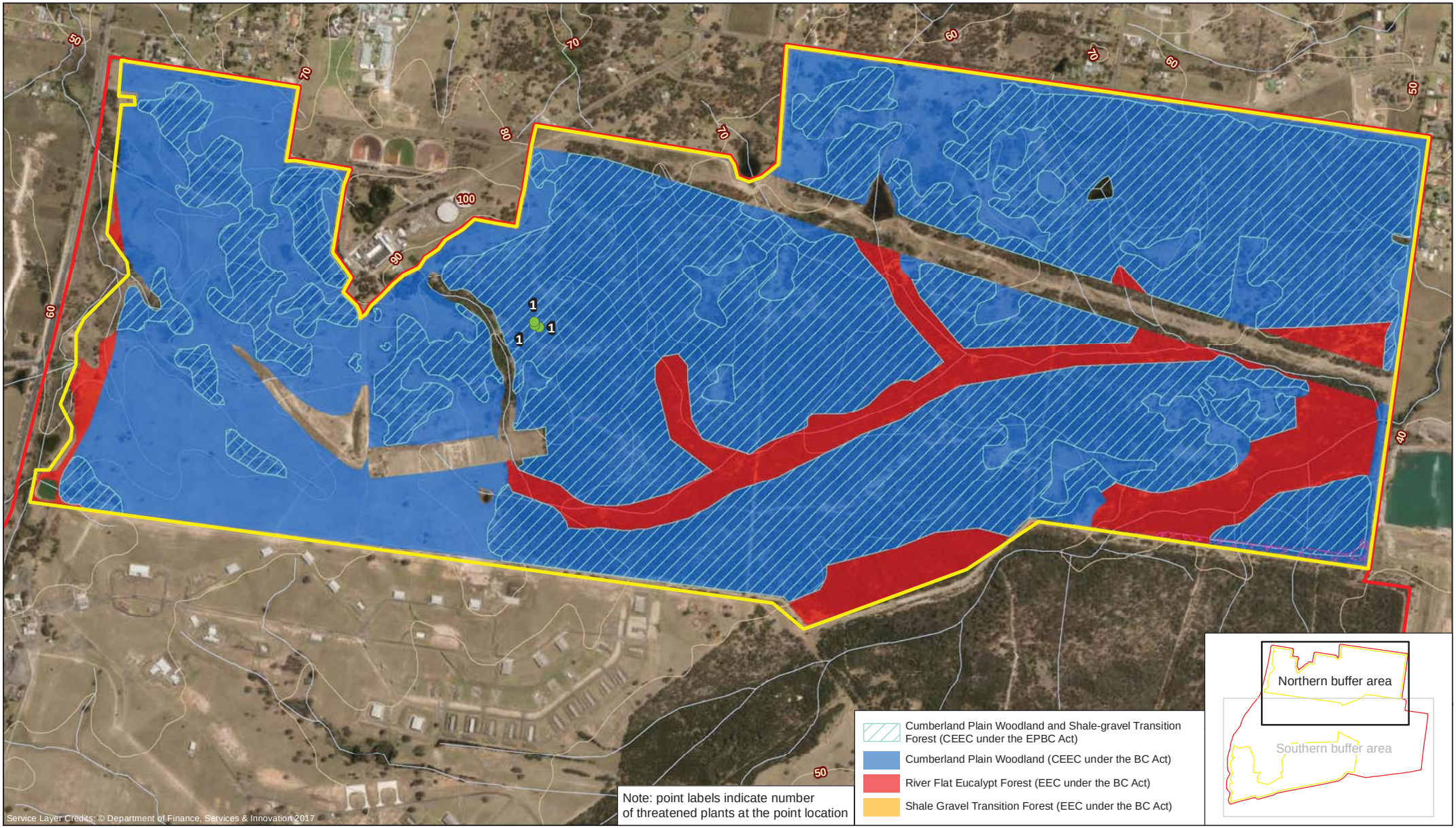
Three threatened fauna species listed under the BC Act were recorded during the January 2018 survey:

- Cumberland Plain Land Snail (*Meridolum corneovirens*), which is listed as an endangered species and is a species-credit type species according to the BBAM
- Little Eagle (*Hieraaetus morphnoides*), which is listed as a vulnerable species
- Dusky Woodswallow (*Artamus cyanopterus*), which is listed as a vulnerable species.

The Speckled Warbler (*Pyrrholaemus sagittatus*) and Varied Sittella (*Daphoenositta chrysoptera*) have previously been recorded at the site (SKM 2014). Both of these species are listed as vulnerable species under the BC Act.

Habitat resources and threatened fauna observed during the site inspection are shown on Figure 12.

The site is likely to include populations of a number of other threatened fauna species and their habitats, including woodland birds, raptors and forest owls, wetland birds and microbats.



Paper Size A4

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Metres

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

N

LEGEND

- Defence Establishment Orchard Hills
- Orchard Hills offset area
- Waterways
- Contours (10m)
- *Marsdenia viridiflora* subsp. *viridiflora* (endangered population under the BC Act)
- *Pultenaea parviflora* (endangered species under the BC Act, vulnerable species under the EPBC Act)
- *Grevillea juniperina* subsp. *juniperina* (vulnerable species under the BC Act)
- *Dillwynia tenuifolia* (vulnerable species under the BC Act)
- *Pultenaea parviflora* (endangered species under the BC Act, vulnerable species under the EPBC Act)

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Biodiversity Offset Delivery Plan

Job Number 21-26204
Revision A
Date 25 Jul 2018

Orchard Hills threatened flora and ecological communities

Figure 11a

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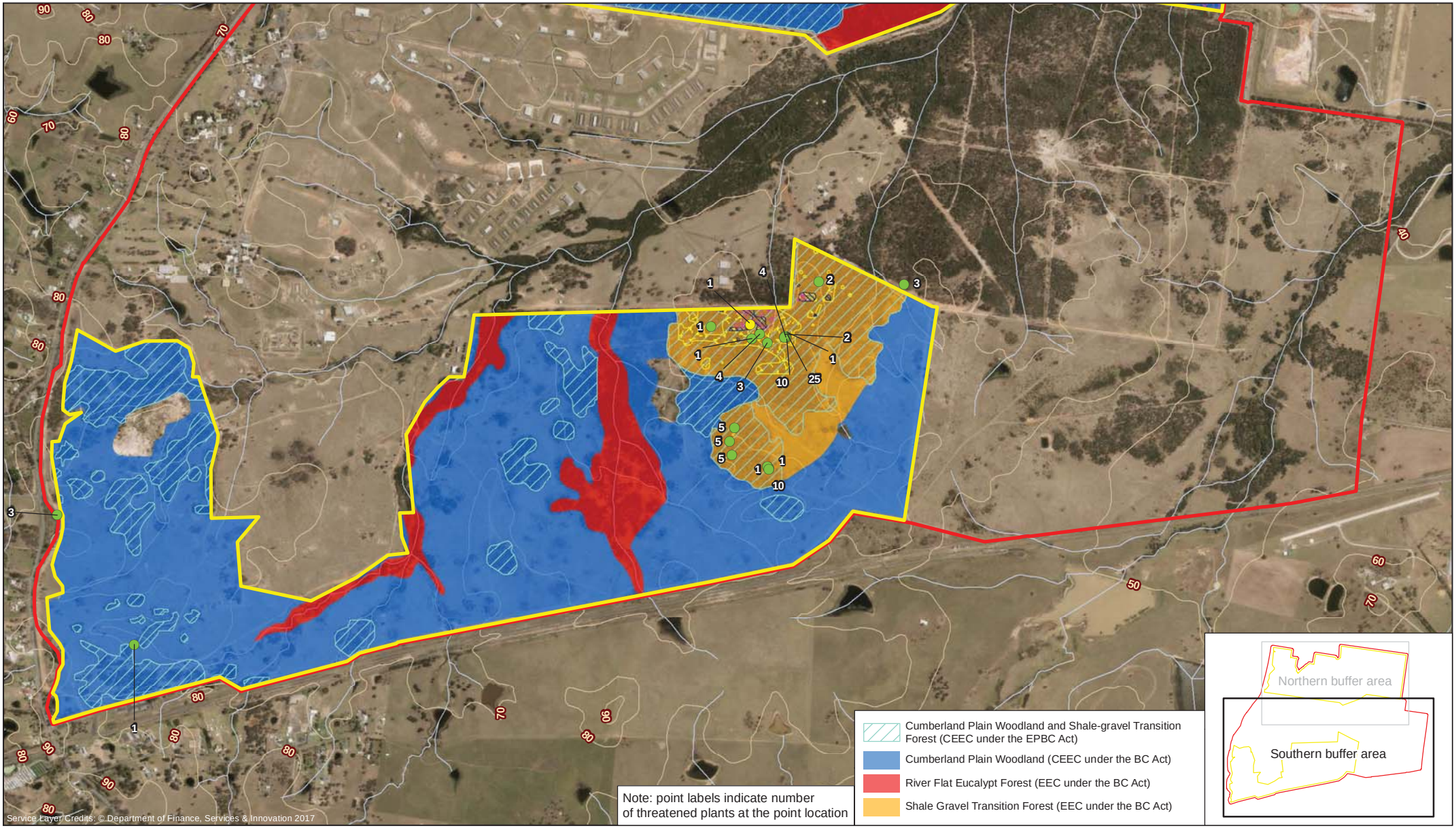
Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data source: Aerial Imagery - SIX Maps 2018, Offset sites - GHD 2017, Cumberland Plain Conservation - OEH 2016, Airport layout data - WSU 2016. Created by:jrprice



Paper Size A4

0 100 200 400

Metres

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

N

LEGEND

- Defence Establishment Orchard Hills
- Orchard Hills offset area
- Waterways
- Contours (10m)
- *Marsdenia viridiflora* subsp. *viridiflora* (endangered population under the BC Act)
- *Pultenaea parviflora* (endangered species under the BC Act, vulnerable species under the EPBC Act)
- *Grevillea juniperina* subsp. *juniperina* (vulnerable species under the BC Act)
- *Dillwynia tenuifolia* (vulnerable species under the BC Act)
- *Pultenaea parviflora* (endangered species under the BC Act, vulnerable species under the EPBC Act)

Department of Infrastructure, Regional Development and Cities
Western Sydney Airport
Biodiversity Offset Delivery Plan

Job Number 21-26204
Revision A
Date 25 Jul 2018

Orchard Hills threatened flora and ecological communities

Figure 11b

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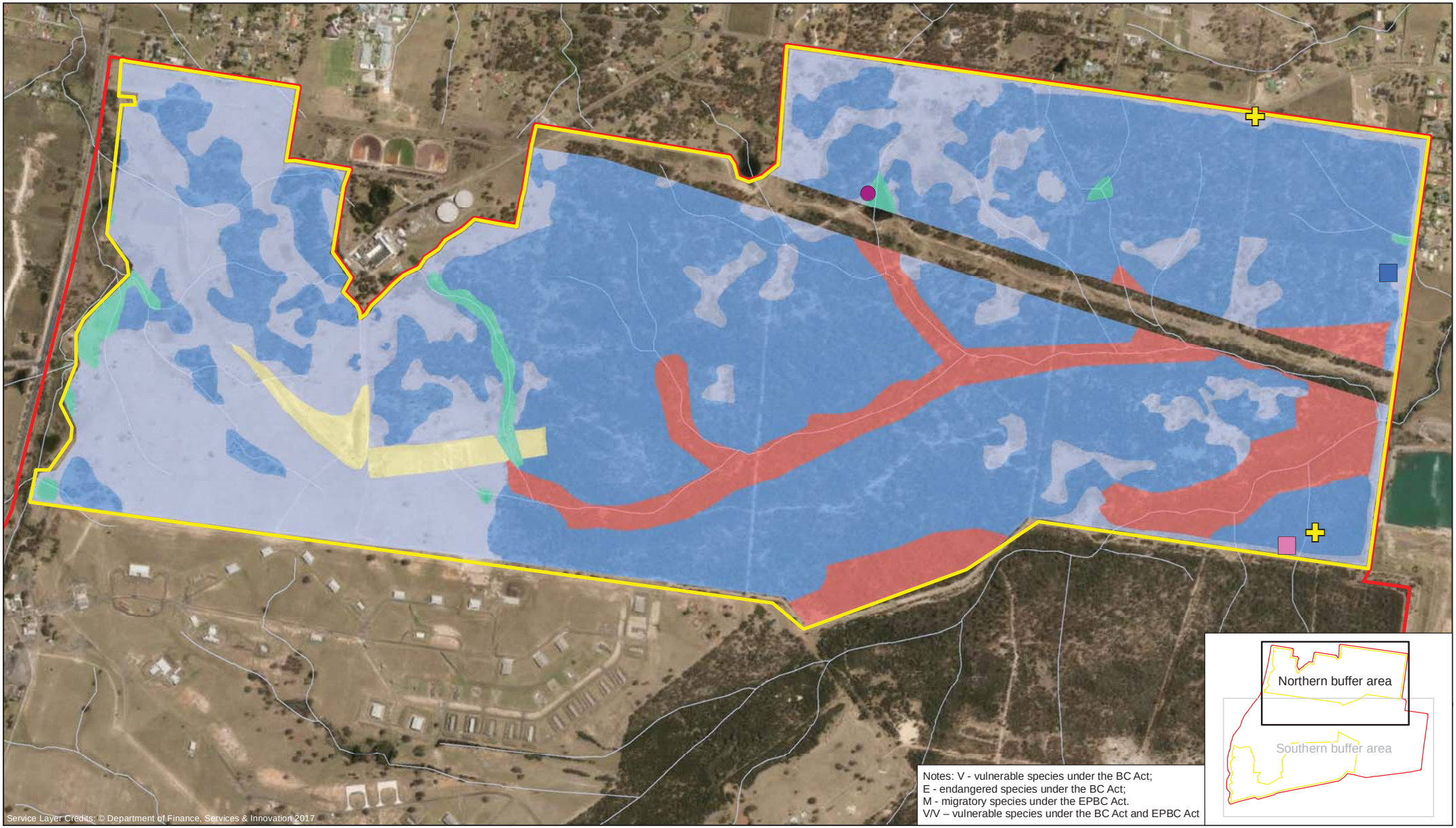
Data source: Aerial Imagery - SIX Maps 2018, Offset sites - GHD 2017, Cumberland Plain Conservation - OEH 2016, Airport layout data - WSU 2016. Created by:jrprice



Notes: V - vulnerable species under the BC Act;
E - endangered species under the BC Act;
M - migratory species under the EPBC Act.
V/V – vulnerable species under the BC Act and EPBC Act

Paper Size A4

0 100 200 400

Metres

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

N

LEGEND

- Defence Establishment Orchard Hills
- Orchard Hills offset area
- Waterways

Migratory species

- Latham's Snipe (M)

Threatened species

- Cumberland Plain Land Snail (E)
- Little Eagle (V)
- Dusky Woodswallow (V)

Habitat types

- Exotic grassland
- Native grassland
- Riparian forest
- Wetland
- Woodland

Department of Infrastructure, Regional Development and Cities
Western Sydney Airport
Biodiversity Offset Delivery Plan

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Orchard Hills threatened fauna and habitat resources

Figure 12a

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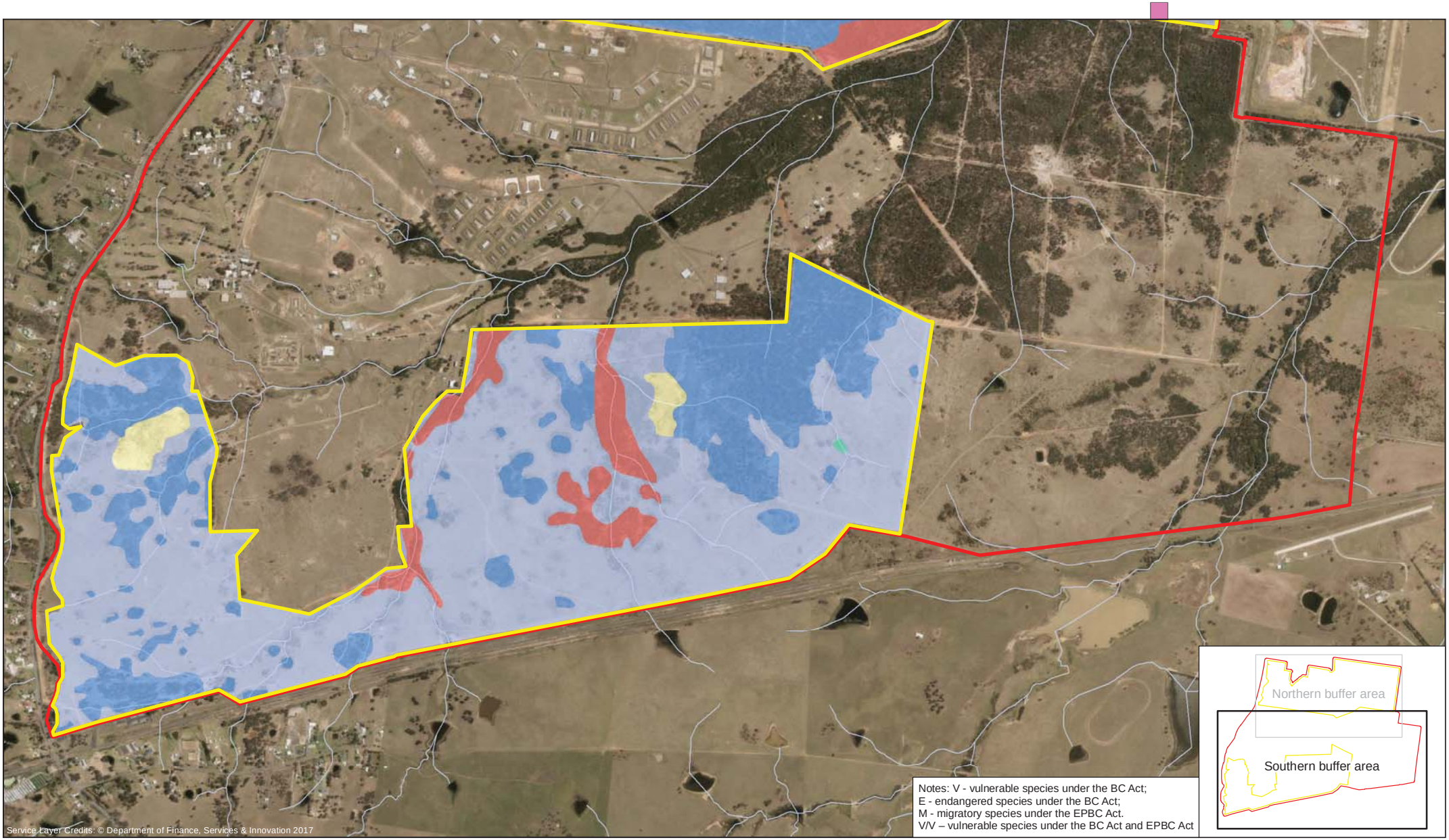
Data source: Aerial Imagery - SIX Maps 2018, Offset sites - GHD 2017, Cumberland Plain Conservation - OEH 2016, Airport layout data - WSU 2016. Created by:jrprice



Paper Size A4

0 100 200 400

Metres

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

N

LEGEND

- Defence Establishment Orchard Hills
- Orchard Hills offset area
- Waterways

Migratory species

- Latham's Snipe (M)

Threatened species

- Cumberland Plain Land Snail (E)
- Little Eagle (V)
- Dusky Woodswallow (V)

Habitat types

- Exotic grassland
- Native grassland
- Riparian forest
- Wetland
- Woodland

Department of Infrastructure, Regional Development and Cities
Western Sydney Airport
Biodiversity Offset Delivery Plan

Orchard Hills threatened fauna and habitat resources

Figure 12b

Job Number 21-26204
Revision A
Date 25 Jul 2018

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Data source: Aerial Imagery - SIX Maps 2018, Offset sites - GHD 2017, Cumberland Plain Conservation - OEH 2016, Airport layout data - WSU 2016. Created by:jrprice

6.1.3 Security of offset

The EPBC Act Offsets Policy requires that offsets sites are legally secured to avoid the risk that the site is developed or otherwise lost.

The offset area will be secured as a result of a number of factors including:

- The site is located on Commonwealth-owned land.
- The EPBC Act provides a comprehensive environment and planning framework for the site under the control of the Environment Minister including through controls contained in Parts 3 (Requirements for environmental approvals) and Part 13 (Species and Communities).

The core offset area is contained within a Commonwealth Heritage Listed area that is subject to additional controls under Part 15 of the EPBC Act. The obligations contained in the MOU are intended to be additional to the Commonwealth Heritage Listing requirements. The MOU entered into between Defence and the Department will provide for:

- the area and boundaries of the Orchard Hills offset site to be formalised, with an expectation that the area will include a core area of no less than 900 hectares and any other additional areas agreed between Defence and the Department
- an Offset Plan to be developed, funded and implemented over a period, expected to be up to 20 years to provide measurable ecological improvements to the quality of habitat for the affected threatened biota at the Orchard Hills offset site consistent with the EPBC Act Offsets Policy and through the potential management actions outlined in this BODP
- various monitoring, record keeping, reporting and auditing arrangements to be put in place consistent with this BODP and the Airport Plan
- the Orchard Hills offset site to be maintained following completion of the improvements, so as to retain long-term benefits of the quality improvements delivered following implementation of the Offset Plan expected to take up to 20 years.

6.1.4 Management of offset

The MOU will include a requirement for the management actions under the Offset Plan to achieve set objectives to improve biodiversity values and specifically the quality of habitat for the affected threatened biota at the Orchard Hills offset site. These actions would be specified in an Offset Plan, which Defence would prepare in consultation with Environment and Energy. Once prepared, the Offset Plan would be submitted to the Department for approval.

The Orchard Hills offset site is currently the subject of a Draft Heritage Management Plan as well as a Bushfire Management Plan, Biosecurity Plan and Biodiversity Monitoring Program (GML 2013). The overarching objective of the Draft Heritage Management Plan and these related plans is to protect and manage the natural values of the Commonwealth Heritage List area (GML 2013). The Offset Plan represents an intensification of the level of management of biodiversity values at the Orchard Hills offset site.

The objectives of the Offset Plan will be to improve the quality of habitat for the affected threatened biota and plants, animals and their habitat in the Offset Area in order to help meet the requirements of this BODP. Specifically, the Offset Plan management actions will be designed to achieve the following objectives:

a. 'Future quality with offset' score that is two greater than the 'Start quality' score that is defined in the Initial Ecological Survey for the area of Cumberland Plain Woodland

b. 'Future quality with offset' score that is one greater than the 'Start quality' score that is defined in the Initial Ecological Survey for the area of habitat for the Swift Parrot and Grey-headed Flying-fox in the Offset Area

c. 'Future quality with offset' score for the area of poorer quality Cumberland Plain Woodland in the Offset Area that is at least:

i) as high as the quality score for the Cumberland Plain Woodland in the Stage 1 Construction Impact Zone (6 out of 10), and

ii) two greater than the 'Start quality' score that is defined in the Initial Ecological Survey for the area of poorer quality Cumberland Plain Woodland in the Offset Area.

The requirement to improve the site quality of poorer quality Cumberland Plain Woodland is a particularly notable increase in the current degree of management, in that the Draft Heritage Management Plan only requires the maintenance of Cumberland Plain Woodland and other TECs in the Heritage List Area and does not require the restoration of degraded areas (GML 2013).

The following section provides an outline of the types of actions that are expected to be required for ongoing management of the Orchard Hills offset site to achieve the proposed improvements in biodiversity values. The Offset Plan would provide additional detail regarding activities, responsibilities, a timeline for each proposed management action, monitoring and auditing.

Potential management actions would include activities such as:

- retention of regrowth and remnant native vegetation and habitat resources such as dead timber and rocks
- supplementation of habitat resources in revegetated and naturally regenerating areas. This will focus on provision of natural fallen timber, nesting hollows and other elements that will not naturally regenerate for very long time periods except in areas with mature old growth canopies
- management of human disturbance and exclusion of land uses that are inconsistent with biodiversity conservation to the extent practical having regard to ongoing Defence use of the site
- management of light pollution from roads and facilities and its impacts on nocturnal fauna
- maintenance of fences, gates, signs and access tracks
- remediation of contaminated sites
- weed control, including treatment of: patches of Blackberry, African Lovegrass and other exotic grasses in open areas; *Juncus acutus* in wetlands and drainage lines; African Olive and other noxious and environmental weeds in woodland and forest

- revegetation or supplementary planting where natural regeneration will not be sufficient to achieve management outcomes, including areas of exotic grassland, bare earth or imported fill. Some areas would be maintained as native grassland to maintain the diversity of habitat types and to help maximise native plant species richness
- reintroduction of locally extinct native fauna that performed important ecosystem roles in natural communities of the Cumberland Plain, such as bettongs and bandicoots, or threatened species that naturally form part of Cumberland Plain communities such as the koala
- management of fire for conservation with consideration of existing fire management plans and the need to maintain the diversity of habitat types and meet Defence operational and safety requirements
- mechanical removal of Native Blackthorn scrub to help restore a natural vegetation structure and native groundcover diversity in areas where it would not be possible to use fire to achieve this aim given the risk of damaging wildfire
- erosion remediation and control
- removal of barriers and reinstatement of natural flows in drainage lines (where consistent with track maintenance and other Defence activities)
- feral cat and fox control and exclusion and control of feral herbivores, such as rabbits and deer, coordinated with existing control programs in the locality
- management of over-abundant native herbivores (kangaroos and wallabies) with consideration of existing monitoring and control programs
- ongoing support for research programs and experimental ecosystem restoration projects at Orchard Hills in support of achieving and improving the required offset outcomes. This would include testing and optimising reintroductions, nutrient cycling, revegetation techniques, soil rehabilitation, dieback treatments and habitat supplementation actions.

These types of management actions represent a substantial intensification of the management of the site and would aim to improve the condition and viability of Cumberland Plain Woodland and the quality of habitat for the Grey-headed Flying-fox and Swift Parrot as described in Table 6.1 below. Performing these management actions would also increase the viability of populations and quality and condition of habitat for native species.

