

16. Biodiversity

The airport site comprises gently undulating, low hills on shale and broad flats on alluvium on the Cumberland Plain. It features remnant patches of grassy woodland and narrow corridors of riparian forest within extensive areas of derived grassland, cropland, and cleared and developed land. The condition of native vegetation at the airport site is generally poor and there is moderate to severe weed infestation throughout the site. The main land uses are agriculture and low density rural residential development. Notwithstanding the generally poor condition of the site it has high conservation significance as a result of the presence of threatened species and ecological communities and the generally limited extent and quality of similar environments in the Western Sydney region.

Construction of the Stage 1 development would result in the removal of approximately 1,065 hectares of vegetation. The majority of this vegetation consists of exotic grassland and cleared land or cropland dominated by exotic species and noxious and environmental weeds. About 280.8 hectares of native vegetation would be removed. The removal of vegetation at the airport site would result in the loss of fauna foraging, breeding, roosting, sheltering and/or dispersal habitat. Construction of the Stage 1 development would also result in indirect impacts on terrestrial and aquatic flora and fauna, including impacts associated with increased fragmentation, altered hydrology, erosion and sedimentation, dust, light, noise and vibration. Indirect impacts may also include fauna displacement, injury and mortality.

Operation of the proposed Western Sydney Airport (the proposed airport) would involve an increased risk of fauna strike from contact with aircraft and ground transportation vehicles. Indirect impacts may include those associated with light, noise and vibration and the introduction of exotic species.

The Stage 1 development would affect threatened species, populations and ecological communities listed under both the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) and the *Threatened Species Conservation Act 1995* (NSW) (TSC Act). Assessments of significance have been prepared for matters of national environmental significance protected under the EPBC Act in accordance with significant impact guidelines prescribed by the EPBC Act. The outcome of these assessments is that the Stage 1 development is likely to have a significant impact on Cumberland Plain Woodland, the Grey-headed Flying-fox and other plants and animals (including a number of species and populations listed as threatened under the TSC Act) in an area of Commonwealth land.

Mitigation and management measures would be implemented to reduce the potential impacts on biodiversity. These measures would include: staged vegetation removal during construction, pre-clearing surveys and plans for the salvage of fauna and habitat resources, translocation programmes for threatened flora and fauna species/populations, and designing the airport to minimise its attractiveness to fauna in order to minimise bird, bat and terrestrial fauna strike. In addition, an environmental conservation zone would be established along the southern perimeter of the airport site where approximately 122 hectares of land would be protected.

Biodiversity offsets are required to compensate for significant residual impacts arising from the proposed airport. An offset package has been prepared to compensate for the removal of approximately 90.8 hectares of Cumberland Plain Woodland, the removal of about 120.6 hectares of foraging habitat for the Grey-headed Flying-fox, and on features of the natural environment including plant populations, fauna populations and several species and communities listed under NSW legislation. The offset package is intended to conserve habitat for the affected threatened biota in suitable offset sites in the surrounding region in perpetuity.

16.1. Introduction

This chapter provides a review of the biodiversity values that may be potentially affected by the development of the proposed Western Sydney Airport (proposed airport). This chapter draws on a comprehensive terrestrial and aquatic ecological impact assessment, which is included as Appendix K1 in Volume 4 and on the offset strategy, which is included as Appendix K2 in Volume 4. The assessment describes terrestrial and aquatic flora and fauna, their habitats at the airport site and the presence and likelihood of occurrence of threatened and migratory species, populations and ecological communities. The potential impacts of the Stage 1 development on terrestrial and aquatic ecology are assessed and mitigation and management measures are identified to reduce potential impacts.

The assessment has been prepared in consultation with the Australian Government Department of the Environment (DoE) and has been carried out in accordance with the *Guidelines for the Content of a Draft Environmental Impact Statement – Western Sydney Airport* (EIS guidelines) for Western Sydney Airport.

16.2. Methodology

The terrestrial and aquatic ecological assessment included a review of databases and relevant