Additional site-specific management actions may be required based on conditions at the site or to alleviate specific threats identified in a more detailed biodiversity assessment of the site. Based on the preliminary biodiversity assessment of the Orchard Hills offset site and an understanding of expected outcomes of management measures, an increase in site quality score with offset of two for Cumberland Plain Woodland, and an increase in site quality score with offset of one for habitat for the Swift Parrot and the Grey-headed Flying-fox have been entered in the offsets assessment guide calculations (see Section 6.1.7). As noted above, these increases would be set as a minimum requirement in the MOU and would be a key target set in the drafting and implementation of the Offset Plan. Table 6.1 provides the validation for the increase in habitat quality score with reference to conservation advice and recovery plans for the affected threatened biota as relevant.

Table 6.1 Effect of management actions on quality of habitat in the Orchard Hills offset site

Management action	Effect on Cumberland Plain Woodland	Effect on Grey-headed Flying-fox habitat and Swift Parrot foraging habitat
Retention of regrowth and remnant native vegetation under a conservation agreement.	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). The Orchard Hills offset site is located in mapped Cumberland Plain Priority Conservation Lands that are identified in the recovery plan for Cumberland Plain Woodland (DECCW 2010, 2011). Together with the specific actions outlined below would improve site condition values by restoring plant species richness, native vegetation cover and habitat attributes to benchmark values supporting the increase in site condition values summarised in Table 2.1.	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 Grey-headed Flying-fox: Objective 1: To identify and protect foraging habitat critical to the survival of Grey-headed Flying-foxes throughout their range Objective 2: To protect and increase the extent of key winter and spring foraging habitat of Grey-headed Flying-foxes (DECCW 2009). Contributes to the following recovery action identified in the recovery plan for the Swift Parrot: Action 2 – Manage and protect Swift Parrot habitat at the landscape scale (Saunders and Tzaros 2011). Together with the specific actions outlined below would improve site condition values by restoring native vegetation cover and habitat attributes to benchmark values and improving the health and productivity of food tree species supporting the increase in site condition values summarised in Table 2.2 and Table 2.3.

Management action	Effect on Cumberland Plain Woodland	Effect on Grey-headed Flying-fox habitat and Swift Parrot foraging 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.

Management action	Effect on Cumberland Plain Woodland	Effect on Grey-headed Flying-fox habitat and Swift Parrot foraging habitat
Regeneration of canopy vegetation in derived native grassland and scrub. Revegetation or supplementary planting where natural regeneration will not be sufficient to achieve management outcomes, including areas of exotic grassland, bare earth or imported fill.	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. The frequent 10 to 100m wide gaps in habitat within the site associated with cleared land would be reduced to only occasional less than 10m wide gaps in habitat within the site associated with access tracks, fence lines etc. supporting the increase in site context values summarised in Table 2.1.	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. The frequent 10 to 100m wide gaps in habitat within the site associated with cleared land would be reduced to only occasional less than 10m wide gaps in habitat within the site associated with access tracks, fence lines etc. supporting the increase in site context values summarised inTable 2.2 and Table 2.3. Contributes to the following recovery objective identified in the recovery plan for the Grey-headed Flying-fox: Objective 2: To protect and increase the extent of key winter and spring foraging habitat of Grey-headed Flying-foxes (DECCW 2009). Contributes to the following recovery objectives and actions identified in the recovery plan for the Swift Parrot: Objective 1: To achieve a demonstrable sustained improvement in the quality and quantity of Swift Parrot habitat to increase carrying capacity Action 2 – Manage and protect Swift Parrot habitat at the landscape scale (Saunders and Tzaros 2011).

Management action	Effect on Cumberland Plain Woodland	Effect on Grey-headed Flying-fox habitat and Swift Parrot foraging habitat
Supplementation of habitat resources in revegetated and naturally regenerating areas.	Increased shelter and foraging habitat for component species, including threatened woodland birds and the Cumberland Plain Land Snail. Associated benefits for vegetation condition and species richness through improved ecosystem function and services such as inoculation with fungi spores, pollination and transmission of propagules.	Unlikely to directly benefit these mobile species of over storey vegetation.
Reintroduction of locally extinct native fauna that performed important ecosystem roles in natural communities of the Cumberland Plain.	Increased species richness. Associated benefits for vegetation condition and ecosystem function through services such as inoculation with fungi spores, pollination and transmission of propagules.	Unlikely to directly benefit these mobile species of over storey vegetation.
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.

Management action	Effect on Cumberland Plain Woodland	Effect on Grey-headed Flying-fox habitat and Swift Parrot foraging habitat
Control of pest fauna (deer, rabbits, pigs, cats, foxes and dogs) and overabundant native herbivores.	Improved health and productivity of native vegetation. Reduced risk of secondary impacts such as erosion and sedimentation and transmission of weeds or disease. Reduced risk of predation or competition having an adverse effect on component species. The removal of these threats to the integrity and species richness of the community supports the increase in site condition score summarised in Table 2.1.	Likely increase in the extent and quality of foraging habitat by increasing the extent, health and productivity of native vegetation containing food tree species. The removal of these threats to the health and productivity of foraging habitat supports the increase in site condition score summarised in Table 2.2 and Table 2.3.
Mechanical removal of Native Blackthorn scrub	Restoration of natural vegetation structure and native groundcover diversity in areas where it would not be possible to use fire to achieve this aim, given the risk of damaging wildfire.	Reduced risk of wildfire and associated risk of harm to individual animals, and of erosion having an impact on the quality of the habitat.
Property maintenance (perimeter fencing, rubbish and barbed wire fence strand removal, erosion control).	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 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 through removal of damaged or obsolete fencing. Reduced risk of adverse impacts on the quality of habitat. Contributes to the following recovery objective identified in the recovery plan for the Grey-headed Flying-fox: 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).
Removal of barriers and reinstatement of natural flows in drainage lines.	Increased quality and connectivity of habitat for component species. Associated benefits for vegetation condition and species richness through improved ecosystem function.	Unlikely to directly benefit these mobile species of over storey vegetation.

Management action	Effect on Cumberland Plain Woodland	Effect on Grey-headed Flying-fox habitat and Swift Parrot foraging habitat
Ongoing support for research programs and experimental ecosystem restoration projects.	Application of research outcomes and adaptive management would increase the effectiveness of the actions described above and the likely benefits. Research may identify novel actions with additional benefits or reduce the risk of mismanagement. Results could be applied at occurrences of the community at other sites and achieve benefits at the regional scale.	Application of research outcomes and adaptive management would increase the effectiveness of the actions described above and the likely benefits. Research may identify novel actions with additional benefits or reduce the risk of mismanagement. Results could be applied to habitat for these species at other sites and achieve benefits at the regional scale.

6.1.5 Monitoring and reporting

The Offset Plan would include provision for monitoring. This section sets out the minimum requirements expected to be included in the Offset Plan.

An inspection of the Offset Area would be undertaken by, or on behalf of, Defence at least every 12 months from finalisation of the Offset Plan to monitor:

- physical condition of fencing and gates to determine whether they are maintained to a standard that can:
  - control human disturbance
  - control the movement of feral and overabundant native herbivores as required by the plan
  - control vertebrate pests as required by the plan.
- any substantive human disturbance of the offset site
- evidence of erosion
- implementation of management actions according to the timeframes specified in the plan
- the effectiveness of the implementation of the management actions according to performance measures specified in the plan, including:
  - the extent, health and condition of native vegetation in revegetation areas relative to targets set in the plan
  - the extent and severity of weed infestations in weed control areas relative to targets set in the plan
  - the condition of any supplementary habitat resources placed in accordance with the plan
  - any other biodiversity values identified as indicators of performance against additional management actions
- the extent, fire impact severity and post-fire vegetation regeneration of any ecological burns implemented in accordance with the plan and/or any wildfires.

Defence would complete and submit to the Department an annual report in relation to compliance with the Offset Plan. The annual report would contain the results of any monitoring, inspections, audits or other relevant requirements set out in the Offset Plan. The annual report will also assess the Offset Plan's ability to continue to meet the requirements of this BODP. This reporting requirement is intended to support compliance by the Department with its obligations under Condition 39(3) of the Airport Plan. The Department will attach the report provided by Defence as a supporting document to the annual report.

The Offset Plan would provide for independent compliance audits to be undertaken so as to support the obligations in Condition 30(11) of the Airport Plan.

The Offset Plan would set out a record keeping regime that Defence would implement in relation to implementation of the Offset Plan.

6.1.6 Timing of delivery

Defence would prepare an Offset Plan for the site within 18 months of the commencement date of the MOU. The offset site and any other agreed areas would be actively managed as an offset for the airport for the period required to achieve the offset improvements discussed in Section 6.1.4, expected to be up to 20 years from the date that the Offset Plan is finalised. Defence would implement the plan, including completion of all monitoring, reporting and auditing requirements.

Once the quality improvements have been achieved, Defence would continue to manage the Orchard Hills offset site so as to maintain the long-term benefits of the quality improvements.

6.1.7 Quantum of offset for affected threatened biota

The following section presents preliminary EPBC Act offsets assessment guide calculations for the affected threatened biota as a guide to the quantum of offset that would be delivered by the conservation and management of the Orchard Hills offset site. Detailed biodiversity assessments will be undertaken to calculate additional data to support and refine the offset calculations. The references to the offset area in the balance of this chapter relate to the core offset area only. If additional offset areas are agreed, this would be reflected in updated calculations that would be presented in annual reports and reviewed through regular audits.

The Department, in consultation with Defence and Environment and Energy, would arrange for a biodiversity assessment report to be prepared by a suitably qualified ecologist (and independently verified) that demonstrates that the Orchard Hills offset site would help deliver an overall conservation outcome that improves or maintains the viability of the affected threatened biota consistent with the EPBC Act Offsets Policy. An Offset Plan would be prepared with additional detail about the management actions that will be performed. The information contained in the biodiversity assessment report and in the Offset Plan is proposed to be used to support and, where required, to refine, the EPBC Act offset assessment guide calculations. Additional or updated data will include the extent and quality of habitat for each species or community, specific management areas and the likely increases in site quality scores with the proposed management and any variation to the area of the offset site. The final calculations and details regarding data and assumptions underlying the results would be compiled during the implementation of this BODP and documented in implementation annual reports and confirmed through audit reports. The offset calculations presented below are presented to provide the Approver with confidence that the Orchard Hills offset site is a suitable direct offset for the airport and would substantially meet the airport's biodiversity offset requirements. The scale and consequences of potential revisions to the preliminary biodiversity assessment and offset calculations included in this BODP may include the following:

- Changes to the mapped area or quality of EPBC Act Cumberland Plain Woodland because of more detailed survey of groundcover vegetation. This could include around 27 hectares of EPBC Act Cumberland Plain Woodland associated with 'Broad-leaved Ironbark – Grey Box – *Melaleuca decora* grassy open forest on clay/gravel soils' that may be reclassified as 'Broad-leaved Ironbark – Grey Box – *Melaleuca decora* forest on clay' and as such not consistent with the community as defined in the listing advice (TSSC 2009). This vegetation would still help meet the offset requirements for plants, animals and their habitats according to the FBA rules.

- Re-mapping of derived native grassland and scrub (including up to 398.1 hectares of poorer condition Cumberland Plain Woodland that contributed to the offset requirement for the EPBC Act-listed form of the community) as exotic vegetation that could not be presented as an offset in accordance with the EPBC Act Offsets Policy. As above, this vegetation would still help meet the offset requirements for plants, animals and their habitats according to the FBA rules.
- Changes to the mapped area or quality of Grey-headed Flying-fox and Swift Parrot foraging habitat based on more detailed survey of over-storey vegetation.
- Identification of additional threatened plants and habitat for species-credit type fauna species to those presented in Table 6.7.
- Changes to the type, extent or severity of weed infestations and other identified threats to biodiversity values which may in turn affect the 'future quality' inputs to Offsets assessment guide calculations or FBA credit calculations.

The preliminary assessments and offset calculations completed to date are likely to provide an appropriate indication of the direct offset value of Orchard Hills. Notably, the majority of the woodland and forest at the site that comprises EPBC Act Cumberland Woodland and/or Grey-headed Flying-fox and Swift Parrot is likely to be consistent with the EPBC Act offset calculations presented below. This is because the extent and quality of woodland and forest vegetation can be relatively accurately assessed based on air photo interpretation, broad habitat assessments and available biodiversity monitoring data.

The extent and composition of native groundcover vegetation in derived grassland areas is harder to predict and is more likely to vary with sampling of additional plot/transects and other targeted biodiversity surveys. These changes may lead to variation in the offset calculations for poorer quality Cumberland Plain Woodland and the FBA credit calculations for plants, animals and their habitats.

It should also be noted that the revised biodiversity assessment and offset calculations would be documented in implementation audit reports and any increase or reduction in the direct offset contribution from the Orchard Hills offset site would be met by changes in the quantum of other direct offsets or other compensatory measures. This approach to the implementation of the BODP will ensure that the biodiversity offset requirements presented in Sections 2 and 3 of this BODP are delivered.

EPBC Act Cumberland Plain Woodland

- *Area of community in the offset site*

Larger and better condition patches of Grey Box – Forest Red Gum grassy woodland on flats and Broad-leaved Ironbark – Grey Box – *Melaleuca decora* grassy open forest at the Orchard Hills offset site comprise occurrences of Cumberland Plain Woodland CEEC, as defined under the EPBC Act and associated guidelines. Patches of woodland at the Orchard Hills offset site that comprise an occurrence of EPBC Act Cumberland Plain Woodland are shown on Figure 11. There are 389.1 hectares of EPBC Act Cumberland Plain Woodland at the Orchard Hills offset site as indicatively shown in Figure 11.

Derived native grassland and other moderate/good to poor condition vegetation at the Orchard Hills offset site does not currently 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). Derived native grassland could be actively managed to regenerate canopy vegetation and to qualify as EPBC Act Cumberland Plain Woodland and so separate offsets assessment guide calculations have been completed for poorer quality Cumberland Plain Woodland as described below and summarised in Table 6.3.

Conservation of the Orchard Hills offset site would result in the secure protection and management of 389.1 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. Therefore an offset area of 389.1 hectares has been entered in the 'area of community' field in the offset calculator section of the offsets assessment guide calculations for EPBC Act Cumberland Plain Woodland.

- *Current quality of community in offset site*

Cumberland Plain Woodland at the Orchard Hills offset site comprises remnant or regrowth native vegetation in generally good condition. The quality of a community is scored out of 10 based on three site characteristics: site condition, site context and species stocking rate (DSEWPaC 2012b). The weighting of these three attributes for Cumberland Plain Woodland at the Orchard Hills offset site was defined in the same way as for the airport site impact calculations, comprising: site condition – 50%; site context – 50%; and species stocking rate – 0% because this attribute is not directly relevant to threatened communities (see Section 2.2.1 for further detail and justification).

Each characteristic was then scored based on the results of the preliminary survey. Site condition was scored as 7/10 based on consideration of the condition thresholds in the listing advice for the community (TSSC 2008), plot/transect data, biodiversity monitoring data from the site (SKM 2014) and general field observations within the vegetation zones that comprise Cumberland Plain Woodland at Orchard Hills as outlined below:

- Good condition Grey Box – Forest Red Gum grassy woodland on flats (HN528, around 344.1 hectares out of the 389.1 hectares of Cumberland Plain Woodland to be conserved). 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 only moderate and was below benchmark in each of the three plot/transects sampled in this vegetation zone. Most native vegetation cover attributes were slightly below benchmark values for this PCT in the plot/transects sampled. It is likely that the comparatively low species richness and native plant cover is substantially attributable to the prolonged dry period and high temperatures preceding the January 2018 sampling of these plot/transects. There were regenerating specimens of all canopy species observed. There are moderate quantities of hollow-bearing trees, including one in the plots sampled. The site contains a high proportion of mature and over-mature trees, including hollow-bearing trees when compared with most patches of Cumberland Plain Woodland in Western Sydney (personal observation). There are good quantities of fallen woody debris and litter cover. There is generally very low exotic plant cover (1 to 2% in plot/transects sampled) mainly consisting of grasses and herbs in the understorey, though as for

native vegetation cover, this may increase during periods of greater rainfall. Longer term monitoring data from the site has revealed low exotic plant cover and moderate to high native plant species richness and cover, with considerable variation attributed to fire regimes and seasonal drought (SKM 2014).

- Good condition Broad-leaved Ironbark – *Melaleuca decora* grassy open forest (HN512, around 48.2 hectares out of the 389.1 hectares of Cumberland Plain Woodland to be conserved). Near-intact, remnant or regrowth open forest. Species richness and most native vegetation cover attributes were at or slightly below benchmark values for this PCT in the plot/transect sampled. There were regenerating specimens of all canopy species observed. There were occasional hollow-bearing trees and moderate quantities of fallen woody debris. This vegetation zone contains very low exotic plant cover, including 0% exotic plant cover along the transect sampled. Longer term monitoring data from the site has revealed very low exotic plant cover and high native plant species richness and cover (SKM 2014).

Site context was scored as 7/10, reflecting the position of the local occurrence of the community in partially cleared land within Orchard Hills, which in turn sits within a fragmented rural landscape. Fragmentation of native vegetation and associated fauna habitats in the locality has previously occurred through clearing for armaments storage and other Defence activities, agriculture, residences 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. Secure fences within and surrounding Orchard Hills would also limit the movement of many fauna species, notably including the substantial macropod population that is confined to the site. The patches of Cumberland Plain Woodland that remain at the Orchard Hills offset site are large (frequently over 100ha) and have low edge-to-area ratios. Patches of woodland are only slightly degraded by edge effects and contain relatively low exotic plant cover compared to Cumberland Plain Woodland at the airport site and the majority of Western Sydney (pers. obs.).

Based on the inputs described above, 'Offset calculator – start quality' (the current, baseline quality of the community in the offset site) was scored as 7/10 overall.

- *Future quality of community in offset site*

The EPBC Act Cumberland Plain Woodland at the Orchard Hills offset site would be managed and improved through activities, such as bush regeneration and management of overabundant native herbivores, as described in Section 6.1.3.

The 'time until ecological benefit', (ie the period required to achieve the probable increase in site quality score and/or decline in site quality without management) was set as 10 years. This is the expected time it takes to establish an offset site, complete primary activities such as fencing, exclusion of harmful activities and unauthorised access, erosion control and remediation of contamination, complete the initial intensive weed control activities, perform at least one ecological burn, complete multiple rounds of overabundant native herbivore and pest fauna control and achieve natural regeneration. The proposed management actions and the likely benefits to the community are described in greater detail in Table 6.1.

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 'offset calculator – future quality with offset' component (ie the likely increase in site quality if the site is managed as a biodiversity offset) was scored as 9/10, reflecting an improvement in the condition and context of the community through the primary activities and improvements in connectivity described above. Notably, after 10 years the severe overgrazing by native and pest herbivores would be substantially controlled and higher plant species richness and a more natural vegetation structure would be restored. It should also be noted that the MOU would include the requirement that implementation of the Offset Plan would result in an improvement in site quality score of Cumberland Plain Woodland of at least 2/10. The Offset Plan would include activities, performance targets and adaptive management responses that would ensure that this improvement in site quality would be achieved.

The 'offset calculator – future quality without offset' component for EPBC Act Cumberland Plain Woodland in the potential offset areas (ie the likely decline in site condition if the site was not managed as a biodiversity offset) was scored as 6/10, reflecting a decline in the condition and possibly also the quantity of the community in the potential offset areas through an additional 10 years of impacts arising from grazing, weed infestation, invasive native scrub, inappropriate fire regimes, erosion, incompatible human activities and other threats. Under the current management framework Defence is obliged only to manage biosecurity risk and maintain the heritage values of the site. Based on conditions observed during the site inspection, the current management framework is not fully mitigating the risks and threats to biodiversity values operating at the site.

The link between the qualitative assessment provided above and the quantitative site quality scores is summarised in Table 2.1. Table 2.1 includes site quality scores for the impact area at the airport site and the 'current', 'future with offset' and 'future without offset' quality scores for the Orchard Hills offset site. Values in the table that relate to these various inputs to the offsets assessment guide calculations for the project are indicated in bold, along with a description of the attributes that define the given values at Orchard Hills and references to source documents.

EPBC Act Cumberland Plain in the offset site will be managed under the Offset Plan for a further 10 years (ie years 11 to 20 of the implementation of the Offset Plan) and additional gains in site quality would be realised. After 20 years, implementation of the Offset Plan will have established a resilient occurrence of the community and substantially removed the threats to biodiversity values currently operating at the site.

In the longer term additional gains in site quality would be achieved through Defence's ongoing management of biodiversity values, 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.

- *Averted risk of loss of offset site*

A principal threat to the biodiversity of the Cumberland Plain is the further loss and fragmentation of habitat. The main and ongoing threats to Cumberland Plain Woodland include clearing for urban, industrial or rural development; the consequent fragmentation of native vegetation remnants; inappropriate grazing and fire regimes; weed invasion and the low level of protection in reserves.

Vegetation clearance is the major contributor to the loss and fragmentation of native vegetation across the Cumberland Plain and is predominately a consequence of dispersed, small-scale clearing actions associated with urban development (TSSC 2009).

Clearing to meet development demands has led to increasingly isolated small remnants, which are more susceptible to degradation, provide lower habitat value and support fewer species (DECCW 2010). In this context, larger remnant patches, such as those at an Orchard Hills offset site, have particular value as they become scarcer and are susceptible to cumulative impacts associated with the fragmentation of the community in the surrounding region.

The offset site is located in the Defence Establishment Orchard Hills within the buffer areas between the armaments storage and demolition areas and surrounding public land. Defence's land use strategy enables a range of activities and developments to occur while preserving the function of the land as a buffer area.

The offset area and its large remnant patches of Cumberland Plain Woodland is subject to significant development pressures as a result of a rapidly developing Western Sydney. There is a notable risk that the offset area at Orchard Hills could be targeted for infrastructure development given population and development pressure on the Cumberland Plain. There are recent precedents of disposal and development of Defence land, including those with areas of Cumberland Plain Woodland and other biodiversity values equivalent to those in the offset area. There are also significant social and economic drivers for provision of large parcels of land such as Orchard Hills as residential and commercial land.

The recovery plan for the Cumberland Plain notes that land values in Western Sydney are high, and that competing land uses and strong population growth is placing significant pressures on remnant ecological communities. The population of the Cumberland Plain is expected to reach 2.18 million people by 2019, increasing Western Sydney's share of the Metropolitan population to 44% (DECCW 2010). In the context of this rapidly emerging development activity, large remnant patches of Cumberland Plain Woodland become even more rare and more valuable in ecological terms.

The Orchard Hills offset site is located within the CCC, which is a community-developed proposal that recognises the biodiversity value of conservation and especially connectivity of habitat on the Cumberland Plain. The majority of the Orchard Hills offset site is also recognised as a conservation priority in the BIO Map (OEH 2015).

As such, the conservation and improvement of a large offset site of no less than 900 hectares at Orchard Hills would realise a significant opportunity to strengthen an important biodiversity connectivity corridor for Western Sydney, and enhance the preservation of the unique, but increasingly threatened, Cumberland Plain Woodland ecology. The additional obligations and security afforded by the MOU and the quality improvements to the community will strengthen the offset site's natural heritage values and reduce the notable risk of the offset site being considered suitable for development in the future.

In addition to these significant development pressures, there is a risk that the threats that are currently functioning to degrade the community would increase in severity to the extent that the entire local occurrence would be lost without active improvement. Notably there is a risk of catastrophic wildfire given the substantial areas of native Blackthorn scrub at the site. There is an associated risk that weed infestation and grazing by pest fauna would suppress post-fire regeneration. In considering this risk it is important to note that a decline in condition below the thresholds for the EPBC Act-listed form of the community would comprise complete loss (ie reduction of canopy cover to less than 10% and/or reduction of native groundcover to below 30% of the groundcover present) (DEWHA 2010).

Aside from these site-specific risks, the risk of complete degradation of the community is also affected by regional-scale threats such as climate change, *Eucalyptus* dieback and weed infestation. It should also be noted that Environment and Energy have set the 'annualised probability of extinction' of the community at 6.8% in the Offsets assessment guide (ie the risk that the entire Australian extent of the community would be lost to development and other threats in a single year). Taking into account both the site-specific risks and regional-scale threats, a risk of loss without offset of a single occurrence of the community over a 20-year period of 15% is considered appropriate.

The MOU would substantially reduce the risk of loss within the large remnant patches of the offset area through the quality improvements to the community. For instance, heightened monitoring and more intensive management would help avert the risk of complete degradation by weed infestation or grazing. The proposed mechanical removal of Native Blackthorn in strategic areas would help avert the risk of a catastrophic wildfire. The provision of dedicated funds for management activities would reduce the risk that the threats currently functioning to degrade the community would increase in extent or severity.

In this context, the proposal would result in a minor but tangible averted risk of loss of the offset site from 15% to 8%.

The above values have been entered in the preliminary offsets assessment guide calculations for EPBC Act Cumberland Plain Woodland at the Orchard Hills offset site included in this BODP as summarised in Table 6.2 below.

Table 6.2 Offsets assessment guide inputs for Orchard Hills offset for EPBC Act Cumberland Plain Woodland

Offsets assessment guide attribute	Value	Justification
Impact Calculator – Quantum of impact – Area	141 hectares	A direct reduction in extent of an occurrence of EPBC Act Cumberland Plain Woodland as documented in detail in the Stage 1 BAR (GHD 2017) and addendum and summarised in Section 2.2.1 above.
Impact Calculator – Quantum of impact – Quality	6/10	Removal of moderate quality patches of the community as documented in detail in the Stage 1 BAR (GHD 2017) and addendum and summarised in Section 2.2.1 above.

Offsets assessment guide attribute	Value	Justification
Offset calculator – Time horizon – Risk related time horizon	20 years	The offset site will be managed to achieve improvements under the Offset Plan (expected to be up to 20 years) and then subsequently to maintain the biodiversity gains. Twenty years is also the maximum timeframe for averting loss in the guide.
Offset calculator – Time horizon – Time until ecological benefit	10 years	EPBC Act Cumberland Plain Woodland would be managed as described in Section 6.1.3. Ecological benefits in moderate to good 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%	The offset site is located in Orchard Hills and is currently functioning as a buffer between the armaments storage and demolition areas and surrounding public land. Defence's land use strategy enables a range of activities and developments to occur while preserving the function of the land as a buffer. The offset area and its large remnant patches of Cumberland Plain Woodland is subject to significant development pressures as a result of a rapidly developing Western Sydney. There is a notable risk that the offset area at Orchard Hills could be targeted for infrastructure development given population and development pressure on the Cumberland Plain. There is a risk that the threats and land management issues that are currently functioning to degrade the community would increase in extent or severity without active management. When combined with the risk of complete degradation of the community through regional-scale threats to the persistence of the community such as climate change, dieback, weed infestation and reduction in extent below the threshold for viability of the community, a risk of loss without offset of 15% was considered appropriate.
Offset calculator – Future area and quality with offset – Risk of loss with offset	8%	The additional obligations and security afforded by the MOU and the quality improvements to the community will strengthen the offset site's natural heritage values and reduce the notable risk of the offset site being considered suitable for development in the future. The provision of dedicated funds for management activities would also reduce the risk that the threats currently functioning to degrade the community would increase in extent or severity. In this context, the proposal would result in a minor but tangible averted risk of loss of the offset site from 15% to 8%.
Confidence in result – averted loss of offset	75%	The Offset Plan implementation would be auditable. There would be little risk of the MOU being overturned or of Defence undertaking actions that are contrary to the MOU. There is some uncertainty linked to regional or national-scale events that are beyond the scope of the agreement. Balancing these two factors, results in 75% confidence in the averted risk of loss calculations.

Offsets assessment guide attribute	Value	Justification
Offset calculator – Start area and quality – Area	389.1 hectares	The area of EPBC Act Cumberland Plain Woodland at the Orchard Hills offset site as mapped on Figure 11.
Offset calculator – Start area and quality – Start quality	7/10	The proposed offset site contains EPBC Act Cumberland Plain Woodland in moderate condition as described above.
Offset calculator – Future area and quality without offset – Future quality without offset (1 to 10)	6/10	EPBC Act Cumberland Plain Woodland would continue to deteriorate through impacts from threats such as over abundant herbivores and weed infestation in the proposed offset areas if they were not set aside for conservation as described above.
Offset calculator – Future area and quality with offset – Future quality with offset (1 to 10)	9/10	EPBC Act Cumberland Plain Woodland at the offset site would be managed as described in Section 6.1.3 and would improve in quality to become an extensive and resilient occurrence of the community containing important habitat resources such as large, hollow-bearing trees. The improvement in site quality of poorer condition Cumberland Plain Woodland described in would contribute to this increase in site quality by connecting remnant patches of EPBC Act Cumberland Plain Woodland.
Confidence in result – change in quality	95%	DSEWPaC (2013) guidance and recent determinations by Environment and Energy suggest that 95% is a reasonable estimate of the effectiveness of industry standard environmental management and bush regeneration techniques when linked to a conservation covenant, secure funding and a monitoring and adaptive management framework.
Percentage of impact offset	**63.52%**	**Based on the offsets assessment guide calculations completed using the inputs above, the Orchard Hills offset site would deliver 63.52% of the offset requirement for Cumberland Plain Woodland.**

Poorer quality Cumberland Plain Woodland

- *Area of community in the offset site*

The Orchard Hills offset site contains extensive areas of derived native scrub or grassland that feature predominantly native vegetation with intact soil profiles, high native species richness, high resilience and by virtue of these attributes, high conservation significance. These patches of the Cumberland Plain Woodland 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%, however they meet the other condition attributes for the community, including greater than 50% perennial native groundcover and connectivity to a patch of at least 0.5 hectares of EPBC Act Cumberland Plain Woodland or contiguous with a native vegetation remnant at least one hectare in area (see DEWHA 2010). When purposefully managed for conservation, suitable recovery and management actions may improve these patches of poorer quality Cumberland Plain Woodland to the point that they can be regarded as part of the ecological community listed under the EPBC Act (TSSC 2008) and reach at least the same site quality score as the impact area, in accordance with the EPBC Act Offsets Policy (DSEWPaC 2012a, 2012b).

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 (DEWHA 2010). 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, high resilience and the capacity for assisted natural regeneration have been included as poorer quality Cumberland Plain Woodland in the offset calculations for the Orchard Hills offset site.

The poorer quality Cumberland Plain Woodland at the Orchard Hills offset site 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 control of overabundant herbivores to permit regeneration of over storey vegetation and supplementary planting where appropriate. The aims of this management would be to achieve restoration of vegetation that comprises EPBC Act Cumberland Plain Woodland, specifically vegetation with greater than 10% canopy cover and greater than 50% 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 (ie 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 (compared to 10 years for EPBC Act Cumberland Plain Woodland). Twenty years is the expected time it takes to establish an offset site under a Biodiversity Management Plan, 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 five to seven years in areas where they had been suppressed by grazing
- significant declines in exotic groundcover after 15 years
- regeneration of canopy species and growth up to eight 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

It should be noted that the groundcover vegetation within poorer quality Cumberland Plain Woodland at Orchard Hills is species rich and in good condition and has been recognised and as high value example of the community for many years (NSW Scientific committee 2009).

The management of poorer quality Cumberland Plain Woodland at Orchard Hills would also connect fragmented patches of vegetation. 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 site context and site condition attributes such as 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.

Areas of poorer quality Cumberland Plain Woodland are shown on Figure 11 and coincide with the extent of the related communities Cumberland Plain Woodland and Shale-gravel Transition Forest listed under the BC Act. Conservation of the Orchard Hills offset site would result in the secure protection and management of 398.1 hectares of poorer quality Cumberland Plain Woodland at the Orchard Hills offset site. Therefore an offset area of 398.1 hectares has been entered in the area of community field in the offset calculator section of the offsets assessment guide calculations for poorer quality Cumberland Plain Woodland as described below and summarised in Table 6.3.

- *Current quality of community in offset site*

Poorer quality Cumberland Plain Woodland at the Orchard Hills offset site comprises regrowth native vegetation in moderate condition (aside from the absence of canopy vegetation). The quality of a community is scored out of 10 based on three site characteristics: site condition, site context and species stocking rate (DSEWPaC 2012b). The weighting of these three attributes for Cumberland Plain Woodland at the Orchard Hills offset site was defined in the same way as for the airport site impact calculations, comprising: site condition – 50%; site context – 50%; and species stocking rate – 0% because this attribute is not directly relevant to threatened communities.

Each characteristic was then scored based on the results of the preliminary survey. Site condition was scored as 5/10 based on consideration of the condition thresholds in the listing advice for the community (TSSC 2008), biodiversity monitoring data from the site (SKM 2014) and general field observations within the vegetation zones that comprise Cumberland Plain Woodland at Orchard Hills as outlined below:

- Good condition Grey Box – Forest Red Gum grassy woodland on flats occurring as isolated patches less than 0.5 hectares in area (HN528, around 3.1 hectares out of the 398.1 hectares of Cumberland Plain Woodland to be conserved). Fragmented patches of remnant woodland with near-intact over storey surrounded by derived grassland. This vegetation meets the native vegetation cover thresholds in the listing advice for the community, but is part of a patch less than 0.5 hectares in area (TSSC 2008). Species richness is moderate and native vegetation cover attributes are slightly below benchmark values for this PCT but this is probably substantially attributable to the prolonged dry period and high temperatures preceding the January 2018 site inspection. These small remnants frequently contain at least one hollow-bearing and/or over-mature tree and tend to comprise a large, remnant tree surrounded by regenerating juvenile trees. There is generally very low exotic plant cover mainly consisting of grasses and herbs in the understorey, though as for native vegetation cover, this may increase during periods of greater rainfall.
- Poor condition Grey Box – Forest Red Gum grassy woodland on flats (HN528, around 385.4 hectares out of the 398.1 hectares of Cumberland Plain Woodland to be conserved). Derived native grassland or scrub with immature or absent over storey. This vegetation does not meet the condition thresholds in the listing advice for the community because it has canopy cover less than 10%, however it is connected to woodland patches substantially greater than 0.5 hectares in area and has greater than 50% native perennial groundcover (TSSC 2008). Species richness was only moderate and native vegetation cover was low across the majority of the site during the January 2018 site inspection, probably reflecting heavy grazing and drought. However within grazing exclusion plots and fenced operational or accommodation land at the establishment species richness and native plant cover were very high, reflecting the resilience and the potential for improvement at the site. There were regenerating specimens of all canopy species observed, though these were mainly restricted to the margins of remnant patches of woodland or paddock trees. Hollow-bearing tress and fallen woody debris are almost absent. There is generally very low exotic plant cover mainly consisting of grasses and herbs in the understorey, though as for native vegetation cover, this may increase during periods of greater rainfall.
- Poor condition Broad-leaved Ironbark – *Melaleuca decora* grassy open forest (HN512, around 9.6 hectares out of the 398.1 hectares of poorer quality Cumberland Plain Woodland to be conserved). Derived native grassland or scrub with immature or absent over storey that does not meet the condition thresholds in the listing advice for the community as for the PCT described above (TSSC 2008). Species richness and native vegetation cover were only moderate across the majority of the extent of this PCT during the January 2018 site inspection, probably reflecting heavy grazing and drought. Groundcover was generally higher than in the PCT described above, probably due to the higher cover of grazing-resistant shrubs in this form of the community but potentially also because of a less abundant macropod population in the southern buffer area where it occurs. There were regenerating specimens of all canopy species observed. There were occasional

hollow-bearing trees and moderate quantities of fallen woody debris. This vegetation zone contains very low exotic plant cover.

Site context was scored as 5/10, reflecting the position of poorer quality Cumberland Plain Woodland as treeless gaps in the local occurrence of the community at Orchard Hills, which in turn sits within a fragmented rural landscape. Fragmentation of native vegetation and associated fauna habitats in the locality has previously occurred through clearing for armament storage and other Defence activities, agriculture, residences 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. Secure fences within and surrounding Orchard Hills would also limit the movement of many fauna species, notably including the substantial macropod population that is confined to the site. The poorer quality Cumberland Plain Woodland would comprise refuge and movement habitat for fauna species of grassland and open country and adjoin large patches of EPBC Cumberland Plain Woodland (frequently over 100 ha).

Based on the inputs described above, 'Offset calculator – start quality' (ie the current, baseline quality of the community in the offset site) was scored as 5/10 overall.

- *Future quality of the community in offset site*

The poorer quality Cumberland Plain Woodland at the Orchard Hills offset site will be managed and improved through activities such as bush regeneration and management of overabundant native herbivores as described in Section 6.1.4. These activities, and especially assisted natural regeneration and supplementary planting, would help to develop the natural woodland vegetation structure of the community. Establishment of canopy vegetation and increased vegetation cover through all strata would in turn provide increased shelter and foraging habitat for component species. In the longer term, revegetation would result in larger patches of woodland and improved connectivity of fauna habitat and improved quality and viability of the community through reduced edge effects.

The 'time until ecological benefit', (ie the period required to achieve the probable increase in site quality score and/or decline in site quality without management) was set as 20 years. This is 10 years longer than the period allowed for EPBC Act Cumberland Plain Woodland. The first 10 years is the expected time it takes to establish an offset site, complete primary activities such as fencing, exclusion of harmful activities and unauthorised access, erosion control and remediation of contamination, complete the initial intensive weed control activities, perform at least one ecological burn, complete multiple rounds of overabundant native herbivore and pest fauna control and achieve natural regeneration. These activities would help achieve regeneration of canopy vegetation and a natural woodland structure in areas of poorer quality Cumberland Plain Woodland. Supplementary planting of over-storey species would also be performed to help achieve at least 10% canopy cover in order to comprise an occurrence of EPBC Act Cumberland Woodland. Twenty years is the expected length of time to achieve this benchmark.

As described above, monitoring of regeneration of poorer condition Cumberland Plain Woodland without a canopy at Mount Annan revealed canopy species growth up to eight metres after 17 years (Royal Botanic Gardens & Domain Trust undated) and the listing advice includes regrowth stands of EPBC Act Cumberland Plain Woodland with canopy shorter than 10 metres tall (TSSC 2008). Based on the results at Mount Annan, 20 years is likely to be sufficient to achieve natural regeneration over broad areas and for regenerating *Eucalyptus* to mature into over storey vegetation. The proposed management actions and the likely benefits to the community are described in greater detail in Table 6.1.

The restoration of 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 'offset calculator – future quality with offset' component (ie the likely increase in site condition if the site is managed as a biodiversity offset) was scored as 7/10, reflecting an improvement in the condition of the community through the primary activities and improvements in connectivity described above. It should also be noted that the MOU will include the requirement that implementation of the Offset Plan would result in an improvement in site quality score of poorer quality Cumberland Plain Woodland of at least 2/10. The Offset Plan would include activities, performance targets and adaptive management responses that would ensure that this improvement in site quality would be achieved.

The 'offset calculator – future quality without offset' component for EPBC Act Cumberland Plain Woodland in the potential offset areas (ie 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 the quality of the community in the potential offset areas through an additional 20 years of impacts arising from overabundant herbivores, weed infestation, invasive native scrub, inappropriate fire regimes, erosion, incompatible human activities and other threats. Under the current management framework Defence is obliged only to manage biosecurity risk and maintain the heritage values of the site. Based on conditions observed during the site inspection the current management framework is not fully mitigating the risks and threats to biodiversity values operating at the site.

The link between the qualitative assessment provided above and the quantitative site quality scores is summarised in Table 2.1. Table 2.1 includes site quality scores for the impact area at the airport site and the 'current', 'future with offset' and 'future without offset' quality scores for the Orchard Hills offset site. Values in the table that relate to these various inputs to the offsets assessment guide calculations for the project are indicated in bold, along with a description of the attributes that define the given values at Orchard Hills and references to source documents.

The offset site 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.

The above values have been entered in the preliminary offsets assessment guide calculations for poorer quality Cumberland Plain Woodland at the Orchard Hills offset site, included in this BODP as summarised in Table 6.3 below.

Table 6.3 Offsets assessment guide inputs for the poorer quality Cumberland Plain Woodland at Orchard Hills offset for EPBC Act Cumberland Plain Woodland

Offsets assessment guide attribute	Value	Justification
Impact Calculator – Quantum of impact – Area	141 hectares	A direct reduction in extent of an occurrence of EPBC Act Cumberland Plain Woodland as documented in detail in the Stage 1 BAR (GHD 2017) and addendum and summarised in Section 2.2.1 above.
Impact Calculator – Quantum of impact – Quality	6/10	Removal of moderate quality patches of the community as documented in detail in the Stage 1 BAR (GHD 2017) and addendum and summarised in Section 2.2.1 above.
Offset calculator – Time horizon – Risk related time horizon	20 years	The offset site will be protected and managed to achieve the improvements under the Offset Plan (expected to be up to 20 years) and then subsequently to maintain the biodiversity gains. 20 years is also the maximum timeframe for averting loss in the guide.
Offset calculator – Time horizon – Time until ecological benefit	20 years	EPBC Act Cumberland Plain Woodland would be managed as described in Section 6.1.3. Ecological benefits in moderate to good 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%	The offset site is located in Orchard Hills and is currently functioning as a buffer between the armaments storage and demolition areas and surrounding public land. Defence's land use strategy enables a range of activities and developments to occur while preserving the function of the land as a buffer. The offset area and its large remnant patches of Cumberland Plain Woodland is subject to significant development pressures as a result of a rapidly developing Western Sydney. There is a notable risk that the offset area at Orchard Hills could be targeted for infrastructure development given population and development pressure on the Cumberland Plain. There is a risk that the threats and land management issues that are currently functioning to degrade the community would increase in extent or severity without active management. When combined with the risk of complete degradation of the community through regional-scale threats to the persistence of the community such as climate change, dieback, weed infestation and reduction in extent below the threshold for viability of the community, a risk of loss without offset of 15% was considered appropriate.

Offsets assessment guide attribute	Value	Justification
Offset calculator – Future area and quality with offset – Risk of loss with offset	8%	The additional obligations and security afforded by the MOU and the quality improvements to the community will strengthen the offset site's natural heritage values and reduce the notable risk of the offset site being considered suitable for development in the future. The provision of dedicated funds for management activities would also reduce the risk that the threats currently functioning to degrade the community would increase in extent or severity. In this context the proposal would result in a minor but tangible averted risk of loss of the offset site from 15% to 8%.
Confidence in result – averted loss of offset	75%	The implementation of the Offset Plan would be auditable. There would be little risk of the MOU being overturned or of Defence undertaking actions that are contrary to the MOU. There is some uncertainty linked to regional or national-scale events that are beyond the scope of the agreement. Balancing these two factors, results in 75% confidence in the averted risk of loss calculations.
Offset calculator – Start area and quality – Area	398.1 hectares	The area of poorer quality Cumberland Plain Woodland at the Orchard Hills offset site as mapped on Figure 11.
Offset calculator – Start area and quality – Start quality	5/10	The proposed offset site contains poorer quality Cumberland Plain Woodland in moderate condition (apart from the absence of over storey vegetation) as described above.
Offset calculator – Future area and quality without offset – Future quality without offset (1 to 10)	4/10	Poorer quality Cumberland Plain Woodland would continue to deteriorate through impacts from threats such as over abundant herbivores and weed infestation in the proposed offset areas if they were not set aside for conservation as described above.
Offset calculator – Future area and quality with offset – Future quality with offset (1 to 10)	7/10	Poorer quality Cumberland Plain Woodland at the offset site would be managed as described in Section 6.1.3 and would improve in quality to become an extensive and resilient occurrence of the community with a woodland structure. A substantially contribution to the increase in site quality would occur through improving connectivity between remnant patches of EPBC Act Cumberland Plain Woodland.

Offsets assessment guide attribute	Value	Justification
Confidence in result – change in quality	95%	DSEWPaC (2013) guidance and recent determinations by Environment and Energy suggest that 95% is a reasonable estimate of the effectiveness of industry standard environmental management and bush regeneration techniques when linked to a conservation covenant, secure funding and a monitoring and adaptive management framework.
Percentage of impact offset	**35.21%**	**Based on the offsets assessment guide calculations completed using the inputs above, the Orchard Hills offset site would deliver 35.21% of the offset requirement for poorer quality Cumberland Plain Woodland.**

Grey-headed Flying-fox

- *Area of habitat in the offset site*

The desktop assessment revealed two records of the Grey-headed Flying-fox at Orchard Hills: a 2006 record from the Northern Buffer Area; and a 2016 record from The Northern Road alignment along the western boundary of the site (OEH 2018a). There are no Grey-headed Flying-fox camps located at the Orchard Hills offset site, although there are at least seven known camps within 20 kilometres (DoE 2014). All native woodland and forest in the Orchard Hills offset site provides potential foraging habitat for this species.

There are 471.1 hectares of foraging habitat at the Orchard Hills offset site associated with the native woodland and forest shown in Figure 12, which comprises critical foraging habitat as defined in the Recovery Plan for the Grey-headed Flying-fox (DECCW 2009).

The conservation of habitat would be the most notable effect on the viability of the Grey-headed Flying-fox arising from conservation of the offset site. Therefore an area of habitat of 471.1 hectares has been entered in the offset calculator section of the offsets assessment guide calculations for the Grey-headed Flying-fox.

- *Current quality of habitat in the offset site*

As described above, all native woodland and forest at the Orchard hills offset site provides foraging habitat for this species. Dominant canopy species include Forest Red Gum, Grey Box and Broad-leaved Ironbark. 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 at the Orchard Hills offset 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).

Environment and Energy'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 Grey-headed Flying-fox habitat at the Orchard Hills offset site was defined in the same way as for the airport site impact calculations, comprising: site condition – 60%; site context – 20%; and species stocking rate – 20% (see Section 2.2.2 for further detail and justification).

Each characteristic was then scored based on the results of habitat assessments conducted during the site inspection and desktop assessment.

Site condition was scored as 7/10 based on:

- the health and condition of the vegetation zones that comprise Grey-headed Flying-fox habitat based on plot/transects, the health and abundance of food tree species and other field survey data. The majority of the habitat in the Orchard Hills offset site is Cumberland Plain Woodland (around 392.3 out of 471.1 hectares), which is in moderate condition as described above. Forest Red Gum – Rough-barked Apple grassy woodland (the remaining 78.9 out of 471.1 hectares) is also 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 across the offset site. As described above for similar vegetation at the airport site, 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).

Site context was scored as 7/10 given:

- the Orchard Hills offset 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 at least seven known roost camps within 20km of the site (DoE 2014) and so it is appropriately located to provide foraging resources for individuals from these camps
- habitat at the Orchard Hills offset site occurs as large patches, within a fragmented, rural landscape. The Grey-headed Flying-fox is a highly mobile species and so gaps in habitat would not limit opportunities for dispersal or recruitment or substantially increase the risk or energy cost of travelling to exploit foraging resources. Some adjoining areas include 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. The species has been observed at the site at least twice in the last 12 years (OEH 2018a). Large numbers of individuals may be present at certain 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.

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

- *Future quality of habitat in the offset site*

As described in Section 6.1.4, conservation and management of Grey-headed Flying-fox habitat at the Orchard Hills offset site would contribute to recovery actions identified in the recovery plan for the species, including Objective 2: To protect and increase the extent of key winter and spring foraging habitat of Grey-headed Flying-foxes (DECCW 2009). The recovery plan sets criteria for tree-planting, restoration and rehabilitation work to increase the extent of, and protect the viability of, habitat containing plants important to Grey-headed Flying-foxes during winter and spring (DECCW 2009).

The 'time until ecological benefit', (ie the period required to achieve the probable increase in site quality score and/or decline in site quality without management) was set as 10 years. This is the expected time it takes to establish an offset site, complete primary activities such as fencing, exclusion of harmful activities and unauthorised access, erosion control and remediation of contamination, complete the initial intensive weed control activities, perform at least one ecological burn, complete multiple rounds of overabundant native herbivore and pest fauna control and achieve natural regeneration. The proposed management actions and the likely benefits are described in greater detail in Table 6.1.

The quality of Grey-headed Flying-fox habitat at the Orchard Hills offset site would be improved through activities such as bush regeneration, regeneration of canopy vegetation, management of pest fauna and overabundant native herbivores and ecological fire management in accordance with the Offset Plan and as described in Section 6.1.4. The main effect of these management actions would be a one point increase in the 'site condition' component of quality from 7/10 to 8/10 through the maintenance and improvement in quality of foraging habitat by increasing the extent, health and productivity of native vegetation containing food tree species. The regeneration of woodland in areas of derived grassland and scrub in the offset area would also result in a one point increase in the site context component of the site quality score from 7/10 to 8/10 by increasing the extent of habitat, removing threats associated with adjoining areas of exotic vegetation and connecting fragmented remnants. The species stocking rate component has been retained at the start score.

Based on the weighted average of these attributes the 'offset calculator – future quality with offset' component (ie the likely increase in site condition if the site is managed as a biodiversity offset) was scored as 8/10. It should also be noted that the MOU will include the requirement that implementation of the Offset Plan would result in an improvement in site quality score of Grey-headed Flying-fox of at least 1/10. The Offset Plan would include activities, performance targets and adaptive management responses that would ensure that this improvement in site quality would be achieved.

The 'offset calculator – future quality without offset' component for Grey-headed Flying-fox in the potential offset area (ie the likely decline in site condition if the site was not managed as a biodiversity offset) was scored as 6/10, reflecting a decline in the condition and site context of habitat in the potential offset areas through an additional 10 years of impacts arising from inappropriate fire regimes, weed infestation, erosion, human activities and other threats. Each of these factors would reduce the health and productivity of food tree species and may contribute to dieback of patches of Grey Box as is frequently observed on the Cumberland Plain in unmanaged native vegetation. Under the current management framework Defence is obliged only to manage biosecurity risk and maintain the heritage values of the site. Based on conditions observed during the site inspection the current management framework is not fully mitigating the risks and threats to biodiversity values operating at the site.

The link between the qualitative assessment provided above and the quantitative site quality scores is summarised in Table 2.2. Table 2.2 includes site quality scores for the impact area at the airport site and the 'current', 'future with offset' and 'future without offset' quality scores for the Orchard Hills offset site. Values in the table that relate to these various inputs to the offsets assessment guide calculations for the project are indicated in bold, along with a description of the attributes that define the given values at Orchard Hills and references to source documents.

The offset site would be managed in perpetuity and additional gains in site quality would be achieved over the longer term through continued regeneration and maturation of food trees.

- *Averted risk of loss of offset site*

A principal threat to the biodiversity of the Cumberland Plain is the further loss and fragmentation of habitat. The main and ongoing threats to Grey-headed Flying-fox habitat include clearing for urban, industrial or rural development; the consequent fragmentation of native vegetation remnants; inappropriate grazing and fire regimes; weed invasion and the low level of protection in reserves. Vegetation clearance is the major contributor to the loss and fragmentation of native vegetation across the Cumberland Plain and is predominately a consequence of dispersed, small-scale clearing actions associated with urban development (TSSC 2009).

Clearing to meet development demands has led to increasingly isolated small remnants, which are more susceptible to degradation, provide lower habitat value and support fewer species (DECCW 2010). In this context, larger patches of habitat such as those at an Orchard Hills offset site have particular value as they become scarcer and are susceptible to cumulative impacts associated with the fragmentation of the community in the surrounding region.

The offset site is located in the Defence Establishment Orchard Hills within the buffer areas between the armaments storage and demolition areas and surrounding public land. Defence's land use strategy enables a range of activities and developments to occur while preserving the function of the land as a buffer area.

The offset area and its Grey-headed Flying-fox habitat is subject to significant development pressures as a result of a rapidly developing Western Sydney. There is a notable risk that the offset area at Orchard Hills could be targeted for infrastructure development given population and development pressure on the Cumberland Plain. There are recent precedents of disposal and development of Defence land, including those with areas of Grey-headed Flying-fox habitat and other biodiversity values equivalent to those in the offset area. There are also significant social and economic drivers for provision of large parcels of land such as Orchard Hills as residential and commercial land.

The recovery plan for the Cumberland Plain notes that land values in Western Sydney are high, and that competing land uses and strong population growth is placing significant pressures on remnant ecological communities. The population of the Cumberland Plain is expected to reach 2.18 million people by 2019, increasing Western Sydney's share of the Metropolitan population to 44% (DECCW 2010). In the context of this rapidly emerging development activity, large areas of Grey-headed Flying-fox habitat have become even more rare and more valuable in ecological terms.

The Orchard Hills offset site is located within the CCC, which is a community-developed proposal that recognises the biodiversity value of conservation and especially connectivity of habitat on the Cumberland Plain. The majority of the Orchard Hills offset site is also recognised as a conservation priority in the BIO Map (OEH 2015).

As such, the conservation and improvement of a large offset site of no less than 900 hectares at Orchard Hills would realise a significant opportunity to strengthen an important biodiversity connectivity corridor for Western Sydney, and enhance the preservation of the unique, but increasingly threatened, Cumberland Plain Woodland ecology. The additional obligations and security afforded by the MOU and the quality improvements to the habitat will strengthen the offset site's natural heritage values and reduce the notable risk of the offset site being considered suitable for development in the future.

In addition to these significant development pressures, there is a risk that the threats that are currently functioning to degrade Grey-headed Flying-fox habitat would increase in severity to the extent that the entire local occurrence would be lost without active improvement. Notably there is a risk of catastrophic wildfire given the substantial areas of native Blackthorn scrub at the site. There is an associated risk that weed infestation and grazing by pest fauna would suppress post-fire regeneration. In considering these risks it is important to note that the loss of mature food trees that comprise viable Grey-headed Flying-fox habitat would comprise complete loss.

Aside from these site-specific risks, the risk of complete degradation of habitat is also affected by regional-scale threats such as climate change, *Eucalyptus* dieback, and weed infestation. In this context a risk of loss without offset of all foraging resources at the site over a 20-year period of 15% was considered appropriate.

The MOU would substantially reduce the risk of loss within the large remnant patches of the offset area through the quality improvements to the habitat. For instance, heightened monitoring and more intensive management would help avert the risk of complete degradation by weed infestation or grazing. The proposed mechanical removal of Native Blackthorn in strategic areas would help avert the risk of a catastrophic wildfire. The provision of dedicated funds for management activities would reduce the risk that the threats currently functioning to degrade habitat would increase in extent or severity.

In this context, the proposal would result in a minor but tangible averted risk of loss of the offset site from 15% to 8%.

The above values have been entered in the offsets assessment guide calculations for the Orchard Hills offset site proposal for the Grey-headed Flying-fox, included in this BODP as summarised in Table 6.4 below.

Table 6.4 Offsets assessment guide inputs for Orchard Hills offset for the Grey-headed Flying-fox

Offsets assessment guide attribute	Value	Justification
Impact Calculator – Quantum of impact – Area	187.8 hectares	The extent of removal of Grey-headed Flying-fox habitat as documented in detail in the Stage 1 BAR (GHD 2017) and addendum and summarised in 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 detail in the Stage 1 BAR (GHD 2017) and addendum and summarised in Section 2.2.2 above.
Offset calculator – Time horizon – Risk related time horizon	20 years	The offset site will be managed to achieve the improvements under the Offset Plan (expected to be up to 20 years) and then subsequently to maintain the biodiversity gains. Twenty years is the maximum timeframe for averting loss in the guide.
Offset calculator – Time horizon – Time until ecological benefit	10 years	Grey-headed Flying-fox habitat would be managed as described in Section 6.1.4. An improvement in the health and productivity of moderate to good condition woodland and forest can be achieved in the short to medium term. This would in turn result in an improvement in the quality and reliability of foraging resources. 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%	The offset site is located in Orchard Hills and is currently functioning as a buffer between the armaments storage and demolition areas and surrounding public land. Defence's land use strategy enables a range of activities and developments to occur while preserving the function of the land as a buffer. The offset area and its Grey-headed Flying-fox habitat is subject to significant development pressures as a result of a rapidly developing Western Sydney. There is a notable risk that the offset area at Orchard Hills could be targeted for infrastructure development given population and development pressure on the Cumberland Plain. There is a risk that the threats and land management issues that are currently functioning to degrade the community would increase in extent or severity without active management. When combined with the risk of complete degradation of the community through regional-scale threats to the persistence of the community such as climate change, dieback, weed infestation and reduction in extent below the threshold for viability of the community, a risk of loss without offset of 15% was considered appropriate.

Offsets assessment guide attribute	Value	Justification
Offset calculator – Future area and quality with offset – Risk of loss with offset	8%	The additional obligations and security afforded by the MOU and the quality improvements to the habitat will strengthen the offset site's natural heritage values and reduce the notable risk of the offset site being considered suitable for development in the future. The provision of dedicated funds for management activities would also reduce the risk that the threats currently functioning to degrade the community would increase in extent or severity. In this context the proposal would result in a minor but tangible averted risk of loss of the offset site from 15% to 8%.
Confidence in result – averted loss of offset	75%	The implementation of the Offset Plan would be auditable. There would be little risk of the MOU being overturned or of Defence undertaking actions that are contrary to the MOU. There is some uncertainty linked to regional or national-scale events that are beyond the scope of the agreement. Balancing these two factors results in 75% confidence in the averted risk of loss calculations.
Offset calculator – Start area and quality – Area	471.1 hectares	The area of Grey-headed Flying-fox habitat associated with woodland and riparian forest at the Orchard Hills offset site as mapped on Figure 12.
Offset calculator – Start area and quality – Start quality	7/10	The proposed offset site contains Grey-headed Flying-fox habitat in moderate condition as described above.
Offset calculator – Future area and quality without offset – Future quality without offset (1 to 10)	6/10	Grey-headed Flying-fox habitat would continue to deteriorate through impacts from threats such as dieback and weed infestation at the offset site if it was not set aside for conservation and actively managed as described above.
Offset calculator – Future area and quality with offset – Future quality with offset (1 to 10)	8/10	Grey-headed Flying-fox habitat at the offset site would be managed as described in Section 6.1.4 and would improve in quality to become an extensive and resilient patch of woodland and forest containing foraging resources. The improvement in site quality of poorer condition Cumberland Plain Woodland described in would contribute to this increase in site quality by connecting remnant patches of woodland and forest.

Offsets assessment guide attribute	Value	Justification
Confidence in result – change in quality	95%	DSEWPaC (2013) guidance and recent determinations by Environment and Energy suggest that 95% is a reasonable estimate of the effectiveness of industry standard environmental management and bush regeneration techniques when linked to a conservation covenant, secure funding and a monitoring and adaptive management framework.
Percentage of impact offset	**71.19%**	**Based on the offsets assessment guide calculations completed using the inputs above, the Orchard Hills offset site would deliver 71.19% of the offset requirement for the Grey-headed Flying-fox.**

As described in Section 6.1.4, conservation and management of Grey-headed Flying-fox habitat at the Orchard Hills offset site would contribute to recovery actions identified in the recovery plan for the species, including Objective 2: To protect and increase the extent of key winter and spring foraging habitat of Grey-headed Flying-foxes (DECCW 2009). The recovery plan sets criteria for tree-planting, and restoration and rehabilitation work to increase the extent of, and protect the viability of, habitat containing plants important to Grey-headed Flying-foxes during winter and spring (DECCW 2009). Conservation plans for the species have included a tree-planting scheme with the dual aim of conserving Grey-headed Flying-foxes and reducing damage to fruit crops (Law et. al. 2002). Forest Red Gum (which would be the primary canopy species in any revegetation areas at Orchard Hills) is identified as a key food tree species for tree-planting schemes in southeast NSW (Law et. al. 2002).

The offsets assessment guide calculations presented above are based on retaining, protecting, managing and expanding around 471.1 hectares of woodland and forest habitat identified in the preliminary assessment. There is also likely to be potential for enabling natural regeneration and revegetating areas by planting food tree species at the Orchard Hills offset site, consistent with the actions presented in the recovery plan. The scope for revegetation and the area of Grey-headed Flying-fox habitat that could be restored would be identified in the Offset Plan. This could then inform additional offset calculations for restoration of Grey-headed Flying-fox habitat, similar to the approach for poorer quality Cumberland Plain Woodland presented in this BODP.

Offset calculations for restoration of Grey-headed Flying-fox habitat would be consistent with the requirements of the EPBC Act Offsets Policy including:

- identification of revegetation areas and management approaches that would ensure that the 'Future quality with offset' would reach at least the same quality score as the habitat to be removed at the airport site
- consideration of an appropriate 'Offset calculator – Time horizon – Time until ecological benefit' to allow sufficient time for establishment and growth of productive and reliable food tree species to achieve this site quality score.

Swift Parrot foraging habitat

- *Area of habitat in the offset site*

The Swift Parrot is a migratory bird species that breeds in Tasmania, migrates to mainland Australia each autumn and forages in Victoria and New South Wales during winter (Saunders and Tzaros 2011). The Swift Parrot may occur in the Orchard Hills offset site on occasion during its winter migration. This species is listed as a critically endangered species under the EPBC Act and an endangered species under the BC Act. All native woodland and forest at the Orchard Hills offset site provides potential foraging habitat for this species.

There are no confirmed records of the Swift Parrot at the Orchard Hills offset site. The species has been observed foraging in similar habitat in the near vicinity of the site, including: a 2014 record at Glenmore Park, around 500 metres to the west of the site; and two 2013 observations at Mulgoa Nature Reserve around two kilometres to the west of the site (OEH 2018a).

The single, migratory population of the Swift Parrot may use foraging habitat at the Orchard Hills offset site on an occasional basis as part of its occupation of winter foraging habitat. Of the canopy species present at the offset site, Forest Red Gum is also identified as a key food tree in the Sydney Metro and Hawkesbury-Nepean areas within the non-breeding range of the species (Saunders and Tzaros 2011), and Grey Box and other eucalypts would provide a source of lerps. Each of the vegetation zones at the Orchard Hills offset site with a forest or woodland structure contains Forest Red Gum and/or Grey Box as dominant canopy species and is potential Swift Parrot foraging habitat. There are 471.1 hectares of foraging habitat at the Orchard Hills offset site associated with the native woodland and forest shown in Figure 12. Therefore an area of habitat of 471.1 hectares has been entered in the offset calculator section of the offsets assessment guide calculations for Swift Parrot foraging habitat.

- *Current quality of habitat in the offset site*

As described above, all native woodland and forest at the Orchard Hills offset site provides foraging habitat for this species based on the presence of Forest Red Gum and Grey Box as dominant canopy species.

Environment and Energy'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 Swift Parrot foraging habitat at the Orchard Hills offset site was defined in the same way as for the airport site impact calculations, comprising: site condition – 40%; site context – 20%; and species stocking rate – 40% (see Section 2.2.3 for further detail and justification).

Each characteristic was then scored based on the results of habitat assessments conducted during the site inspection and desktop assessment.

Site condition was scored as 7/10 based on:

- the presence of Forest Red Gum as a dominant canopy species across the offset site. As described above, Forest Red Gum is recognised as a key species in the Hawkesbury-Nepean region in the draft recovery plan (DECCW 2009) (GHD 2016a)

- the health and condition of the vegetation zones that comprise Swift Parrot foraging habitat, based on plot/transects, vegetation monitoring data (SKM 2014), the size and abundance of food tree species and other field survey data. The majority of the habitat in the Orchard Hills offset site is Cumberland Plain Woodland (around 392.3 out of 471.1 hectares), which is in moderate condition as described above. Forest Red Gum – Rough-barked Apple grassy woodland (the remaining 78.9 out of 471.1 hectares) is also in moderate condition comprising remnant or regrowth native vegetation with near-intact over storey
- moderate abundance due to the likely moderate effect of aggressive competitors such as Noisy Miners and Rainbow Lorikeets in the extensive patches of woodland and forest at the site, compared to more severe effects of these competitors in fragmented patches in an agricultural landscape such as habitat at the airport site.

Site context was scored as 7/10 because habitat at the Orchard Hills offset site occurs as large patches, within a fragmented, rural landscape. The Swift Parrot is a highly mobile species and so gaps in habitat would not limit opportunities for dispersal or recruitment, or substantially increase the risk or energy cost of travelling to exploit foraging resources. Some adjoining areas include 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 4/10, comprising an area of potentially productive foraging habitat within the broad range of this highly mobile species but with no evidence of use by large numbers of individuals or of site fidelity. There are no previous records (last 30 years) of the Swift Parrot from within Orchard Hills or immediate areas (OEH 2018a). There are eight records of the Swift Parrot in the locality and scattered records across the Cumberland Plain, but limited evidence of any concentration of records at any locations and very few records of the species in south-western Sydney (OEH 2018a). A broad-scale habitat map prepared for the Greater Southern Sydney Region identifies the largest area of habitat for the Swift Parrot within the Burragorang Valley (approximately 35 kilometres to the southwest of the Orchard Hills offset site), with smaller patches around Glenmore, west of Liverpool, and around Wedderburn (DECC 2007).

Based on the inputs described above 'Impact calculator – quantum of impact – quality' (ie the quality of habitat in the airport disturbance footprint) was scored as 6/10 overall (rounded to the nearest whole number).

- *Future quality of habitat in the offset site*

As described in Section 6.1.4, conservation and management of Swift Parrot foraging habitat at the Orchard Hills offset site would contribute to recovery actions identified in the recovery plan for the Swift Parrot (Saunders and Tzaros 2011). Notably, management action 2.1a, 'Encourage and support the protection, conservation management and restoration of Swift Parrot nesting and foraging habitat through agreements with landowners', includes provision for relevant on-ground actions (but not limited to):

- retaining and expanding mature and mixed-age habitat and protecting and managing it by fencing and providing a buffer zone from disturbances
- enabling natural regeneration by fencing off and managing remnant vegetation and buffer zones to control grazing and other impacts caused by uncontrolled access

- ongoing management of fenced off areas, including pest, weed and fire management (Saunders and Tzaros 2011).

The ‘time until ecological benefit’ (ie the period required to achieve the probable increase in site quality score and/or decline in site quality without management) was set as 10 years. This is the expected time it takes to establish an offset site, complete primary activities such as fencing, exclusion of harmful activities and unauthorised access, erosion control and remediation of contamination, complete the initial intensive weed control activities, perform at least one ecological burn, complete multiple rounds of overabundant native herbivore and pest fauna control and achieve natural regeneration. The proposed management actions and the likely benefits are described in greater detail in Table 6.1.

The quality of Swift Parrot foraging habitat at the Orchard Hills offset site would be improved through activities such as bush regeneration, regeneration of canopy vegetation, management of pest fauna and overabundant native herbivores and ecological fire management in accordance with the Offset Plan and as described in Section 6.1.4. The main effect of these management actions would be a one point increase in the ‘site condition’ component of quality from 7/10 to 8/10 through the maintenance and improvement in quality of foraging habitat by increasing the extent, health and productivity of native vegetation containing food tree species. The regeneration of woodland in areas of derived grassland and scrub in the offset area would contribute to the increase in site condition score. The site context and species stocking rate components have been retained at the start score.

Based on the weighted average of these attributes the ‘offset calculator – future quality with offset’ component (ie the likely increase in site condition if the site is managed as a biodiversity offset) was scored as 7/10. It should also be noted that the MOU will include the requirement that implementation of the Offset Plan would result in an improvement in site quality score of Swift Parrot foraging habitat of at least 1/10. The Offset Plan would include activities, performance targets and adaptive management responses that would ensure that this improvement in site quality would be achieved.

The ‘offset calculator – future quality without offset’ component for Swift Parrot foraging habitat in the potential offset area (ie the likely decline in site condition if the site was not managed as a biodiversity offset) was scored as 5/10, reflecting a decline in the condition and site context of habitat in the potential offset areas through an additional 10 years of impacts arising from inappropriate fire regimes, weed infestation, erosion, human activities and other threats. Each of these factors would reduce the health and productivity of food tree species and may contribute to dieback of patches of Grey Box, as is frequently observed on the Cumberland Plain in unmanaged native vegetation. Under the current management framework Defence is obliged only to manage biosecurity risk and maintain the heritage values of the site. Based on conditions observed during the site inspection the current management framework is not fully mitigating the risks and threats to biodiversity values operating at the site.

The link between the qualitative assessment provided above and the quantitative site quality scores is summarised in Table 2.3. Table 2.3 includes site quality scores for the impact area at the airport site and the ‘current’, ‘future with offset’ and ‘future without offset’ quality scores for the Orchard Hills offset site. Values in the table that relate to these various inputs to the offsets assessment guide calculations for the project are indicated in bold, along with a description of the attributes that define the given values at Orchard Hills and references to source documents.

The offset site would be managed in perpetuity and additional gains in site quality would be achieved over the longer term through continued regeneration and maturation of food trees.

- *Averted risk of loss of offset site*

A principal threat to the biodiversity of the Cumberland Plain is the further loss and fragmentation of habitat. The main and ongoing threats to Swift Parrot foraging habitat include clearing for urban, industrial or rural development; the consequent fragmentation of native vegetation remnants; inappropriate grazing and fire regimes; weed invasion and the low level of protection in reserves. Vegetation clearance is the major contributor to the loss and fragmentation of native vegetation across the Cumberland Plain and is predominately a consequence of dispersed, small-scale clearing actions associated with urban development (TSSC 2009).

Clearing to meet development demands has led to increasingly isolated small remnants, which are more susceptible to degradation, provide lower habitat value and support fewer species (DECCW 2010). In this context, large patches of foraging habitat such as those at an Orchard Hills offset site have particular value as they become scarcer and are susceptible to cumulative impacts associated with the fragmentation of the community in the surrounding region.

The offset site is located in the Defence Establishment Orchard Hills within the buffer areas between the armaments storage and demolition areas and surrounding public land. Defence's land use strategy enables a range of activities and developments to occur while preserving the function of the land as a buffer area.

The offset area and its large patches of foraging habitat is subject to significant development pressures as a result of a rapidly developing Western Sydney. There is a notable risk that the offset area at Orchard Hills could be targeted for infrastructure development, given population and development pressure on the Cumberland Plain. There are recent precedents of disposal and development of Defence land, including those with areas of Cumberland Plain Woodland and other biodiversity values equivalent to those in the offset area. There are also significant social and economic drivers for provision of large parcels of land such as Orchard Hills as residential and commercial land.

The recovery plan for the Cumberland Plain notes that land values in Western Sydney are high, and that competing land uses and strong population growth is placing significant pressures on remnant ecological communities. The population of the Cumberland Plain is expected to reach 2.18 million people by 2019, increasing Western Sydney's share of the Metropolitan population to 44% (DECCW 2010). In the context of this rapidly emerging development activity, large remnant patches of Cumberland Plain Woodland become even more rare and more valuable in ecological terms.

The Orchard Hills offset site is located within the CCC, which is a community-developed proposal that recognises the biodiversity value of conservation and especially connectivity of habitat on the Cumberland Plain. The majority of the Orchard Hills offset site is also recognised as a conservation priority in the BIO Map (OEH 2015).

As such, the conservation and improvement of a large offset site of no less than 900 hectares at Orchard Hills would realise a significant opportunity to strengthen an important biodiversity connectivity corridor for Western Sydney, and enhance the preservation of the unique, but increasingly threatened, Cumberland Plain Woodland ecology. The additional obligations and security afforded by the MOU and the quality improvements to the foraging habitat will strengthen the offset site's natural heritage values and reduce the notable risk of the offset site being considered suitable for development in the future.

In addition to these significant development pressures, there is a risk that the threats that are currently functioning to degrade Swift Parrot foraging habitat would increase in severity to the extent that the habitat resources at the site would be lost without active improvement. Notably there is a risk of catastrophic wildfire given the substantial areas of native Blackthorn scrub at the site. There is an associated risk that weed infestation and grazing by pest fauna would suppress post-fire regeneration. In considering this risk it is important to note that the loss of mature food trees that comprise viable Swift Parrot foraging habitat would comprise complete loss.

Aside from these site-specific risks, the risk of complete degradation of foraging habitat is also affected by regional-scale threats such as climate change, *Eucalyptus* dieback and weed infestation. In this context a risk of loss without offset of all foraging resources at the site over a 20-year period of 15% was considered appropriate.

The MOU would substantially reduce the risk of loss through the quality improvements to the habitat. For instance, heightened monitoring and more intensive management would help avert the risk of complete degradation by weed infestation or grazing. The proposed mechanical removal of Native Blackthorn in strategic areas would help avert the risk of a catastrophic wildfire. The provision of dedicated funds for management activities would reduce the risk that the threats currently functioning to degrade the community would increase in extent or severity.

In this context, the proposal would result in a minor but tangible averted risk of loss of the offset site from 15% to 8%.

The above values have been entered in the offsets assessment guide calculations for the Orchard Hills offset site proposal for Swift Parrot foraging habitat included in this BODP as summarised in Table 6.5 below.

The above values have been entered in the offsets assessment guide calculations for the Orchard Hills offset site proposal for Swift Parrot foraging habitat included in this BODP as summarised in Table 6.5 below.

Table 6.5 Offsets assessment guide inputs for Orchard Hills offset for Swift Parrot foraging habitat

Offsets assessment guide attribute	Value	Justification
Impact Calculator – Quantum of impact – Area	187.8 hectares	The extent of removal of Swift Parrot foraging habitat as documented in detail in the Stage 1 BAR (GHD 2017) and addendum and summarised in Section 2.2.3 above.
Impact Calculator – Quantum of impact – Quality	5/10	Removal of moderate quality Swift Parrot foraging habitat as documented in detail in the Stage 1 BAR (GHD 2017) and addendum and summarised in Section 2.2.3 above.
Offset calculator – Time horizon – Risk related time horizon	20 years	The offset site will be managed to achieve the improvements under the Offset Plan (expected to be up to 20 years) and then subsequently to maintain the biodiversity gains. Twenty years is the maximum timeframe for averting loss in the guide.

Offsets assessment guide attribute	Value	Justification
Offset calculator – Time horizon – Time until ecological benefit	10 years	Swift Parrot foraging habitat would be managed as described in Section 6.1.4. An improvement in the health and productivity of moderate to good condition woodland and forest can be achieved in the short to medium term. This would in turn result in an improvement in the quality and reliability of foraging resources. 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%	The offset site is located in Orchard Hills and is currently functioning as a buffer between the armaments storage and demolition areas and surrounding public land. Defence's land use strategy enables a range of activities and developments to occur while preserving the function of the land as a buffer. The offset area and its large patches of foraging habitat is subject to significant development pressures as a result of a rapidly developing Western Sydney. There is a notable risk that the offset area at Orchard Hills could be targeted for infrastructure development given population and development pressure on the Cumberland Plain. There is a risk that the threats and land management issues that are currently functioning to degrade the community would increase in extent or severity without active management. When combined with the risk of complete degradation of the community through regional-scale threats to the persistence of the community such as climate change, dieback, weed infestation and reduction in extent below the threshold for viability of the community, a risk of loss without offset of 15% was considered appropriate.
Offset calculator – Future area and quality with offset – Risk of loss with offset	8%	The additional obligations and security afforded by the MOU and the quality improvements to the foraging habitat will strengthen the offset site's natural heritage values and reduce the notable risk of the offset site being considered suitable for development in the future. The provision of dedicated funds for management activities would also reduce the risk that the threats currently functioning to degrade the community would increase in extent or severity. In this context the proposal would result in a minor but tangible averted risk of loss of the offset site from 15% to 8%.
Confidence in result – averted loss of offset	75%	The implementation of the Offset Plan would be auditable. There would be little risk of the MOU being overturned or of Defence undertaking actions that are contrary to the MOU. There is some uncertainty linked to regional or national-scale events that are beyond the scope of the agreement. Balancing these two factors, results in 75% confidence in the averted risk of loss calculations.
Offset calculator – Start area and quality – Area	471.1 hectares	The area of Swift Parrot foraging habitat associated with woodland and riparian forest at the Orchard Hills offset site as mapped on Figure 12.

Offsets assessment guide attribute	Value	Justification
Offset calculator – Start area and quality – Start quality	6/10	The proposed offset site contains Swift Parrot foraging habitat in moderate condition as described above.
Offset calculator – Future area and quality without offset – Future quality without offset (1 to 10)	5/10	Swift Parrot foraging habitat would continue to deteriorate through impacts from threats such as dieback and weed infestation at the offset site if it was not set aside for conservation and actively managed as described above.
Offset calculator – Future area and quality with offset – Future quality with offset (1 to 10)	7/10	Swift Parrot foraging habitat at the offset site would be managed as described in Section 6.1.4 and would improve in quality to become an extensive and resilient patches of woodland and forest containing foraging resources. The improvement in site quality of poorer condition Cumberland Plain Woodland described in would contribute to this increase in site quality by connecting remnant patches of woodland and forest.
Confidence in result – change in quality	95%	DSEWPaC (2013) guidance and recent determinations by Environment and Energy suggest that 95% is a reasonable estimate of the effectiveness of industry standard environmental management and bush regeneration techniques when linked to a conservation covenant, secure funding and a monitoring and adaptive management framework.
Percentage of impact offset	**46.91%**	**Based on the offsets assessment guide calculations completed using the inputs above, the Orchard Hills offset site would deliver 46.91% of the offset requirement for Swift Parrot foraging habitat .**

As described in Section 6.1.4, conservation and management of Swift Parrot foraging habitat at the Orchard Hills offset site would contribute to recovery actions identified in the recovery plan for the Swift Parrot (Saunders and Tzaros 2011). Notably, management action 2.1a 'Encourage and support the protection, conservation management and restoration of Swift Parrot nesting and foraging habitat through agreements with landowners', includes provision for relevant on-ground actions (but not limited to):

- retaining and expanding mature and mixed-age habitat and protecting and managing it by fencing and providing a buffer zone from disturbances
- enabling natural regeneration by fencing off and managing remnant vegetation and buffer zones to control grazing and other impacts caused by uncontrolled access
- revegetating areas and connecting remnant habitats by planting feed tree species, fencing them off and managing them

- ongoing management of fenced off areas, including pest, weed and fire management (Saunders and Tzaros 2011).

The offsets assessment guide calculations presented above are based on retaining, protecting, managing and expanding around 471.1 hectares of mature and mixed-age habitat identified in the preliminary assessment. There is also likely to be potential for enabling natural regeneration and revegetating areas by planting feed tree species at the Orchard Hills offset site, consistent with the actions presented in the recovery plan. The scope for revegetation and the area of Swift Parrot foraging habitat that could be restored would be identified in the Offset Plan. This could then inform additional offset calculations for restoration of Swift Parrot foraging habitat, similar to the approach for poorer quality Cumberland Plain Woodland presented in this BODP.

Offset calculations for restoration of Swift Parrot foraging habitat would be consistent with the requirements of the EPBC Act Offsets Policy including:

- identification of revegetation areas and management approaches that would ensure that the 'Future quality with offset' would reach at least the same quality score as the habitat to be removed at the airport site, and
- consideration of an appropriate 'Offset calculator – Time horizon – Time until ecological benefit' to allow sufficient time for establishment and growth of productive food tree species to achieve this site quality score.

6.1.8 Quantum of offset for plants, animals and their habitat

The preliminary assessment of the Orchard Hills offset site included an estimate of the potential offset contribution for impacts on plants, animals and their habitat arising from the airport. As described above, a detailed, supplementary ecological survey will be completed and a Biodiversity Assessment Report will be prepared for the site. The biodiversity values of the Orchard Hills offset site will be assessed using the BBAM as the means of quantifying potential offset contributions. This approach allows direct comparison with the FBA and credit calculations included in Chapter 3 as well as consideration of the current market for biodiversity credits. Vegetation being presented as offsets for EPBC Act Cumberland Plain Woodland would also be assessed with regards to the condition thresholds for the community as defined under the EPBC Act and associated guidelines (DEWHA 2010).

The preliminary biodiversity assessment included an estimate of the number and type of ecosystem credits that could be generated at the site, based on the rate of generation of credits in similar vegetation zones at biobank sites in Western Sydney and comparison with the credits required to offset the impacts of the airport as documented in the *Western Sydney Airport Stage 1 Biodiversity Assessment Report* (GHD 2017) and addendum (GHD 2018).

Vegetation zones at the Orchard Hills offset site are summarised in Table 6.6, along with the estimated number of ecosystem credits that would be generated and comparison with the credits required to offset the impacts of the airport. The ecosystem credits that would be generated at the Orchard Hills offset site are a suitable like-for-like match for the airport's impacts according to the FBA credit trading rules. The majority of the PCTs / ecosystem credit types present at the airport site are represented at Orchard Hills. There is no 'Grey Box – Forest Red Gum grassy woodland on shale (HN529)' at the Orchard Hills offset site, however the offset requirement for this PCT can be met by trading with 'Grey Box – Forest Red Gum grassy woodland on flats (HN528)' under the FBA credit trading rules. It should also be noted that both of these PCTs comprise part of the ecological community Cumberland Plain Woodland.

An offset site at Orchard Hills could also make a substantial contribution to the species-credit requirement for the airport's impacts on plants, animals and their habitats. It is not possible to estimate species credits in the same way as ecosystem credits because the biodiversity monitoring of the site has not included total threatened plant population counts (SKM 2014) and targeted surveys have not been conducted for many of the fauna species that could be present. Table 3.6 presents the species credits required to offset impacts of the airport and a preliminary estimate of the species credits potentially available at the Orchard Hills offset site based on previous records and the extent of habitat.

As described above, the polygons indicating areas of *Pultenaea parviflora* and *Dillwynia tenuifolia* populations on Figure 3 contained very few individuals in January 2018 and biodiversity monitoring has indicated significant fluctuations in the abundance of these species between 2008 and 2013 (SKM 2014). The current low abundance of these species is probably because of the prolonged dry weather and intensity of grazing over the last 12 months. Both species have a hard seed coat and can persist in the soil seed bank and then regenerate in response to favourable weather and fire or other disturbance events (OEH 2018b). A total of nine *Pultenaea parviflora* and 28 *Dillwynia tenuifolia* would generate the species credits required to offset the airport's impacts on these species. Despite the low abundance of these species at the Orchard Hills offset site in 2018 it could easily generate the required quantum of offset given:

- 8.5 hectares of mapped *Pultenaea parviflora* habitat and up to 20 individuals in a single 20m x 20m monitoring plot in 2013
- 0.9 hectares of mapped *Dilwynia tenuifolia* habitat and up to 110 individuals in a single 20m x 20m monitoring plot in 2013 (SKM 2014).

The Orchard Hills offset site could make a substantial contribution to the offset requirement for *Marsdenia viridiflora viridiflora* based on the known sporadic distribution of the species at the site (SKM 2014) and the detection of around 50 individuals with relatively limited survey effort in January 2018. However it is probably unlikely that the total requirement of 5,800 credits, comprising around 816 individuals, could be sourced from the site alone. Conditions may be suitable for confirming the abundance of this species at the site in coming months; despite being known to die back to an underground tuber during periods of stress (OEH 2018b) this species can be readily detectable during dry periods because dieback of grasses and other groundcover vegetation can make it easier to locate *Marsdenia viridiflora viridiflora* stems (pers. obs.).

The Spiked Rice-flower (*Pimelea spicata*) has never been recorded at Orchard Hills despite substantial areas of potentially suitable habitat. Even if present it is unlikely to be detected at the site in coming months given the current drought and grazing-affected condition of the potential habitat.

The Orchard Hills offset site could generate the required quantum of offset for the Cumberland Plain Land Snail and these species credits could be calculated based on the survey results and habitat assessments to date. The site also has considerable potential to generate the required quantum of offset for the Black Bittern (*Ixobrychus flavicollis*) and Southern Myotis (*Myotis macropus*) roosting habitat subject to further targeted ecological survey to confirm the presence of these species at the site and the extent of occupied habitat.

Table 6.6 Vegetation zones, estimated ecosystem credits at Orchard Hills offset site and credits required for the airport

Zone ID	Vegetation zone	Condition	BC Act status	EPBC Act status	Area (hectares)	Estimated number of biodiversity credits[2]	Ecosystem credits required for airport[3]
1	Good condition Grey Box – Forest Red Gum grassy woodland on flats (HN528, Moderate/good to high)	Moderate/good to high	CEEC	CEEC[1]	344.1	3,441	8,406[4]
2	Poor condition Grey Box – Forest Red Gum grassy woodland on flats (HN528, Moderate/good to poor)	Moderate/good to poor	CEEC		385.4	4,625	4,336[4]
10	Low condition Grey Box – Forest Red Gum grassy woodland on flats (HN528, Moderate/good to poor)	Low			16.9	135	-
	Total Grey Box – Forest Red Gum grassy woodland on flats (HN528)				**746.4**	**8,201**	**12,742**
5	Good condition Forest Red Gum – Rough-barked Apple grassy woodland (HN526, Moderate/good to high)	Moderate/good to high	EEC		78.9	789	2146
6	Poor condition Forest Red Gum – Rough-barked Apple grassy woodland (HN526, Moderate/good to poor)	Moderate/good to poor	EEC		14.2	170	506
	Total Forest Red Gum – Rough-barked Apple grassy woodland (HN526)				**93.0**	**959**	**2,652**

Zone ID	Vegetation zone	Condition	BC Act status	EPBC Act status	Area (hectares)	Estimated number of biodiversity credits[2]	Ecosystem credits required for airport[3]
7	Good condition Broad-leaved Ironbark – *Melaleuca decora* shrubby open forest on clay soils (HN513 Moderate/good to high)[5]	Moderate/good to high	EEC	CEEC[5]	48.2	482[5]	338[5]
8	Poor condition Broad-leaved Ironbark – Grey Box – *Melaleuca decora* grassy open forest on clay/gravel soils (HN512 Moderate/good to poor)	Moderate/good to poor	EEC		9.6	115	21
9	Freshwater wetland on floodplain (HN630, Moderate/good)	Moderate/good			7.6	61	915
	Total				**904.7**		**16,709**

Notes: 1) Dependent upon patch size and condition thresholds as stated in the guidelines (DEWHA 2010). 2) Based on the rate of credits generated per hectare in similar vegetation zones at a biobank site previously assessed by GHD. Additionality may apply (ie discounting of credits because of pre-existing obligations to manage the site for conservation). Existing obligations and funding for management actions will need to be confirmed. The credit estimates presented in this preliminary assessment are based on the BBAM. The Orchard Hills offset biodiversity assessment report will be prepared with reference to the BBAM to allow for costs estimates with comparison to the current market for biodiversity credits and to ensure equivalence with the Framework for Biodiversity Assessment and BBAM credit estimates included in the BODP. 3) As calculated in the Stage 1 BAR addendum (GHD 2018). 4) Including the offset requirement for Grey Box – Forest Red Gum grassy woodland on shale (HN529) in equivalent condition since these two ecosystem credit types can be traded. 5) May also contribute to the offset requirement for EPBC Act Cumberland Plain Woodland, pending confirmation of PCT.

Table 6.7 Species credits required to offset impacts of the airport and potentially available at the Orchard Hills offset site

Common name	Scientific name	Threatened species multiplier	Species credits required	Individuals / area available at offset site	Estimated species credits available at offset site
Black Bittern	*Ixobrychus flavicollis*	1.3	224	Up to 86.4 hectares of potential habitat in Forest Red Gum – Rough-barked Apple grassy woodland (HN526) and Coastal freshwater wetland (HN630)[1]	Up to 613[2]
Cumberland Plain Land Snail	*Meridolum corneovirens*	1.3	2,441	At least 392.3 hectares of occupied habitat.	At least 2,785[3]
Dillwynia tenuifolia	*Dillwynia tenuifolia*	1.8	540	0.9 hectares of mapped habitat.	Greater than 540[4]
Marsdenia viridiflora subsp. *viridiflora* in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	*Marsdenia viridiflora* subsp. *viridiflora* – endangered population	4.0	5,800	At least 50 individuals.	At least 355 credits
Pultenaea parviflora	*Pultenaea parviflora*	1.5	60	8.5 hectares of mapped habitat.	Greater than 60[4]
Southern Myotis roosting habitat	*Myotis macropus* roosting habitat	2.2	1,617	At least 86.4 hectares of potential habitat in Forest Red Gum – Rough-barked Apple grassy woodland (HN526). Additional areas in other woodland and forest adjacent to waterbodies.[1]	At least 613[1]

Common name	Scientific name	Threatened species multiplier	Species credits required	Individuals / area available at offset site	Estimated species credits available at offset site
Spiked Rice-flower	*Pimelea spicata*	2.6	107,068	At least 392.3 hectares of potential habitat associated with better condition Grey Box – Forest Red Gum grassy woodland on flats and Broad-leaved Ironbark – *Melaleuca decora* shrubby open forest on clay soils [1]	t.b.c.[1]

Notes**:** 1) pending confirmation of the presence of the species at the site and definition of a species polygon encompassing occupied habitat. 2) Upper limit based on all Good condition Forest Red Gum – Rough-barked Apple grassy woodland and all Freshwater wetland on floodplain at the site. The species polygon may not encompass all of these PCTs. 3) Conservative estimate based only on Good condition Grey Box – Forest Red Gum grassy woodland on flats. Additional habitat may be available in Good condition Forest Red Gum – Rough-barked Apple grassy woodland and Good condition Broad-leaved Ironbark – *Melaleuca decora* shrubby open forest on clay soils. 4) Additional targeted ecological surveys are required to confirm numbers but based on the area of habitat and previous records (SKM 2014) the required quantum is likely to be exceeded.

6.2 Longer term direct offsets

This BODP presents the direct offsets that have been confirmed at the time of publication. A desktop assessment and consultation with NSW Government and Australian Government agencies, conservation groups and private landowners will be undertaken through the implementation phase of the BODP to identify additional, longer term offset contributions. This process will continue until the full quantum of offset required for the airport has been secured. The section below presents the options available for delivering longer term direct offsets, the criteria for their selection and the process for calculating and securing offsets.

6.2.1 Purchase of credits through the NSW Biodiversity Offsets Scheme

Overview of proposal

The NSW Biodiversity Offsets Scheme provides for conservation of offset sites under a BSA made under Division 2 of Part 5 of the BC Act. A developer can purchase and retire biodiversity credits from a BSA site to secure an offset. A BSA is the strongest conservation covenant available on private land in NSW and, along with the BAM, provides for sound calculation of offset contributions, a management plan, secure and performance-based funding, monitoring and oversight by the NSW Biodiversity Conservation Trust (BCT, formerly Nature Conservation Trust). This combination of attributes makes the NSW Biodiversity Offsets Scheme an effective means of delivering direct offsets and the purchase of appropriate biodiversity credits through the scheme will make a substantial contribution to the offset proposal presented in this BODP. Members of the Experts Group were supportive of this approach.

This approach could deliver the full quantum of offset required for impacts on *Pimelea spicata.* Occupied habitat for *Pimelea spicata* and for other species-credit species will be a particular focus of this proposal.

Identification and assessment of offsets

A broad desktop assessment and consultation program was performed throughout the preparation of this BODP to identify potential direct offsets for the airport development. This desktop assessment process will continue after approval of the BODP up until the full quantum of biodiversity offsets are implemented in accordance with the plan.

The inputs to the desktop assessment include:

- the ‘Biodiversity credits register’ (OEH 2018d), which identifies existing BSA sites with biodiversity credits that could offset impacts on the affected threatened biota and that are available for sale
- the ‘Expression of interest register’ (OEH 2018e), which identifies potential offset sites that could generate suitable biodiversity credits in the future
- available biodiversity assessment reports for existing and potential offset sites, which describe the biodiversity values of the sites and confirm the extent and quality of habitat for the affected threatened biota
- consultation with private landowners, ecological consultants, the Biodiversity Conservation Trust, Experts Group members, as well as agencies such as NSW OEH, the NSW Department of Planning and Environment and the Western Sydney Parklands Trust to identify or to describe potential offset sites.

While retaining a focus on value for money for any credits purchased, the following biodiversity criteria will be used to confirm direct offset sites:

- presence of Cumberland Plain Woodland, linked to the credit types HN528, HN529 and HN512 (OEH 2018c):
  - 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 occupied *Pimelea spicata* habitat
- presence of habitat for the Grey-headed Flying-fox and Swift Parrot, based on the presence of known food tree species and critical habitat criteria listed in recovery plans for the species
- presence of other biodiversity values appropriate to offset the 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 airport, and which as a minimum is located in the Cumberland Interim Biogeographic Regionalisation for Australia (IBRA) sub-region (DSEWPaC 2011)
- land that is within the CCC or other identified priority conservation lands or wildlife corridors or that could connect fragmented patches of habitat
- land that is already set aside as a BSA site and that has suitable biodiversity credits for sale; that is likely to be set aside as a BSA site 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 offset site.

The main focus of this BODP is 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). This BODP also includes the conservation and management of poorer quality Cumberland Plain Woodland that could be managed to achieve that condition.

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 (ie the offset area). Where appropriate, this assessment would rely upon the results of BioBanking/BAM assessments or other ecological surveys already conducted at the site
- if a site is already subject to a BSA, then the biodiversity credits linked to the offset area would be purchased and retired
- if a site is not yet subject to a BSA, the site would be assessed using BAM, the site owner would enter into a BSA, and the biodiversity credits linked to the offset area would be purchased and retired.

Direct offsets for the affected EPBC Act-listed biota will be calculated using the offsets assessment guide in accordance with the EPBC Act Offsets Policy based on the area of habitat for the affected threatened biota at offset sites. The area of habitat would be converted to biodiversity credits based on the rate of generation of credits per hectare in the appropriate vegetation zone(s) within the offset area. 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.

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 fully offset residual significant impacts on plants, animals and their habitat. A substantial area of poor condition vegetation at the airport site does not comprise habitat for any EPBC Act-listed biota, but must nevertheless be offset. The number and type of biodiversity credits that would be required to offset the airport's Stage 1 impacts on plants, animals and their habitat are specified in the Biodiversity credit report (see Appendix A of the Stage 1 BAR addendum, GHD 2018) and summarised in Table 3.5.

The EPBC Act Offsets Policy and the FBA and BAM 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 that the offset site must be able to reach the same site quality score as the development site. Therefore, only habitat that has similar ecological attributes and that has an equal or greater site quality score than the habitat at the airport site (or which could be improved to that score through management) could be presented as offsets for the affected threatened biota. The suite of biodiversity credits that are associated with the offset areas for the affected threatened biota would be purchased and retired in order to secure the appropriate standard of offsets.

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 (ie have the same or greater conservation significance). The FBA also allows trading of ecosystem credits associated with poorer condition vegetation at an offset 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 also requires the calculation of biodiversity offsets for poorer condition vegetation. A substantial area of poorer condition vegetation at the airport site has contributed to the amount of offset required for residual significant impacts on plants, animals and their habitat. Credits associated with vegetation that could not meet the standard of EPBC Act Cumberland Plain Woodland would only be presented as an offset for similar poorer condition vegetation at the airport site.

The difference between the EPBC Act and FBA rules are unlikely to be problematic in implementing this BODP. A practical example could include using 'Grey Box – Forest Red Gum grassy woodland on shale (HN529)' to offset impacts on 'Grey Box – Forest Red Gum grassy woodland on flats (HN528)' because both of these PCTs comprise part of the ecological community Cumberland Plain Woodland and this would be considered a like-for-like match according to the EPBC Act Offsets Policy. Species credits should normally be traded on a like for like basis, and the FBA includes some flexibility in circumstances where direct trades are not available (OEH 2014a).

Security of offset

A BSA comprises a conservation covenant on the title of the lots within the offset site. The covenant is the strongest mechanism available on private lands in NSW and restricts subsequent land uses other than conservation unless the BSA is varied or terminated by the NSW Minister for the Environment to permit alternative uses. Certain mining rights may be granted over a BSA site, and public authorities can carry out certain developments on a BSA 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, for the purposes of EPBC Act offset calculations, the risk of loss of the offset sites with a BSA in place would be very low. Depending on the land use zoning and previous land uses at a BSA site, the averted risk of loss component of offset calculations may be high.

Management framework

A BSA includes a binding requirement to perform management actions that will achieve improvements in biodiversity values at the offset site. A management action plan (MAP), detailing rehabilitation activities and a management program is prepared for inclusion in the BSA application. The MAP would include the costs and timeframes for each proposed management action.

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

- exclusion of domestic grazing and management of human disturbance
- retention of regrowth and remnant native vegetation and revegetation where appropriate
- fencing, track maintenance and erosion control
- weed and pest fauna control
- management of fire for conservation
- retention or supplementing of habitat resources such as dead timber and rocks.

In general, 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 offset site. These types of management actions would be used to improve the condition and viability of Cumberland Plain Woodland. Management would also improve the quality of foraging resources for the Grey-headed Flying-fox and Swift Parrot by increasing the extent, health and productivity of native vegetation containing food tree species. These actions would mitigate threats to *Pimelea spicata* populations where present, such as grazing, competition with weeds, and inappropriate fire regimes. In time, they are likely to lead to an increase in population sizes and an increase in the area of occupied habitat.

Management actions would be specified in greater detail in the 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 BAM to alleviate specific threats or respond to particular issues at a site.

6.2.2 Acquisition of land

Overview of proposal

This proposal involves the acquisition of suitable parcels of land, containing biodiversity characteristics relevant to the impacts of the airport development, being acquired and secured for conservation and given to local conservation groups to manage.

It leverages off the 2014–2017 CCC program, which has been managed through the Biodiversity Conservation Division in Environment and Energy. The CCC program aimed to protect and regenerate threatened bushland on the Cumberland Plain in Western Sydney by establishing a corridor to connect patches of remnant Cumberland Plain Woodland to improve the resilience of the community and to support the movement of species through the landscape. As part of the CCC, Environment and Energy chaired the CCC Reference Group, which advised the Australian Government on lands for acquisition within the corridor, with a focus on parcels that contain Cumberland Plain Woodland. Members of the Experts Group were supportive of the program and the potential of similar arrangements being used to acquire land and secure offsets for the airport development.

Members of the CCC Reference Group include OEH, Penrith City Council, the University of Western Sydney, non-government organisations (NGOs) working in environmental management and bush regeneration, local Aboriginal stakeholders, and the Greater Sydney Local Land Services. A number of CCC Reference Group members are now working together on conservation projects both on public and private land in the Penrith region.

Under this proposal, the Department envisages an advisory group such as the CCC Reference Group advising on parcels of land for acquisition that meet the specific requirements of the BODP. Utilising this advice, the Department would then provide funding for the acquisition and ongoing management of several parcels of land to deliver specific biodiversity outcomes.

At this stage of the delivery of offsets for the airport it is anticipated that the acquisition of land for conservation could deliver around 1 to 5% of the total quantum of offset required for the airport. This is likely to include up to 5% of the offset requirement for Cumberland Plain Woodland and an associated contribution towards the ecosystem credit requirement for impacts on plants, animals and their habitats. A contribution toward the offset requirement for impacts on *Pimelea spicata* or for other species credits within the offset requirement for plants, animals and their habitats may also be achieved, depending on the sites identified by the advisory group.

Identification and assessment of offsets

In the process of identifying conservation sites:

- members of the advisory group would identify potential conservation land, typically by liaising with real estate agents on land for sale, reviewing development applications, and consulting with local landowners and stakeholders
- preliminary investigations of the land will be undertaken to determine if it is suitable for land acquisition for conservation. If so, a process of formal land evaluation and negotiations with the vendor will be initiated

- if the acquisition is successful, then the Department provides the required funding to acquire the land. A conservation covenant would then be placed over the land, which would then be sold to a third party. The third party, often a local NGO, would be required to manage the land in perpetuity, consistent with the covenant, to achieve conservation outcomes.

The advisory group would select offset sites for the airport development according to clear criteria. This would 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 airport development.

The following biodiversity criteria will be used by the advisory group to identify potential sites for acquisition:

- Sites chosen will have relevant ecological communities and species to meet offsetting requirements, including:
  - presence of Cumberland Plain Woodland, linked to the credit types HN528, HN529 and HN512 (OEH 2018c):
    - 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 and Swift Parrot based on the presence of known food tree species and critical habitat criteria listed in recovery plans for the species
  - presence of occupied *Pimelea spicata* habitat and/or other biodiversity values appropriate to offset the airport's impacts on plants, animals and their habitats.
- Sites will be strategically located and enhance connectivity outcomes for the Cumberland Plain, including:
  - land that is relatively close to the airport site, in order to more directly benefit the populations and communities affected by the airport, and which as a minimum is located in the Cumberland IBRA sub-region (DSEWPaC 2011)
  - land that is within the CCC or other identified priority conservation lands or wildlife corridors or that could connect fragmented patches of habitat.
- An appropriate mechanism will be applied to ensure security of tenure in perpetuity.
- Time and flexibility will be built into the process to ensure the best land parcels can be acquired.
- Acquisition processes will make use of the expertise of appropriate local experts in site selection and governance.
- Sites will be actively managed under a funded plan, which includes monitoring and evaluation, to deliver specific biodiversity outcomes.
- Value for money will be considered in the selection of sites.

Security of offset

Properties acquired will be subject to a conservation covenant applied to the Land Title. It is likely that this will be under the provisions of the BC Act. The BC Act establishes three main types of voluntary private land conservation agreements:

- BSAs that provide permanent protection and management of biodiversity and allow for the creation of biodiversity credits as described above
- conservation agreements, which are permanent or time-bound agreements and may be eligible for stewardship payments
- wildlife refuge agreements, which are an entry-level option for landholders who want to protect the biodiversity on their property but do not wish to enter into a permanent agreement (NSW Government 2018).

Properties acquired and set aside as an offset for the airport would be protected by this conservation covenant and possibly also through other arrangements with the NGO responsible for managing the site.

The offsets assessment guide calculations supporting the implementation of this offset proposal 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.

Management framework

The conservation mechanism decided upon will include a binding requirement to perform management actions that will achieve improvements in biodiversity values at the offset site. Management actions would include measures to conserve and improve habitat and alleviate threats equivalent to those described in the above proposal for the Purchase of credits through the NSW Biodiversity Offsets Scheme. The specific type and intensity of management actions would depend on the condition and biodiversity values of the offset site and would be prescribed in a plan.

Performing these management actions would increase the quality and condition of habitat for the affected threatened biota and plants, animals and their habitats at the site.

6.2.3 Restoration and rewilding programs

Overview of proposal

The Department may also deliver biodiversity offsets for the airport through other forms of direct offsets that deliver a clear conservation outcome but are not linked to a parcel of land that could be secured under an appropriate conservation covenant. Consultation with the Experts Group and other investigations conducted in the preparation of this BODP have identified a number of such options that could deliver direct offsets collectively referred to as restoration and rewilding programs.

The EPBC Act Offsets Policy acknowledges that, in some situations, there may be difficulties in permanently securing a site for conservation purposes due to the existing tenure of the land, but that there is still the potential to treat such proposals as direct offsets. The Offsets Policy states that such situations will be considered by Environment and Energy on a case-by-case basis and, where the security of an offset is diminished, the risk to any protected matters, and subsequently the magnitude of offsets required, will increase (DSEWPaC 2012a).

With reference to the conceptual model for offset calculations presented as Figure 4, restoration and rewilding programs could deliver a substantial 'management gain' but minor (if any) 'averted risk of loss'.

At this stage of the delivery of offsets for the airport development, it is anticipated that restoration or rewilding projects could deliver up to 10% of the total quantum of offset required for the airport development. An appropriate portion of the funds likely to be available to secure offsets has been linked to this approach. This is likely to include up to 10% of the offset requirement for Cumberland Plain Woodland and an associated contribution towards the ecosystem credit requirement for impacts on plants, animals and their habitats. A contribution toward the offset requirement for impacts on *Pimelea spicata* or for other species credits within the offset requirement for plants, animals and their habitats may also be achieved, depending on the programs that are implemented.

Identification and assessment of offsets

Restoration and rewilding programs would be selected, defined and funded during the longer term implementation of this BODP. Programs would be selected based on consideration of the Department's criteria for evaluation of potential biodiversity offsets as well as the criteria in the EPBC Act Offsets Policy. These would include a focus on restoring species, communities and their habitats that are equivalent to the affected protected matters relevant to the airport development.

When applied to poorer condition environments, programs would be located in areas of confirmed habitat for the affected protected matters, relevant to the airport development, with appropriate soil type and landscape position supported by evidence such as adjoining stands of native vegetation in better condition. They would be 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).

Programs would be fully funded, including allowance for ongoing management and monitoring. They would also be located on a site that would not be at substantial risk of future development (given the absence of a secure conservation covenant), and that preferably has not already been set aside for conservation.

In addition, through consultation with the Experts Group, the Department identified the following characteristics as relevant to any restoration and rewilding proposals:

- sites chosen will have relevant ecological communities and species to meet offsetting requirements
- land tenure of sites will be closely considered to ensure long-term viability of restoration and revegetation
- sites of work will be strategically chosen to improve connectivity and conservation corridors
- long-term management objectives and funding sources must be built into any programs, along with ongoing monitoring and evaluation
- restoration and rewilding must be additional to the status quo
- preference for programs that take a strategic partnership or consortium approach to achieving the best restoration outcomes for the Cumberland Plain
- preference for programs that link with other measures such as Aboriginal land management, research and other on-ground conservation work.

The following options for restoration or rewilding programs have been identified and assessed as potentially suitable as offsets for the airport to date:

- Planting or restoration of vegetation in areas of previously cleared or degraded land rather than the conservation of intact ecological communities. Such an option 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 2005a).
- Rewilding of patches of remnant vegetation on the Cumberland Plain. The objective of rewilding is to restore as far as possible a fully functional ecosystem of the Cumberland Plain through the permanent eradication of feral species and the reintroduction of native fauna species. Reintroduced species would include fauna that are locally or regionally extinct and that perform ecosystem services such as bioturbation of soils, inoculation of soils with mycorrhizae, fertilisation of plants or transmission of seeds. A rewilding project would involve construction and maintenance of a feral-predator-proof fence around the perimeter of a site, intensive management of pest fauna within the site and translocation of selected native fauna species.
- Regional-scale management programs such as permanent eradication of target weeds, and coordinated cross-tenure control of feral animals.
- Cross-tenure measures to improve the effectiveness of vegetated corridors so wildlife can move freely and safely. This would involve permanent removal of key barriers to wildlife in existing corridors in easements or other open space that would be conserved but which based on their current tenure could not be set aside as BSA sites (or equivalent).
- Direct restoration of Cumberland Plain Woodland and other native vegetation at sites that will be conserved but which based on current tenure could not be set aside as BSA sites (or equivalent).

Security of offset

Proposals for restoration and rewilding programs would be implemented on sites that would not be at substantial risk of future development, however would not be protected under a secure conservation covenant. As described above, the EPBC Act Offsets Policy acknowledges that there may be difficulties in permanently securing a site for conservation purposes and that where the security of an offset is diminished, the magnitude of offset will decrease. These factors would be accounted for in the EPBC Act offsets assessment guide calculations. At the same time, the management framework described below and the systems and governance provided by those responsible for implementing the proposal would help mitigate the risk of the offset not succeeding.

Management framework

Each restoration and rewilding program would be implemented under a biodiversity management plan (or equivalent) providing a description of the existing environment of the program site(s), proposed restoration activities, roles and responsibilities, costs and timing. The structure and content of the plan would depend on the scope of the program, but each plan would include as a minimum:

- a description of the existing environment of the program site(s), including clear descriptions of the extent and quality of habitat for the affected threatened biota and other plants, animals and their habitats as a guide to offset calculations
- program delivery reports
- intent and forum for program delivery results to inform future management decisions (as appropriate)
- measures that would be implemented to help ensure the security and success of the offset proposal.

The final quantum of offset delivered by these programs would be based on the condition of habitat and specific management actions proposed. The biodiversity management plan (or equivalent) will support an increase in the site quality score, avert a decrease in the site quality score, as well as provide confidence in the result of the changes in the site quality score in the offsets assessment guide calculations.

Quantum of offset for affected threatened biota

Offset contributions from delivery of restoration and rewilding programs would be calculated as a percentage offset contribution to the total requirement for each affected protected matter. The calculations will use the offsets assessment guide and present justifications for how each of the input values were derived. The Department will discuss with Environment and Energy what particular methods are appropriate to each case.

Quantum of offset for plants, animals and their habitat

Consistent with the approach throughout this BODP, the EPBC Act offsets assessment guide calculations would be used to estimate the biodiversity credit equivalent provided by restoration and rewilding program outcomes. These estimates would be derived by taking the percentage offset calculated using the offsets assessment guide (accounting for minor averted risk of loss and low certainty) and equating it to an equivalent percentage of the total biodiversity credit requirement for the affected biota.

7 Other compensatory measures

7.1 Overview

As described above, the EPBC Act Offsets Policy requires that (subject to specified exceptions) a minimum of 90% of a project's impacts must be directly offset and the remainder may be met by other compensatory measures, such as a financial contribution to research, education or conservation (DSEWPaC 2012a; DoE 2016). As for direct offsets, these measures must contribute to the ongoing viability of the affected threatened biota to help deliver an overall conservation outcome that improves or maintains the viability of the protected matter.

Key considerations, with reference to the EPBC Act Offsets Policy, will include that any offsets must be timely, should ideally be targeted to complement broader conservation programs and must be based on sound ecological survey and assessment. Any offset proposals must be additional to any existing funding for conservation programs. This additionality will be demonstrated through robust accounting mechanisms.

As a coordinated approach to consulting on the development of offset proposals, including the consideration of appropriate other compensatory measures, the Department established an Experts Group as described in Section 4.1 and Chapter 5.

The following other compensatory measures are required by the Airport Plan:

- Mount Annan threatened flora propagation, conservation and research programs
- Greening Australia program to deliver a reliable supply of native seed.

These proposals for other compensatory measures are presented in Sections 7.2 and 7.3 below, along with discussion of how they are consistent with the requirements presented in Appendix A of the EPBC Act Offsets Policy, including:

- how each proposal will:
  - improve the viability of the protected matter(s)
  - be targeted towards activities in recovery plans
  - be transparent, scientifically robust and timely
  - be undertaken by a suitably qualified organisation
  - consider best-practice research approaches
- timing of delivery of the proposal
- details of funding arrangements and how funds will be managed appropriately and records will be kept and maintained
- the framework for monitoring program performance and research outcomes
- the intent and forum for publishing research findings in peer-reviewed scientific journals (as appropriate)
- the intent and forum for research findings to inform future management decisions (as appropriate).

The summary of each of the other compensatory measures presented below includes detailed consideration of these criteria and especially how each proposal will improve the viability of protected matters.

The EPBC Act offsets assessment guide provides a robust approach for calculating the quantum of biodiversity offsets delivered by a direct offset proposal. It also includes metrics for calculating a dollar contribution that could be made towards other compensatory measures to make up an offset shortfall. This BODP includes other compensatory measures that are required by the Airport Plan conditions and that will be implemented prior to the full suite of direct offsets being identified. The EPBC Act offsets assessment guide will be used to confirm the total cost of the offset contribution that must be met by funding other compensatory measures, once the cost of delivering the minimum 90% direct offsets is known. This will then allow back-calculation of the percentage of the total offset requirement that would be met by the other compensatory measures required by the Airport Plan conditions and presented in this BODP. The offset contributions would be confirmed during the implementation of this BODP and documented in the final implementation audit report.

If the compensatory measure also contributes to the offset requirement for plants, animals and their habitats, then this offset contribution will also be presented as an estimate of the credit equivalent for each class of biodiversity credit linked to the proposal outcomes.

The implementation of this BODP is likely to include delivery of research, conservation or restoration programs additional to those described in detail below. Potential longer term other compensatory measures are identified in Section 7.4 along with the criteria for selection of suitable measures and the process for implementation.

7.2 Threatened flora propagation program

7.2.1 Overview of proposal

Condition 33 of the Airport Plan requires the delivery of a Threatened Flora Propagation Program (TFPP), developed in consultation with Environment and Energy, OEH, and the Australian Botanic Gardens, Mount Annan (ABGMA). The offset package, as presented in the finalised 2016 airport EIS, had previously recommended that the BODP include consideration of the salvage and propagation of the known local populations of *Pultenaea parviflora* and *Marsdenia viridiflora* subsp. *viridiflora* and any other threatened plants detected at the airport site (GHD 2016a). Consultation with Environment and Energy during the preparation of the offset package for the 2016 airport EIS confirmed that the TFPP may be considered as a proportion of the other compensatory measures component of the BODP. To qualify for this approach, the program must be undertaken as part of a sound scientific framework, with adequate monitoring and reporting that genuinely increases the knowledge and understanding of the species. The TFPP would be a compensatory measure for *Pimelea spicata, Marsdenia viridiflora* subsp. *viridiflora* and *Pultenaea parviflora*.

As part of the work required to meet the Airport Plan biodiversity conditions, ABGMA has been engaged by GHD as a sub-consultant to deliver a TFPP. Located in Western Sydney, ABGMA is the native plant garden of the Royal Botanic Garden, Sydney, and specialises in the conservation and seed storage of NSW threatened species. Operating out of PlantBank, a state-of-the art $20 million purpose-built seed storage and research centre, staff have extensive experience in collecting and conserving Western Sydney flora.

The objectives of the TFPP are to:

- make seed collections of *Pultenaea parviflora*, *Marsdenia viridiflora* subsp. *viridiflora* and *Pimelea spicata* from the airport site, ensuring that adequate ex situ seed collections are held at the Australian PlantBank at the ABGMA
- collect cuttings from the airport site and/or access other sources of seed to ensure that sufficient propagules are available to meet the program's targets
- conduct seed germination and cutting trials to establish the best techniques to propagate and grow these three plant species
- grow a minimum of 500 plants of each of *Pultenaea parviflora* and *Marsdenia viridiflora* subsp. *viridiflora*, to be available at program completion, and
- grow a minimum of 1000 plants of *Pimelea spicata*, ensuring genetic sampling across the airport site population and plants available at project completion.

The propagation of *Pultenaea parviflora* was the subject of a previous study at Mount Annan in 1990. This previous study was conducted in a relatively orthodox manner, whereas this project assesses newer propagation technology.

The propagation and seed biology of *Marsdenia viridiflora* subsp. *viridiflora* is relatively unknown, and so the TFPP has used an adaptive and flexible approach to assess current propagation techniques and seed characteristics.

The physiology, seed biology and germination of *Pimelea spicata* is known to present challenges to propagation. Previous experience with this species at Mount Annan indicates a low strike rate for cutting propagation and physiological seed dormancy that must be overcome to achieve seed germination. The TFPP has allowed for testing of a number of seed and cutting treatments to help identify the optimal approach to propagation of the species.

Following on from the seed germination and cutting trials, up to 500 plants of *Pultenaea parviflora* and 500 plants of *Marsdenia viridiflora* subsp. *viridiflora* and 1000 plants of *Pimelea spicata* will be produced in 50mm forestry tube size pots. The program would directly contribute to translocation and ecosystem restoration activities by providing source populations of these threatened plants. The end use of the plants at the conclusion of the trial will be determined in conjunction with the implementation of the BODP. The majority of the plants are likely to be used in revegetation programs at direct offset sites to help maintain the population size and genetic viability of the regional populations of these species. A subset of the tube stock plants could be used to establish a longer term potted ex situ collection at the Mount Annan nursery as described below.

In addition to the requirements of Condition 33 of the Airport Plan, ABGMA will deliver a broader *Pimelea spicata* research and conservation works program as a compensatory measure for the airport as an extension of the TFPP. The Royal Botanic Gardens (RBG) Evolutionary Ecology section will assist ABGMA deliver a regional-scale genetic research project to help understand the ecology of *Pimelea spicata* and assist with its conservation. The study would include leaf material handling, storage and preparation; DNA extractions and sequencing analyses, genomic data handling; downstream population genetic analyses; interpretation of the findings and preparation of relevant reports. The RBG Evolutionary Ecology section has applied these techniques to an ongoing research project, Restore & Renew, to obtain distribution-wide measures of genomic

diversity across more than 200 NSW species commonly used in restoration projects and to support the management and conservation of threatened flora species. The objectives of the project are to assess genetic diversity and genetic structure across the remaining distribution of *Pimelea spicata*, and investigate possible association between genetic and geographic / environmental diversity.

Photo 1 *Pultenaea parviflora* seedlings at ABGMA nursery grown from 1992 collection

The regional-scale genetic research project would improve an understanding of:

- genetic health, population structure and genetic diversity patterns of *Pimelea spicata* at the airport site and across the species' geographic range
- genetic diversity at the individual level and whether genetic patterns of divergence are consistent across the related populations
- whether the population at the airport has low fitness and low genetic variability that would reduce the potential for plants to persist and adapt to future environmental changes if translocated.

Given the size and regional significance of the *Pimelea spicata* population at the airport site, this population will receive targeted genetic sampling to place this population in the overall context of the species' genetic spectrum. Importantly, this genetic research will guide the selection of material to be propagated and managed ex situ at ABGMA as potted live collections to be used in restoration / translocation programs.

The proposal will target actions identified in the *Pimelea spicata* R. Br. Recovery Plan (DEC 2005b), consistent with the requirements for other compensatory measures in the EPBC Act Offsets Policy. Specifically the genetic research will help address limits to current knowledge and research questions that will assist in the effective conservation of *Pimelea spicata,* including:

- What is the long-term viability of small and geographically isolated populations of *Pimelea spicata*?
- How is the total genetic diversity of *Pimelea spicata* distributed within and among populations?

- How much genetic diversity would be lost with the loss of any one population (DEC 2005b)?

ABGMA will expand the TFPP to help establish a longer term potted ex situ *Pimelea spicata* collection at the Mount Annan nursery. This potted ex situ collection would provide a source of cutting material to support any future translocation or amenity planting of the *Pimelea spicata* population from the airport site once the plants are removed during the Stage 1 construction works. This program would draw upon information from the *Pimelea spicata* genetic study and experience in propagation techniques gained throughout the TFPP. The proposal is for a potted collection of around 100 plants, comprising 30 genetic individuals, informed by the results of the genetic study and selected to minimise kinship and maximise genetic diversity.

This task would include repotting, growing-on, data entry and horticultural maintenance of a potted clonal ex situ collection at the Mount Annan nursery beyond the conclusion of the TFPP. Specific tasks would include daily monitoring, watering, data updating and record keeping, pest and disease management and plant nutrition, as well as six-monthly progress reports that could be calculated on an annual basis and would support reporting requirements for the BODP as set out in the Airport Plan conditions.

The well-sampled clonal material would facilitate a detailed understanding of the species to enable its optimum management in an ex situ setting. Trials would provide additional species-specific information to be collated. This would provide plant development milestones and reliable timelines for successful future planting projects, in addition to supplying concrete information on optimal aftercare in-ground. The potted ex situ collection would provide superior cutting material for propagation. There is also the potential for nursery seed production. Seed production has been observed in plants 1.5 to 2 years after germination (NSW NPWS 1997 cited in DEC 2006). Germination methods can be trialled in addition to adopting methods already trialled in the TFPP, such as smoke application to increase germination.

This potted ex situ collection, held at the ABGMA nursery for a minimum five years, would provide the following benefits and contribution to the viability of *Pimelea spicata*:

- Well-sampled clonal genetic material from the airport site *Pimelea spicata* population that will be removed during the airport construction phase
- plants grown under ideal nursery conditions that will provide superior cutting material for propagation
- provision of large amounts of cutting material to support a future translocation of the airport site population to another Western Sydney site, which could be delivered as a direct offset
- a source of seed for long-term storage at PlantBank.

Photo 2 *Marsdenia viridiflora* subsp. *viridiflora* seedlings at ABGMA nursery grown from cuttings and seed collected in 2017

7.2.2 Monitoring and reporting framework

The TFPP includes provision of periodic, point form project reports to the Department. At completion of the project, a brief report on the project methodology and results will be produced. The report will include seed collecting and viability testing results, photos, propagation trial results, field observations and future conservation recommendations for all three species.

ABGMA will explore opportunities to publish research outcomes in a peer-reviewed scientific journal.

The end use of the propagated *Pultenaea parviflora*, *Marsdenia viridiflora* subsp. *viridiflora* and *Pimelea spicata* will be documented in the BODP Implementation Audit Report(s) and biodiversity monitoring plans for individual offset sites as appropriate.

Ongoing monitoring and reporting for the *Pimelea spicata* genetic research program would be as specified in a sampling and study delivery plan. This is unlikely to include periodic reporting to the Department given the length of the project, which is anticipated to be less than 12 months.

A program delivery report would be provided to the Department presenting the scope and methodology for the genetic study, results and key research findings. The research would be presented for publishing in a peer-reviewed conservation based scientific journal, with the publication to be confirmed with the RBG Evolutionary Ecology section. The research outcomes would also directly contribute to the sampling strategy for the ex situ potted *Pimelea spicata* population to be held at ABGMA. The results of the genetic analysis would help to achieve appropriate genetic diversity and resilience in the potted population and inform appropriate translocation and restoration activities.

Periodic ex situ potted *Pimelea spicata* population program delivery reports would be provided to the Department to coincide with BODP Implementation Audit reports specified by the Airport Plan conditions (every 18 months based on data compilation conducted nominally every six months). These will be provided for a period of at least five years.

Key research outcomes of the TFPP and genetic research would be used to inform future management decisions and activities more broadly through provision of the program delivery report and published research to stakeholders, including:

- OEH Saving Our Species program officers responsible for *Pimelea spicata*
- Western Sydney University and other organisations delivering research programs focusing on threatened biota of the Cumberland Plain
- Greening Australia, Local Land Services and other organisations delivering conservation and restoration programs focusing on threatened biota of the Cumberland Plain.

7.2.3 Timing of delivery

Stage one of this compensatory measure, the TFPP, commenced in April 2017 with the collection of *Marsdenia viridiflora* subsp. *viridiflora* fruits and cuttings from the airport site and the planning for collection of *Pimelea spicata* and *Pultenaea parviflora* material. The delivery of the TFPP has continued throughout 2017 and is expected to be finalised according to the following program:

- 4 August, 1 November and 30 November 2017 – airport site visits completed with mesh seed bags placed on *Marsdenia viridiflora* and *Pultenaea parviflora* plants to capture seed fall after ripening. Cuttings of *Pimelea spicata* were collected in November.
- December 2017 – management of the *Pimelea spicata* population at the airport site to try and improve conditions for collection through weeding and supplementary watering.
- March 2018 – site visit revealed *Pultenaea parviflora* plants with mesh bags were pulled out of the ground by vandals; however, the dead plants and seed bags (with seed) were recovered and 50 seeds were retrieved from the mesh bags and are now held at PlantBank.
- May 31 2018 – additional collections from the airport site, including collection of 2040 *Pimelea spicata* cuttings comprising significantly better quality material than earlier collections (ie cuttings collected from healthier, more actively growing plants).
- June 25 2018 – processing of seed and cuttings, propagation trials and potting-on to date:
  - *Pultenaea parviflora* – seed propagation was commenced using the PlantBank 1992 seed collection. 600 seeds resulted in a total of 444 plants potted-on to 140mL pots and 69 tube stock, which are growing well. 77 cuttings were taken from the airport site, which resulted in one plant (now potted as tube stock). The target number of plants has been exceeded (514 in total).

- *Marsdenia viridiflora* subsp. *viridiflora* – Cutting and seed propagation at ABGMA nursery has resulted in a total of 170 plants now potted-on to tube stock size, super tube or 140mL pot size and growing well. 162 plants were grown from semi-hardwood cuttings and eight were grown from seed. Given the poor condition of *Marsdenia* plants at the airport site, ABGMA anticipates using the current nursery plant stock to harvest additional cuttings in an effort to reach the target quantity of 500 plants.
- *Pimelea spicata* – 710 cuttings were taken on 30 November 2017, resulting in a total of 29 tube stock plants. Three different cutting hormone treatments were used, with the best strike rate of 7%. A further 2040 cuttings were taken on 31 May 2018 from better quality material as described above. Initial indications are that the strike rate will be higher with this batch and the target of 1000 may be possible. Should Mount Annan not achieve a 50% strike rate, another collection can be scheduled.

Photo 3 *Pimelea spicata* at the airport site managed to try and improve conditions for collection through weeding

Stage two of the compensatory measure, the *Pimelea spicata* research and conservation program, will commence in the 2018/19 Financial Year according to the following indicative program:

- August to September 2018 – determine scope of works and sampling strategies with relevant stakeholders, including the Department and GHD.
- August to September 2018 – leaf sampling of *Pimelea spicata* individuals from around 10 regional populations.
- September to October 2018 – samples curated, relevant data organised, and leaf material freeze-dried to facilitate high-quality DNA extraction and enable long-term storage.
- October to November 2018 – DNA extraction and analysis.
- January to February 2019 – environmental modelling and genetic population analyses.

- January to February 2019 – provision of data and information from the genetic study to support commencement of the propagation of ex situ potted *Pimelea spicata* collection.
- March 2019 – draft report and recommendations.
- April 2019 – final report and submission of results as a peer-reviewed research paper.

The delivery of the ex situ *Pimelea spicata* potted collection program is anticipated to commence in January to March 2019, depending on the delivery of the genetic research program and the suitability of seasonal conditions for cutting collection. The program would then proceed according to the following indicative timeline:

- Day 1 to day 60-80 – collection of plant material, propagation of vegetative material and growing-on of tube stock, then
- 40 to 60 additional days – growing and potting-on to 125mm pot, then
- 100 to 120 additional days – growing and potting-on to 200mm pot, then
- maintenance of 100 x 200mm potted plants sampled over a maximum of 30 individuals, and provision of cuttings to support restoration activities for a maximum of five years.

7.2.4 Quantum of offset for affected threatened biota

The TFPP would be presented as a compensatory measure for *Pimelea spicata*. The TFPP meets the requirements for other compensatory measures presented in Appendix A of the EPBC Act Offsets Policy with respect to *Pimelea spicata*, because it:

- will improve the viability of *Pimelea spicata*, by:
  - improving the effectiveness and knowledge of propagation techniques for the species
  - maintaining an ex situ population of the species and providing cuttings and seed to help establish or expand populations of the species across Western Sydney.
- is transparent (through monitoring and reporting requirements included in the contract between ABGMA and GHD and reporting in the Department's BODP reports), scientifically robust (through best-practice collection, production and genetic analysis techniques) and timely (in that stage 1 of the TFPP commenced in mid-2017, over one year prior to the expected commencement of main construction works for the airport)
- is being undertaken by a suitably qualified organisation, in ABGMA
- will target actions identified in the *Pimelea spicata* R. Br. Recovery Plan (DEC 2005b). Specifically the genetic research will help address limits to current knowledge and research questions identified in the recovery plan that will assist in the effective conservation of *Pimelea spicata* (DEC 2005b).

The offset delivered by the TFPP will be calculated as a percentage offset contribution to the total requirement for *Pimelea spicata* using the 'Other compensatory ($)' section of the EPBC Act offsets assessment guide. The EPBC Act offsets assessment guide will confirm the total cost of the offset contribution that must be met by funding other compensatory measures, once the cost of delivering the minimum 90% direct offsets is known. This will then allow back-calculation of the percentage of the total offset requirement for *Pimelea spicata* that would be met by dedicated funding for the TFPP. The offset contribution from the TFPP would be confirmed during the implementation of this BODP and documented in the BODP implementation audit reports.

7.2.5 Quantum of offset for plants, animals and their habitats

The TFPP would deliver biodiversity offsets for *Pimelea spicata*, *Marsdenia viridiflora* subsp. *viridiflora* and *Pultenaea parviflora* as part of the offset requirement for plants, animals and their habitats. The offset requirement for these threatened plants has been calculated with reference to the NSW FBA methodology and is expressed in terms of species credits that must be purchased and retired. The EPBC Act offsets assessment guide calculations will be used to estimate the species-credit equivalent provided by the proposal outcomes. These estimates will be derived by taking the percentage offset calculated using the offsets assessment guide and equating it to an equivalent percentage of the total species-credit requirement (calculated using the FBA) for these threatened plants. The biodiversity offset for *Pimelea spicata*, *Marsdenia viridiflora* subsp. *viridiflora* and *Pultenaea parviflora* provided by the TFPP will be documented in the BODP implementation audit reports.

7.3 Greening Australia seed collection and production program

7.3.1 Overview of proposal

Revegetation programs rely upon native plant species stock that is preferably of local provenance. Programs on the Cumberland Plain have, in general, been limited by seed supply and it is likely that there will be insufficient stock for Commonwealth revegetation projects in the next five years (Hollow, R. Environment and Energy, pers. comm.). Beyond that, there is not a dedicated program for collection and production of seed. Support is required for seed collection and production operations to ensure that there is sufficient stock for revegetation and biodiversity restoration programs.

In accordance with Condition 32 of the Airport Plan, the Department has entered into an agreement with Greening Australia to contribute funds to the organisation's Cumberland Seed Hub program in Western Sydney. The agreement will ensure that the funded elements of the Cumberland Seed Hub program have the objective of producing a reliable source of native seed for ecological restoration work in Western Sydney's Cumberland Plain and are specific to the threatened vegetation communities found on the Cumberland Plain, with the primary focus on species associated with Cumberland Plain Woodland. Native seed collection includes harvest from Cumberland Plain Woodland and other native plant communities at the airport site.

The Cumberland Seed Hub project is based around the Richmond High Diversity Production Area and Processing Facility supported by wild collection and other production areas throughout Western Sydney. The hub utilises traditional agricultural techniques to maximise seed yields from around 120 native plant species and is the only high-diversity native seed production facility in the region (Greening Australia 2016). Plant species are cultivated as individual crops in dedicated beds with appropriate soil and microclimatic characteristics. Weeds are excluded and supplementary water is provided as required to maximise output of seed or cuttings. Photo 4 shows *Pimelea spicata* beds at the Richmond High Diversity Production Area and Processing Facility.

Photo 4 *Pimelea spicata* beds in the Cumberland Seed Hub

The arrangement of the Cumberland Seed Hub allows the selection of individual species for restoration projects, enabling the establishment of vegetation to suit the site's target vegetation community or in response to site constraints. Greening Australia can provide a number of species from each of the main plant growth form groups to ensure that the vegetation community being restored is species rich and structurally diverse. This approach provides habitat resources and complexity to help support higher native fauna species richness. It also ensures that should a plant species drop out of the system another 'like' species is able to fill the niche, making it harder for unwanted species to establish and reducing long-term maintenance requirements (Greening Australia 2016).

The majority of current restoration practices focus upon a reduced range of species, generally with a focus upon the canopy and shrub layers. Ground layer vegetation, where included, tends toward a reduced mix of easy to source, common and widespread species. The reasons for this are varied but usually come from lack of access to a reliable source population for production of sufficient quality seed and the commonly held belief that re-establishing complex ground layer vegetation is not possible or cost effective. As a result, species lists tend to be limited to 20 to 25 species, predominantly focused upon canopy and shrub species and a limited species richness of tussock grasses, herbs and sedges. The Cumberland Seed Hub has over 120 native groundcover species in production, representing a substantial increase in the potential native plant species richness that could be achieved at restoration sites (Wood, R. Greening Australia, pers. comm.).

Greening Australia promotes a complex grassy woodland restoration method that includes the combination of intensive seed production to provide bulk seed lots, appropriate site preparation (to reduce nutrient loads and weed seed) and direct sowing of seed. This approach achieves groundcover densities of 250,000 to 500,000 plants per hectare and diversity greater than 50 species compared to 1500 to 2500 plants per hectare in conventional tree-planting programs and a maximum of 50,000 plants per hectare and diversity of 8 to 25 species for intensive tube stock planting revegetation techniques (Greening Australia 2016). The Cumberland Seed Hub will facilitate this approach as well as increasing the diversity of plant species available for other restoration techniques.

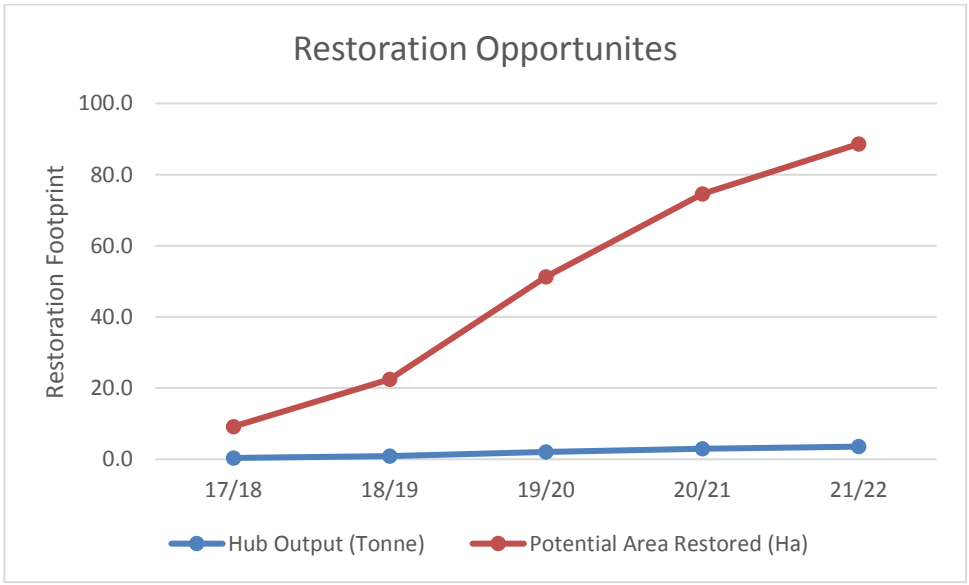
Plant species richness and structural diversity of plant life form groups are widely recognised as key indices of vegetation condition and biodiversity value, for instance in the NSW BioBanking methodology (OEH 2014b) and BAM (OEH 2017). Increasing species diversity also improves the conservation outcome that can be achieved by providing a more resilient and functional vegetation system that is capable of responding to changing conditions and that requires lower long-term maintenance inputs (Greening Australia 2016).

The Cumberland Seed Hub facilitated by the agreement with the Department will enhance conservation actions at offset sites and restoration programs that would directly benefit the species and plant communities affected by the airport. The seed supply program is presented in this BODP as a compensatory measure that contributes to the offset requirement for Cumberland Plain Woodland, *Pimelea spicata* and for plants, animals and their habitats by facilitating ecological restoration of these species and their habitats at offset sites and other lands across Western Sydney.

The agreement with the Department will help Greening Australia increase the output of their seed production areas and the volume of wild collection to facilitate restoration of up to 100 hectares a year by the end of the five-year agreement period. Figure 13 presents the anticipated Cumberland Seed Hub output in metric tonnes and the potential area that could be restored using this seed based on Greening Australia projections (Greening Australia 2016). The Cumberland Seed Hub will enhance restoration projects and increase the biodiversity gains that can be achieved within an anticipated 250 hectares of Cumberland Plain Woodland over the five years that the project will be directly supported as an offset for the airport.

The Cumberland Seed Hub will continue to operate and to help maintain Cumberland Plain Woodland through the provision of native species-rich seed for many years after the conclusion of the agreement with the Department. The hub infrastructure and stock plants will be maintained by Greening Australia using alternative funding sources on an ongoing basis.

Figure 13 Cumberland Seed Hub output and potential restoration footprint



The Richmond High Diversity Production Area and Processing Facility includes a population of *Pimelea spicata* that has been used to harvest cuttings for use in restoration projects. The *Pimelea spicata* production population consists of approximately 50 plants collected from two wild populations at Prospect Reservoir and Narellan.

To date, these cuttings have been successfully used to enhance a Greening Australia complex grassy woodland restoration site at Parrot Farm, Narellan. Around 15 *Pimelea spicata* individuals were planted out within an area of approximately one hectare of formerly severely degraded and weed-infested land. The planting site was immediately adjacent to occupied *Pimelea spicata* habitat and used material harvested from this adjacent population (Wood, R. Greening Australia, personal communication). Successive rounds of planting will be performed to achieve higher densities as part of a self-sustaining population.

The number and diversity of source populations of *Pimelea spicata* production plants will increase over the next five years, including source plants from the airport site produced by the Mount Annan TFPP (see Section 7.2). As described above, the Cumberland Seed Hub will continue to operate and to help maintain the viability of *Pimelea spicata* through provision of plants for revegetation projects for many years after the conclusion of the agreement with the Department.

7.3.2 Monitoring and reporting framework

The agreement between the Department and Greening Australia includes the requirement for an Annual Business Plan and detailed written and/or verbal briefings throughout the contract. Progress reports are to be provided annually, with the initial report provided in late 2017, and the remaining four reports due annually on 31 August until 2021.

Each report will set out:

- details of the services provided during the period to which the report relates
- the infrastructure and equipment acquired and developed
- the operational activities undertaken
- a description of the milestones that have been met or not met
- details of the fees received and the monies expended on providing the services, and progress against meeting the objectives of the Native Seed Production Area program.

7.3.3 Timing of delivery

The program commenced in July 2017 and under the agreement the Department will provide $2 million annual funding over five years, staged to suit the program's production cycle. Wild harvesting and seed production activities at the Cumberland Seed Hub increased through the second half of 2017 as anticipated by the business overview for the project and as shown in Figure 13. Delivery of offsets through a reliable, species-rich source of native seed to enhance restoration of Cumberland Plain Woodland and planting-out of *Pimelea spicata* has commenced prior to the impacts of the airport occurring.

7.3.4 Quantum of offset for affected threatened biota

Cumberland Plain Woodland

The Cumberland Seed Hub project meets the requirements for other compensatory measures presented in Appendix A of the EPBC Act Offsets Policy, because it:

- will improve the viability of Cumberland Plain Woodland, by providing species-rich and local provenance seed for restoration programs that would be applied to occurrences of this ecological community at offset sites and other lands across Western Sydney
- is targeted towards activities in the NSW recovery plan for the Cumberland Plain, including facilitating active management to best-practice standards to prevent the degradation of the remaining bushland in the fragmented landscape of Western Sydney (DECCW 2010)
- is transparent (through the monitoring and reporting requirements included in the contract between Greening Australia and the Department), scientifically robust (through best-practice seed collection and production techniques) and timely (in that it commenced in mid-2017, over one year prior to the expected commencement of main construction works for the airport)
- is to be undertaken by a suitably qualified organisation in Greening Australia.

The offset delivered by the Cumberland Seed Hub will be calculated as a percentage offset contribution to the total requirement for Cumberland Plain Woodland using the 'Other compensatory ($)' section of the EPBC Act offsets assessment guide. The EPBC Act offsets assessment guide will confirm the total cost of the offset contribution that must be met by funding other compensatory measures, once the cost of delivering the minimum 90% direct offsets is known. This will then allow back-calculation of the percentage of the total offset requirement for Cumberland Plain Woodland that would be met by the $10 million of dedicated funding for the Cumberland Seed Hub. The offset contribution from the Cumberland Seed Hub would be confirmed during the implementation of this BODP and documented in the final implementation audit report.

Pimelea spicata

The Cumberland Seed Hub project meets the requirements for other compensatory measures presented in Appendix A of the EPBC Act Offsets Policy with respect to *Pimelea spicata*, because it:

- will improve the viability of *Pimelea spicata*, by maintaining an ex situ population of the species and providing cuttings and seed to help establish or expand populations of the species across Western Sydney
- is transparent (through the monitoring and reporting requirements included in the contract between Greening Australia and the Department, which will be incorporated into the Department's reports on the BODP), scientifically robust (through best-practice seed collection and production techniques) and timely (in that funding commenced in mid-2017, over one year prior to the expected commencement of main construction works for the airport)
- is being undertaken by a suitably qualified organisation, in Greening Australia.

The Cumberland Seed Hub project is not specifically targeted towards activities in the recovery plan for the species (DEC 2005b), which focuses on maintenance of natural populations and does not identify supplementary planting to help maintain or expand populations as a specific action. However, the Seed Hub project has contributed to other priority recovery actions for the species through propagation of plants sourced from the Prospect Reservoir and Narellan populations, which are identified as the two management sites where conservation activities need to take place to ensure the conservation of this species within the NSW Saving Our Species program (OEH 2018b). The hub has also facilitated successful planting-out of plants at Parrot Farm within the Narellan *Pimelea spicata* population.

The offset delivered by the Cumberland Seed Hub will be calculated as a percentage offset contribution to the total requirement for *Pimelea spicata* using the 'Other compensatory ($)' section of the EPBC Act offsets assessment guide. The EPBC Act offsets assessment guide will confirm the total cost of the offset contribution that must be met by funding other compensatory measures, once the cost of delivering the minimum 90% direct offsets is known. This will then allow back-calculation of the percentage of the total offset requirement for *Pimelea spicata* that would be met by the $10 million of dedicated funding for the Cumberland Seed Hub. The offset contribution from the Cumberland Seed Hub would be confirmed during the implementation of this BODP and documented in the BODP implementation audit reports.

7.3.5 Quantum of offset for plants, animals and their habitats

The Cumberland Seed Hub would deliver biodiversity offsets for the individual plants, animals and their habitats that collectively comprise Cumberland Plain Woodland, including *Pimelea spicata*. The offset requirement for plants, animals and their habitats has been calculated with reference to the FBA and is expressed in terms of the number and type of biodiversity credits that must be purchased and retired (see Chapter 3). The EPBC Act offsets assessment guide calculations will be used to estimate the biodiversity credit equivalent provided by the proposal outcomes. These estimates will be derived by taking the percentage offset calculated using the offsets assessment guide and equating it to an equivalent percentage of the total biodiversity credit requirement (calculated using the FBA) for the affected biota. The biodiversity offset for plants, animals and their habitats provided by the Cumberland Seed Hub will be documented in the BODP implementation audit reports.

7.4 Longer term other compensatory measures

7.4.1 Overview of proposal

As outlined in Chapter 4, the Department, assisted by GHD, has consulted with various stakeholders, including members of the Experts Group, on potential longer term other compensatory measures such as conservation, research, educational and training programs. GHD have completed a preliminary assessment against the EPBC Act Offsets Policy and the Department's criteria for the evaluation of potential biodiversity offsets and confirmed that such offset measures, if appropriately implemented, could deliver suitable biodiversity offsets for the airport development. The Experts Group have discussed and provided advice on several different types of other compensatory measures and the inclusion of such measures in the offset delivery package has received general support (Chapter 5). Due to the requirements of the EPBC Act Offsets Policy and Australian Government procurement and funding policies, the specifics of these research and conservation programs would be defined during the longer term implementation of this BODP.

The proposals under consideration by the Department include:

- research into effective restoration techniques for threatened ecological communities and species on the Cumberland Plain
- capacity building and training opportunities, including Aboriginal land management, in on-ground conservation and ecological restoration activities.

At this stage of the delivery of offsets for the airport it is anticipated that longer term programs for other compensatory measures could deliver up to 5% of the total quantum of offset required for the airport and an appropriate portion of the funds likely to be available to secure offsets have been linked to this approach.

7.4.2 Identification and assessment of offsets

Research and capacity building programs would be selected, defined and funded during the longer term implementation of this BODP. Programs would be selected based on consideration of the Department's criteria for evaluation of potential biodiversity offsets as well as the criteria in Appendix A of the EPBC Act Offsets Policy, including how a proposal would:

- improve the viability of the protected matter
- be targeted towards activities in recovery plans
- be transparent, scientifically robust and timely
- be undertaken by a suitably qualified organisation
- consider best-practice research approaches.

In addition, through consultation with the Experts Group, the Department identified the following characteristics as relevant to any research and capacity building programs, including training:

- research should align with the Research Priorities in the Commonwealth Conservation Advice and Appendix 4 of the Cumberland Plain Recovery Plan
- research to have strong engagement with local projects and organisations and contribute to capacity building
- Aboriginal land management to be based on partnerships and consultative co-design processes with leadership from local Aboriginal peoples
- Aboriginal land management, as a complementary outcome, can apply to any land-based proposed offset measures
- research and capacity building programs should be complementary to on-ground works undertaken as part of the offsets package and contribute to ongoing monitoring, evaluation and adaptive management practices
- funding for training would not extend to those with existing obligations under BSAs.

The following options for other compensatory measures have been identified by the Experts Group as potentially suitable offset measures:

- a research program which would aim to ensure the success of ecological restoration techniques in capturing, producing and establishing biodiversity for Western Sydney
- an Indigenous Ranger training and education program that supports other offset measures in the package
- an assessment of the practical and economic viability of novel ecological restoration techniques in the context of the NSW Biodiversity Offset Scheme and BAM
- training land managers and developing their skills in land management and ecological restoration techniques to improve biodiversity values in the long term

7.4.3 Monitoring and reporting framework

Proposals for other compensatory measures will include:

- details of funding arrangements and how funds will be managed appropriately and records will be kept and maintained
- the framework for monitoring program performance and research outcomes, which in all cases will include appropriate information for inclusion in the Department's reports on implementation of this BODP
- the intent and forum for publishing of research findings in peer-reviewed scientific journals (as appropriate)
- the intent and forum for research findings to inform future management decisions (as appropriate).

7.4.4 Quantum of offset for affected threatened biota

Research and education programs would be presented as compensatory measures that contribute to the offset requirement for the affected threatened biota as follows:

- Cumberland Plain Woodland, by achieving improvements in ecological restoration techniques that would be applied to occurrences of this ecological community BSA sites and other lands across Western Sydney
- Grey-headed Flying-fox and Swift Parrot foraging habitat, by achieving improvements in ecological restoration techniques that would improve the extent, viability and productivity of populations of food tree species at BSA sites and other lands across Western Sydney.

This offset contribution would be presented as a percentage offset contribution to the total requirement for each affected protected matter along with justification for how the value was derived.

7.4.5 Quantum of offset for plants, animals and their habitats

Research and education programs would be presented as compensatory measures that contribute to the offset requirement for plants, animals and their habitats by achieving improvements in ecological restoration techniques that would be applied to populations of these species and their habitats at BSA sites and other lands across Western Sydney. This offset contribution would be presented as an estimate of the credit equivalent for each class of biodiversity credit linked to the program outcomes.

8 Implementation of the BODP

8.1 Overview of the offset proposal

The offset proposal presented in this BODP includes the direct offsets, other compensatory measures and longer term options described above. The offset proposal has been developed based on the Department's *assessment criteria for biodiversity offsets* developed with reference to the EPBC Act Offsets Policy and Airport Plan conditions and refined in consultation with the Experts Group.

The offset proposal has been developed by the Department and its nominated Suitably Qualified Expert in accordance with the Airport Plan conditions and based on:

- applying best practice, based on advice and engagement with the Experts Group and other key biodiversity stakeholders in the Western Sydney Region
- alignment with existing conservation priorities for the Cumberland Plain
- a collaborative and strategic approach to ensure best outcomes, and
- proposed measures that rate highly against the assessment criteria.

Table 8.1 The Western Sydney Airport Stage 1 offset proposal

Measure	Summary	Characteristics	Quantum of offset	Timing
Direct offsets			**At least 90%**	
Orchard Hills offset site (Section 6.1)	Secure the ongoing conservation and enhance the biodiversity value of a large site with strategic value and a significant amount of like-for-like native vegetation in close proximity to the airport site.	Secures and strengthens the conservation outcomes of a large site with strategic value and strong connectivity benefits, in addition to existing environmental obligations. Conservation of a significant amount of Cumberland Plain Woodland and other like-for-like native vegetation and habitats in close proximity to the airport site. Strong potential for complementary outcomes.	A preliminary biodiversity assessment of the Orchard Hills offset site has been completed and the Department proposes to enter into a MOU with Defence (Section 6.1.3). Based on the preliminary Offsets assessment guide calculations conservation and management of the Orchard Hills offset site could meet around:	Implementation commences in the 2018/19 Financial Year.

Measure	Summary	Characteristics	Quantum of offset	Timing
		Under the MOU, there would be requirements for active management, monitoring, reporting and auditing to improve biodiversity values with a commitment to achieve an increase in site quality and provision for ongoing management. Moderate averted risk of loss through exclusion of future development or harmful activities. Management described in the Offset Plan, prepared in accordance with the MOU, to be fully funded for the improvement period, anticipated to be up to 20 years with a high certainty of success and ongoing conservation and management obligations.	- 63.5% of the offset requirement for EPBC Act Cumberland Plain Woodland and 35.2% of the offset requirement for poorer quality Cumberland Plain Woodland; - 71% of the offset requirement for the Grey-headed flying-fox; and - 47% of the offset requirement for Swift Parrot foraging habitat (see Section 6.1.7). The Orchard Hills offset site could also meet a substantial proportion of the offset requirement for impacts on plants, animals and their habitats as a direct offset when translated into the equivalent biodiversity credits (see Section 6.1.8).	An Offset Plan would be completed within 18 months of the commencement date of the MOU. The core offset site and any other agreed areas would be actively managed as an offset for the airport for the period required to achieve the offset improvements discussed in Section 6.1.4, expected to be up to 20 years, with ongoing maintenance thereafter.
Purchase of credits through the NSW Biodiversity Offsets Scheme (Section 6.2.1)	Secure areas for conservation in perpetuity through the purchase of biodiversity credits.	The NSW Biodiversity Offsets Scheme provides for a secure conservation covenant, detailed management plan, secure funding, monitoring, and auditing and enforcement by the BCT. Sites chosen will have relevant ecological communities and species to meet offset requirements. Sites will be strategically located with good connectivity outcomes with a preference for sites close to the impact site. Sites with well-established and high quality stands of ecological communities or strong potential for restoration will be prioritised.	The quantum of offset that would be delivered is subject to the identification of suitable suites of credits sourced from appropriate offset sites, information presented in Biodiversity Stewardship Site Assessment Reports in accordance with the BAM and EPBC Act offset calculations. This measure is likely to deliver: - around 5 to 10% of the offset requirement for Cumberland Plain Woodland; - around 15 to 25% of the offset requirement for the Grey-headed Flying-fox;	Purchase of credits will be staged, with an initial tranche of credits purchased in the 2018/19 Financial Year, and the required credits expected to be purchased and secured within 3 years of BODP approval.

Measure	Summary	Characteristics	Quantum of offset	Timing
			- up to 35% of the offset requirement for Swift Parrot foraging habitat; and - up to 100% of the offset requirement for Pimelea spicata when linked to an area of occupied habitat. This measure would meet a substantial proportion of the offset requirement for impacts on plants, animals and their habitats with a particular focus on securing up to 100% of the offset requirement for *Pimelea spicata* as species credits and targeted offsets for other threatened biota not delivered by other measures.	
Acquisition of land (Section 6.2.2)	Acquisition of strategic parcels of land that promote connectivity for the Cumberland Plain Corridor to be managed in perpetuity by a third party.	Sites chosen will have relevant ecological communities and species to meet offsetting requirements Sites will be strategically located and enhance connectivity outcomes for the Cumberland Plain Corridor. An appropriate mechanism will be applied to ensure security of tenure in perpetuity. Time and flexibility will be built into the process to ensure the best land parcels can be acquired. Acquisition processes will make use of the expertise of appropriate local experts in site selection and governance. Active management plans will include provisions for monitoring and evaluation, and	The quantum of offset that would be delivered is subject to the identification of suitable sites, biodiversity survey and assessment with reference to the BAM, preparation of a biodiversity management plan (or equivalent) and EPBC Act offset calculations. This measure may deliver: - up to 5% of the offset requirement for Cumberland Plain Woodland; - up to 5% of the offset requirement for the Grey-headed Flying-fox; - up to 5% of the offset requirement for Swift Parrot foraging habitat; and - up to 15% of the offset requirement for Pimelea spicata.	An advisory group will be established in the 2018/19 Financial Year, and it is expected that suitable parcels of land will be identified and secured within 3 years of the establishment of the advisory group.

Measure	Summary	Characteristics	Quantum of offset	Timing
		will be funded to deliver specific biodiversity outcomes.	This measure would also help meet the offset requirement for impacts on plants, animals and their habitats.	
Restoration and rewilding programs (Section 6.2.3)	Improve the extent, connectivity and condition of native vegetation and habitat in the Cumberland Plain on non-biodiversity stewardship sites.	Measures will be selected that have strategic or complementary benefits that help ensure conservation gains at least equivalent to other options for direct offsets. Sites chosen will have relevant ecological communities and species to meet offsetting requirements. Land tenure of sites will be closely considered to ensure long-term viability of restoration and revegetation. Sites of work will be strategically chosen to improve connectivity and conservation corridors. Long-term management objectives and funding sources must be built into any programs, along with ongoing monitoring and evaluation. Restoration and rewilding must be additional to the status quo. There will be a preference for programs that link with other measures such as Aboriginal land management, research and other on-ground conservation work.	The quantum of offset that would be delivered is subject to the identification of suitable sites and programs, biodiversity survey and assessment with reference to the BAM, preparation of a biodiversity management plan (or equivalent) and EPBC Act offset calculations. This measure may deliver: - around 5 to 10% of the offset requirement for Cumberland Plain Woodland; - around 5 to 15% of the offset requirement for the Grey-headed Flying-fox; - up to 15% of the offset requirement for Swift Parrot foraging habitat; and - up to 15% of the offset requirement for Pimelea spicata. This measure would also help meet the offset requirement for impacts on plants, animals and their habitats with a particular focus on securing targeted offsets for threatened biota not delivered by other measures.	Scoping and identifying restoration and rewilding programs will commence in the 2018/19 Financial Year, with programs expected to be delivered for up to 10 years.

Measure	Summary	Characteristics	Quantum of offset	Timing
Other compensatory measures			**Up to 10%**	
Threatened Flora Propagation Program (TFPP) (Section 7.2)	Propagation, research program and in situ collection of threatened plant species found at the airport site.	TFPP implemented in accordance with Condition 33 of the Airport Plan. Additional genetic research program targeting regional populations of *Pimelea spicata* and helping to address knowledge gaps identified in the recovery plan for the species (DEC 2005b). Maintenance of an ex situ potted collection of *Pimelea spicata* to support translocation of the airport site population and restoration programs.	The quantum of offset delivered will be calculated as a percentage offset contribution to the total requirement for *Pimelea spicata* using the 'Other compensatory ($)' section of the EPBC Act offsets assessment guide. Would also deliver biodiversity offsets for individual threatened plants, estimated by taking the percentage offset calculated using the offsets assessment guide and equating it to an equivalent percentage of the total species-credit requirement (calculated using the FBA) for *Pimelea spicata, Pultenaea parviflora,* and *Marsdenia viridiflora* subsp. *viridiflora*.	TFPP commenced in the 2016/17 Financial Year and will be completed in 2018/19. Genetic research program and maintenance of an ex situ population to commence in the 2018/19 Financial Year, with the research to complete in 2019/20 and the ex situ population to be maintained for a period of 5 years.
Greening Australia seed collection and production program (Section 7.3)	Secure ongoing collection of native seeds for the region	Native seed production implemented in accordance with Condition 32 of the Airport Plan. The Department has entered into an agreement with Greening Australia to contribute funds to the organisation's Cumberland Seed Hub program in Western Sydney. Delivers a reliable, species-rich and local provenance source of native seed for use in restoration activities. Research outcomes should inform future on-ground activities.	The quantum of offset delivered will be calculated as a percentage offset contribution to the total requirement for Cumberland Plain Woodland and *Pimelea spicata* using the 'Other compensatory ($)' section of the EPBC Act offsets assessment guide. Would also deliver biodiversity offsets for individual plants, animals and their habitats, estimated by taking the percentage offset calculated using the	Program commenced in the 2017/18 Financial Year and will run for 5 years and be completed in 2021/22.

Measure	Summary	Characteristics	Quantum of offset	Timing
			offsets assessment guide and equating it to an equivalent percentage of the total biodiversity credit requirement (calculated using the FBA) for the affected biota.	
Longer term research and capacity building, including training (Section 7.4)	Undertake research into effective restoration techniques for threatened ecological communities and species on the Cumberland Plain Provide capacity building and training, including Aboriginal land management, in on-ground conservation and ecological restoration activities.	Research should align with the Research Priorities in the Commonwealth Conservation Advice and Appendix 4 of the Cumberland Plain Recovery Plan. Research to have strong engagement with local projects and organisations and contribute to capacity building. Be complementary to on-ground works undertaken as part of the offsets package and contribute to ongoing monitoring, evaluation and adaptive management practices. Funding for training would not extend to those with existing obligations under BSAs.	The quantum of offset delivered will be calculated as a percentage offset contribution to the total requirement for affected threatened biota using the 'Other compensatory ($)' section of the EPBC Act offsets assessment guide. Also likely to deliver biodiversity offsets for individual plants, animals and their habitats, which would be estimated by taking the percentage offset calculated using the offsets assessment guide and equating it to an equivalent percentage of the total biodiversity credit requirement (calculated using the FBA) for the affected biota.	Scoping and identifying programs will commence in the 2018/19 Financial Year, with programs expected to be delivered for up to 10 years.
Complementary outcomes				
Aboriginal land management	Secure long-term training and employment opportunities in land management and restoration	To be based on partnerships and consultative co-design processes with leadership from local Aboriginal groups. Preference for approaches that make strong links to other offset	As a complementary outcome, would not contribute to the biodiversity offset requirement.	Timing would be the same as for the relevant land-based proposed offset measures Aboriginal land

Measure	Summary	Characteristics	Quantum of offset	Timing
	for Aboriginal peoples in Western Sydney.	measures included in the offset proposal. As a complementary outcome can be applied to any land-based proposed offset measures.		management is complementary to.

8.2 Implementation of the BODP

The Department will implement this BODP consistent with Condition 30(10) of the Airport Plan. The primary tasks involved with implementing the plan will be:

- securing of the Orchard Hills offset site under the MOU, preparation and independent verification of a comprehensive biodiversity assessment (arranged by the Department), and preparation and implementation of the Offset Plan by Defence
- continued implementation of the TFPP and Greening Australia seed collection and production program as other compensatory measures
- identification and implementation of additional, longer term direct offsets and other compensatory measures (in consultation with Environment and Energy) to deliver the total quantum of biodiversity offsets required by the BODP.

Under the *Public Governance, Performance and Accountability Act 2013* (Cth), the Department must ensure that the use of public resources, including expenditure for the purpose of biodiversity offsets, is efficient, effective, ethical and economical. To the extent the expenditure of money to obtain biodiversity offsets involves procurement, the Commonwealth Procurement Rules will apply to the process and in some cases the Commonwealth Grant Rules and Guidelines may be applicable.

Consistent with Airport Plan Condition 30(10), the Department will ensure that independent audits of the implementation of the BODP will be conducted in respect of the 12-month period following approval of the BODP, and each subsequent 18-month period until all biodiversity offsets required by the BODP have been secured or implemented. An audit report will be prepared at each of these prescribed milestones and will be submitted to Environment and Energy within six months of the conclusion of each implementation period.

In accordance with Airport Plan Condition 30(9), the Department will provide the Environment Department with GIS Shapefiles identifying the location and boundaries of each direct offset site within three months of legally securing and establishing management arrangements for the site, unless otherwise approved by an Approver.

8.2.1 Securing the Orchard Hills offset site

The Department proposes to enter into a MOU with Defence in relation to the conservation of a biodiversity offset area at Orchard Hills. The MOU would require Defence to prepare an Offset Plan for the offset area that is expected to run for up to 20 years.

The Offset Plan would be informed by a biodiversity assessment report prepared by a suitably qualified ecologist, based on ecological survey of the site. The Offset Plan would set out management actions to be performed at the site that would deliver an overall conservation outcome that improves or maintains the viability of the protected matters, consistent with the EPBC Act Offsets Policy. The plan would be prepared in consultation with the Department and Environment and Energy, and Defence would be required to put this plan in place within 18 months of the commencement date of the MOU.

Defence would review and update the Offset Plan every five years to ensure that it remains appropriate. An inspection of the offset site would be undertaken regularly to monitor the physical condition of fencing and gates, record of any substantive human disturbance and any evidence of erosion. There would be independent auditing of compliance, as well as annual reports containing the results of any monitoring, inspections, audits or other relevant actions required by the Offset Plan.

8.2.2 Implementation of existing offset measures

With regard to the Greening Australia seed collection and production program, the Department has entered into a contract with Greening Australia for these services, as required under Condition 32(1) of the Airport Plan. The contract details a scheme of annual reports, project plan updates and contractual milestones over the five years of the agreement. A first annual report was provided in October 2017, and an update to the Project Plan was provided in April 2018. The final report will be provided by August 2021.

In accordance with Condition 33 of the Airport Plan, ABGMA has been contracted, through the Department's consultant GHD, to undertake a TFPP, collecting seeds and completing propagation trials of threatened flora species at the airport site. Under this arrangement, the ABGMA prepared a Threatened Flora Propagation Plan, outlining objectives, timeframes and outputs. A project update report was delivered in May 2018.

For the second stage of the TFPP, ABGMA will complete a regional-scale genetic research project on *Pimelea spicata* and maintain an ex situ *Pimelea spicata* potted collection. For the research project, a program delivery report will be provided to the Department presenting the scope and methodology for the genetic study, results and key research findings. There is unlikely to be periodic reporting to the Department given the length of the project, which is anticipated to be less than 12 months, commencing in the 2018/19 Financial Year. The potted collection is expected to commence in in the 2018/19 Financial Year, depending on the delivery of the genetic research program and the suitability of seasonal conditions for cutting collection. Funding would be provided to maintain the collection for a period of five years.

8.2.3 Identification and implementation of additional offsets

Based on the preliminary calculations completed for this BODP, the offset measures described above would not be sufficient to offset all the biodiversity impacts of the Stage 1 development of the airport. Additional offset sites and other compensatory measures will be identified and implemented to address this shortfall.

A number of additional potential offset sites or direct restoration programs have already been considered in the preparation of this BODP but could not be formally included at this stage because insufficient information was available about biodiversity values, future ownership and management and/or arrangements with the Department to secure offsets. An overview of these longer term options for direct offsets is provided in Section 6.2.

The Department will consult with Environment and Energy as the process for implementing these additional offsets is developed.

Securing offsets through the NSW Biodiversity Offsets Scheme

Under the EPBC Act Offsets Policy, the use of market-based mechanisms for securing offsets is supported. With regard to the offsets required for the airport development, the relevant market-based mechanism is the Biodiversity Offsets Scheme operated by the NSW Government. Offsets are secured when a proponent purchases credits from a vendor and the proponent then applies to the Biodiversity Conservation Trust to have the credits retired on a voluntary basis. For a proportion of its required biodiversity offsets, the Department will enter into commercial arrangements to purchase credits from vendors through the NSW Scheme and then retire the credits to the Biodiversity Conservation Trust. Over the short term, this involves credits that are currently available or are to become available shortly.

Throughout the preparation of this BODP, a broad desktop assessment and consultation program was performed to identify potential direct offsets for the airport development. The Department has held initial discussions with some vendors of offset sites with relevant credits currently available and also where survey and assessment have not yet been completed and biodiversity credits have not yet been generated. Where credits have not yet been generated, the Department may enter into an options agreement with the vendor, whereby credits can be purchased and sold at a future date once they are available. Further identification of offsets and consultation will take place after approval of the BODP up until the full quantum of biodiversity offsets are implemented in accordance with the BODP.

Securing offsets through the acquisition of land

Implementation of the acquisition of land proposal will involve leveraging off an existing advisory group or the inception of a new advisory group, to identify potential conservation land and undertake preliminary investigations of parcels of land to determine suitability for the offset requirements of the airport development. The Department would consult with Environment and Energy in relation to the advisory group arrangements. The Department would provide the required funding for acquisition of the land and a conservation covenant would be placed over the land. The third party, potentially a local NGO, would be required to manage the land in perpetuity, consistent with the covenant, to achieve conservation outcomes. A binding agreement would include management actions to conserve and improve habitat and alleviate threats. Based on the approach adopted by the CCC Reference Group, the process of securing offsets is envisaged to take place over three years.

Securing offsets through restoration and rewilding programs

Restoration and rewilding programs would be selected, defined and funded during the longer term implementation of this BODP. Programs would be selected based on consideration of the Department's criteria for evaluation of potential biodiversity offsets as well as the criteria in the EPBC Act Offsets Policy. These would include a focus on restoring species, communities and their habitats that are equivalent to the affected protected matters relevant to the airport development.

The EPBC Act Offsets Policy provides that offset sites should be securely titled for conservation and that arrangements should be made to ensure funding of appropriate management actions. The Policy does identify that in some situations there may be difficulties in permanently securing a site for conservation purposes due to the existing tenure of the land. Such situations will be considered by Environment and Energy on a case-by-case basis. In a situation where the security of an offset is diminished, the risk to any protected matters, and subsequently the magnitude of offsets required, will increase.

Each restoration and rewilding program would be implemented under a biodiversity management plan (or equivalent) providing a description of the existing environment of the program site(s), proposed restoration activities, roles and responsibilities, costs and timing. The final quantum of offset delivered by these programs would be based on the condition of habitat and specific management actions proposed.

Longer term other compensatory measures

Longer term options for other compensatory measures have been discussed in Section 7.4. These include options for conservation, research, educational and training programs, including Aboriginal land management, 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. Key considerations, with reference to the EPBC Act Offsets Policy, will include that any other compensatory measures 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.

The Experts Group has identified a number of potential research, capacity building and training options that meet these criteria. The Department will continue to consult with government agencies and other relevant parties about suitable options. In accordance with Appendix A of the EPBC Act Offsets Policy, suitable research or education programs must be selected through an open tender process. Any research and education programs that form part of the offsets for the airport development will be implemented in accordance with the Policy. This includes the requirements for periodic reporting to the Department and Environment and Energy on progress and key findings, and that the research institution will publish findings in an internationally recognised peer-reviewed scientific journal or be of a standard that would be acceptable for publication in such a journal.

9 Conclusions

The Department has prepared this BODP to meet the requirements set out in Condition 30 of the Airport Plan. These requirements include that the BODP takes into account the biodiversity assessment and offset package in the airport EIS (GHD 2016a) and the *Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy October 2012* (EPBC Act Offsets Policy) (DSEWPaC 2012a). This BODP sets out an offsets proposal which compensates for the residual significant impacts associated with the Stage 1 Development of the Western Sydney Airport.

Biodiversity offsets are required for significant residual impacts of the Stage 1 Development on:

- threatened species and communities listed under the EPBC Act (affected threatened biota)
- plants, animals and their habitat, including threatened biota listed under the NSW BC Act.

The quantum of offsets for impacts on affected threatened biota has been calculated using the 'offsets assessment guide' spreadsheet in accordance with the EPBC Act Offsets Policy. The guide calculates the percentage of the total requirement for the individual protected matter that would be delivered by an offset proposal. Further to this, offsets for significant residual impacts on plants, animals and their habitat should be calculated with reference to the NSW FBA methodology. The FBA is based on the NSW Biodiversity Banking and Offsets Scheme (BioBanking) credit calculator and assessment methodology and was the methodology used to calculate offsets for major projects in NSW at the time that the airport EIS was prepared. Offset calculations have been based on a Stage 1 BAR (GHD 2017) and addendum report (GHD 2018) that include the results of a supplementary survey and assessment of the airport site and reflect recent changes to the Construction Impact Zone as a result of the development of the airport site layout. The Stage 1 BAR and addendum report have been independently verified in accordance with Condition 30(4)(c) of the Airport Plan.

This BODP sets out an offset proposal that would deliver a substantial proportion of the offsets required for the airport as direct offsets, prior to construction impacts occurring. The BODP also presents a strategy for confirming and implementing longer term offset measures to deliver the full quantum of biodiversity offsets required. At this stage of the planning and implementation of the BODP, the intent is to deliver a large majority of biodiversity offsets through conservation of suitable offset sites.

A large component of these direct offsets that would be implemented in accordance with this BODP are associated with the offset site at the Defence Establishment Orchard Hills (Orchard Hills). Notably the Orchard Hills offset site could deliver over 90% of the offset requirement for the critically endangered ecological community Cumberland Shale Plains Woodland and Shale-Gravel Transition Forest as direct offsets. The Orchard Hills offset site would be conserved and managed according to the terms of a proposed MOU between the Department and Defence. Arrangements will be put in place to establish the land area, characteristics to be protected and management measures to be implemented at the Orchard Hills offset site. These matters will help confirm the quantum of offset that will be delivered by the Orchard Hills offset site.

Additional direct offsets for the airport would be secured by purchasing and retiring biodiversity credits from BSA sites. As part of the development of this BODP, a variety of biodiversity restoration and management projects have been identified that would deliver substantial conservation outcomes but not all would be applied to a permanently secured offset site. These longer-term offset measures have been identified in consultation with the Experts Group and are collectively referred to as 'restoration and rewilding projects' and 'land acquisition'.

In addition to these direct offsets, a TFPP and a native seed production program will be implemented as other compensatory measures in accordance with the Airport Plan conditions and the EPBC Act Offsets Policy. Additional longer term research and capacity building programs, including training and Aboriginal land management, identified in consultation with the Experts Group, will be strategically implemented as part of this BODP where they can contribute to specific outcomes for affected threatened biota.

Due to a variety of factors, most notably the scale and nature of the biodiversity offsets required for the airport, it will not be possible to identify and secure all of the proposed biodiversity offsets as part of this BODP. The Department has identified several strategic offsetting opportunities, which would 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. This BODP sets out the approach and framework for the staged delivery of offsets. A staged approach will assist in resolving the challenges and realising the opportunities described above.

The Airport Plan conditions require that this BODP must be consistent with the EPBC Act Offsets Policy to the satisfaction of the Approver. Table 9.1 provides a summary of how this BODP meets each of the overarching principles included in the EPBC Act Offsets Policy that are applied in determining the suitability of offsets.

Table 9.1 Consistency with the EPBC Act offset principles

Offset principles (DSEWPaC 2012a)	Western Sydney Airport BODP
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 BODP has been developed in accordance with biodiversity offset assessment methodologies that have been developed by government agencies in order to ensure that offset measures would improve or maintain the viability of the affected protected matters. The conservation outcomes that would be delivered by this BODP are based on: the quantum of biodiversity offsets that would be delivered for the affected threatened biota listed under the EPBC Act as calculated with the offsets assessment guide; and the quantum of biodiversity offsets required for impacts on plants, animals and their habitat as calculated with reference to the FBA and using the credit calculator for a major project. The conservation outcomes delivered by offset measures would be confirmed through the implementation of this BODP using these offset assessment methodologies and approved by Environment and Energy. This will ensure that the final quantum of offset secured and implemented will improve or maintain the viability of the biodiversity values affected by the airport.

Offset principles (DSEWPaC 2012a)	Western Sydney Airport BODP
2. be built around direct offsets but may include other compensatory measures	The BODP is based on direct offsets for the protected matters affected by the proposal. Direct biodiversity offsets would be delivered through: conservation and management of the Orchard Hills offset site under an MOU between the Department and Defence; purchase of biodiversity credits through the NSW Biodiversity offset Scheme; acquisition of strategic parcels of land that promote connectivity for the Cumberland Plain Corridor to be managed in perpetuity by a third party; and certain restoration and rewilding programs that include direct management actions applied to specific areas of habitat, but which cannot be readily secured by registration of a conservation agreement on title to the sites. At this stage of the implementation of the BODP, it is intended that at least 90% of the offset requirement for each protected matter would be delivered as direct offsets. This BODP includes other compensatory measures that are required by the Airport Plan conditions: a TFPP for populations of threatened plants at the airport site; and the Greening Australia seed collection and production program to deliver a reliable, species-rich and local provenance source of native seed. The implementation of the BODP is also likely to include longer term research and capacity building measures as other compensatory measures.
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 2012a). 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 an offset site determine the multiplier that applies to credit calculations.

Offset principles (DSEWPaC 2012a)	Western Sydney Airport BODP
4. be of a size and scale proportionate to the residual impacts on the protected matter	This BODP 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. Residual impacts arising from construction of the airport have been calculated based on data presented in the Stage 1 BAR and addendum (GHD 2017, 2018), prepared and independently verified in accordance with the Airport Plan conditions. 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: 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 2012a). 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).

Offset principles (DSEWPaC 2012a)	Western Sydney Airport BODP
5. effectively account for and manage the risks of the offset not succeeding	The Orchard Hills offset site will be secured as a result of a number of factors including: • The site is located on Commonwealth-owned land. • The EPBC Act provides a comprehensive environment and planning framework for the site under the control of the Environment Minister. • The core offset area is contained within a Commonwealth Heritage Listed area that is subject to additional controls under Part 15 of the EPBC Act. • The obligations contained in the MOU are intended to be additional to the Commonwealth Heritage Listing requirements. Most other direct offsets will be secured by registration of a BSA on title to the sites. A BSA is the strongest conservation covenant available on private land in NSW and restricts subsequent land uses other than conservation unless the BSA is varied or terminated by the NSW Minister for the Environment to permit alternative uses. Certain mining rights may be granted over an offset site, and certain development can be carried out by public authorities on an offset 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 conservation agreement confers an obligation on the landowner to conserve and manage the biodiversity values of the offset site in order to ensure that the offsets would improve or maintain the viability of the affected protected matters. All direct offset mechanisms linked to offset sites in this BODP would include: • sufficient funds to perform the required management actions for the offset period; • preparation of an annual monitoring report to ensure compliance with the requirements of the agreement and the effectiveness of management actions; and • periodic inspections and auditing to ensure compliance. The security and the management and monitoring framework afforded by the relevant agreements would 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 Environment and Energy, as overseen by the Department. Any alternative offset contributions would include similar measures to mitigate the risks of the offset not succeeding. These would include measures as appropriate, such as alternative conservation covenants, monitoring and adaptive management frameworks or oversight by appropriate conservation bodies.

Offset principles (DSEWPaC 2012a)	Western Sydney Airport BODP
6. be additional to what is already required, determined by law or planning regulations or agreed to under 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 biodiversity offsets required under the Airport Plan conditions are the only legal requirement for biodiversity offsets in relation to the airport. The offset measures included in this BODP are not set aside as an offset for another development. The process of identifying offset sites, biodiversity credits or other longer term measures through the implementation of this BODP will include confirmation that any potential measures are additional to any other legal requirement and are not already set aside as an offset.
7. be efficient, effective, timely, transparent, scientifically robust and reasonable	As stated above, this BODP 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 BODP includes an approach to securing the majority of the offset requirement for protected matters affected by the proposal at the time of drafting. Biodiversity offsets would continue to be identified and secured according to the criteria and process outlined in this BODP. The BODP has been submitted and will require approval from the Environment Minister or an SES officer in Environment and Energy prior to the commencement of main construction works for the Stage 1 development of the airport. This means that a significant component of the 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.

Offset principles (DSEWPaC 2012a)	Western Sydney Airport BODP
8. have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced.	The majority of the offsets implemented in accordance with this BODP will be direct offsets associated with: the Orchard Hills offset site and the obligations in the MOU between the Department and Defence; and offset sites which already have, or will have, a BSA registered on title to the sites. These conservation agreements confer an obligation on the landowner to conserve and manage the biodiversity values of the offset site in order to ensure that the offsets would improve or maintain the viability of the affected protected matters. Each requires preparation of an annual monitoring report to ensure compliance with the requirements of the agreement and the effectiveness of management actions. BSAs also include periodic inspections by the NSW BCT to ensure compliance and enforcement measures up to and including compulsory acquisition of the site by the BCT. Any longer term direct offset measures would include similar measures to mitigate the risks of the offset not succeeding. These would include measures such as conservation covenants, monitoring and adaptive management frameworks or oversight by appropriate conservation bodies. This BODP includes other compensatory measures that are required by the Airport Plan conditions: a TFPP for populations of threatened plants at the airport site; and the Greening Australia seed collection and production program to deliver a reliable, species-rich and local provenance source of native seed. These measures are being delivered under contracts that include measures for monitoring and measuring performance against the objectives of the offset measure. The implementation of the BODP is also likely to include longer term research and capacity building measures as other compensatory measures. Each of these measures, when implemented would include prescribed governance arrangements and procedures for monitoring and reporting on program performance that will be developed in accordance with the requirements of Appendix 1 of the EPBC Act Offsets Policy.

In addition, the BODP is required to meet other requirements set out in the conditions in the Airport Plan. This BODP meets all of those requirements (refer to Table 1.1 in Section 1.5).

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Attachment A: Biodiversity Experts Group Members

Membership of the Biodiversity Experts Group comprised representatives from the following groups:

- NSW Office of Environment and Heritage
- Greater Sydney Local Land Services
- Blacktown City Council
- Camden Council
- Liverpool City Council
- Penrith City Council
- Deerubbin Local Aboriginal Land Council
- Gandangara Local Aboriginal Land Council
- Muru Mittigar Ltd
- Western Sydney University
- Greening Australia
- Cumberland Conservation Network
- Mulgoa Valley Landcare Group

Attachment B: Biodiversity Experts Group Terms of Reference

Background

The Department of Infrastructure and Regional Development and Cities (the Department) is responsible for delivering biodiversity offsets to compensate for the potential impacts on biodiversity values resulting from the airport and to conserve the biodiversity values of the Cumberland Plain and the broader Western Sydney region. A Biodiversity Experts Group, established by the Department, will provide technical advice in relation to the sourcing of offsets and other compensatory offset measures. Members of the Experts Group will have demonstrated experience and expertise in the field of ecology, with particular reference to biodiversity offsets, to assist in achieving favourable environmental outcomes, which improve or maintain the viability of biodiversity values to be offset.

Stage 1 of Western Sydney Airport will be constructed and operated in accordance with the Airport Plan which authorises the Stage 1 development in accordance with the *Airports Act 1996* (Cth). The Airport Plan for the Western Sydney Airport, determined by the Minister for Urban Infrastructure on 5 December 2016, contains a number of conditions to mitigate and manage the potential impacts on biodiversity associated with the project.

In accordance with Condition 31 of the Airport Plan, a Biodiversity Experts Group will be established to provide a coordinated approach to the Department's consultation with appropriately qualified and experienced community members and stakeholders in preparing a BODP. Further, the work of the Experts Group will also inform the Department's approach to wider community engagement activities relating to the delivery of the BODP. The delivery plan will be consistent with the Airport Plan, taking into account, among other factors, the Biodiversity Offset Package of Volume 4 of the airport EIS and the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) Environmental Offsets Policy (October 2012).

The BODP must be approved by either the Minister for the Environment and Energy or a Senior Executive Service (SES) Officer of Environment and Energy prior to the commencement of Main Construction Works for the airport. The BODP represents one of the preconditions to substantial physical works occurring on the airport site.

The airport EIS assessed that construction of the Stage 1 development of the airport would result in the removal of approximately 1,150 hectares of vegetation within the construction impact zone – the area directly impacted by the construction of the Stage 1 development. While the majority of the affected area is comprised of exotic species or cleared cropland, around 320 hectares of native vegetation may require clearing. The removal of vegetation at the airport site will result in the loss of fauna foraging, breeding, roosting, sheltering and/or dispersal habitat. In particular, the Stage 1 development is likely to have a significant impact on EPBC Act-listed biota, including the Cumberland Shale Plains Woodland and Shale-Gravel Transition Forest (Cumberland Plain Woodland), the Grey-headed Flying-fox and *Pimelea spicata*. *Pimelea spicata* was identified during the updated ecological survey work required by conditions of the Airport Plan. Offset measures in the BODP will also cover impacts to the foraging habitat of the Swift Parrot (as required by conditions of the Airport Plan), and other

features of the natural environment including plant populations, fauna populations and several species and communities, including those listed under NSW legislation.

Purpose of Terms of Reference

The purpose of these Terms of Reference is to establish the principal role and objectives of the Biodiversity Experts Group, and the intent for the group to work collaboratively on the development of a Biodiversity Offset Delivery Plan for the airport, to meet the Australian Government's requirements under the EPBC Act Offsets Policy and the Airport Plan.

Role of the Biodiversity Experts Group

The role of the Biodiversity Experts Group is to provide advice to the Infrastructure Department in relation to:

- the preparation and development by the Department (including its specialist service provider) of the BODP
- the identification and conservation outcome of securing direct biodiversity offsets for the BODP, including through supporting and facilitating consultation with local land owners and other relevant stakeholders
- the identification and conservation outcome of securing other compensatory offset measures for the BODP, including opportunities to provide funding to existing bush regeneration or revegetation programmes
- proposed direct offsets and other compensatory offset measures that are secured or implemented prior to approval of the BODP
- feedback received by members from the wider community on biodiversity offsets for Stage 1 of the airport development and consideration of this feedback in developing the BODP

Membership

As the agency responsible for establishing the Biodiversity Experts Group and convening meetings to consult with the Experts Group, the Department, in consultation with the Department of the Environment and Energy, will determine membership of the Experts Group. Membership will include:

- two representatives from the NSW Government Office of Environment and Heritage (OEH)
- one representative from the NSW Government Local Land Services (LLS) (reporting to the NSW Department of Primary Industries)
- four local government officers from local councils in the vicinity of the project and within the Cumberland Plain
- three representatives from local Aboriginal Land Councils and/or other local Aboriginal stakeholder groups in Western Sydney
- one academic or representative from a university, with expertise on biodiversity offsets and processes
- up to three representatives from other community or conservation groups

In addition, officers from the Department of Environment and Energy may attend meetings in an observer capacity.

Meetings

As the Convenor of the Experts Group, the Department will determine the times and venues for meetings. It is expected that the Experts Group will convene at least four times in the lead up to the Department's submission of a final BODP to the Department of Environment and Energy planned to occur by mid-2018. In addition, out-of-session consultation will also occur on an as needs basis between the Department (including its specialist provider) and the Experts Group on the identification and securing of offsets and other related matters.

Where organisations have nominated a person to be a member of the Experts Group and that person is unable to attend a particular meeting, the organisation is encouraged to arrange for, and have approved by the Department, a substitute to attend in their place. This provision is for when infrequent and unexpected situations arise, and should only be used in those circumstances, to ensure continuity of attendance by the organisation.

Notices and agendas for meetings will be distributed so that they reach members not less than five days prior to the scheduled date for each meeting. Records of meetings will be kept and distributed by the Department to members not less than fourteen days after each meeting.

Role of the Department

The role of the Department in the Biodiversity Experts group is to:

- convene and chair all meetings of the group to ensure that adequate discussion time is devoted to issues of significance and that unanticipated items of business can be discussed
- support a frank and respectful exchange of views
- seek the input of all members as to agenda items
- approve meeting agendas prior to distribution
- provide for follow-up of action items
- consider the advice of the Experts Group in the planning and development of the BODP and ensure that the advice is incorporated into the final BODP, and
- facilitate communication between the Experts Group and the Biodiversity consultants to the Department, as appropriate.

Role of members

The role of members of the Experts Group is to:

- provide advice, which will be incorporated by the Department into the preparation and development of the BODP
- provide advice in relation to identifying and securing direct biodiversity offsets and other compensatory offset measures for the BODP, which aims to increase the connectivity of habitat for threatened species and improve or maintain the viability of biodiversity values to be offset
- objectively participate in discussion of agenda items at Experts Group meetings
- identify and raise other potential issues that are relevant to the work and objectives of the Experts Group
- treat sensitive information that is shared as part of the airport development appropriately, and

- disclose and update to the Department any interests in relation to any site or offset being considered by the Experts Group, as a member of the public or as a representative of an organisation provided with membership on the Experts Group. Any interests disclosed will be recorded on a Biodiversity Experts Group Register of Interests.

Note: The Biodiversity Experts Group Register of Interests will only be used by the Department and its advisers for the purposes of the conduct of the Experts Group, for considering any advice provided by members and to inform preparation and implementation of the BODP.

Expenses

- The Department will meet the cost of meeting expenses, including venue costs and catering.

Media, Communication and Reporting

- The Department is responsible for all communications activities, including media releases and public comment.
- The Department will provide updates to the public on the progress of the Experts Group and the delivery of Stage 1 biodiversity offsets through a website.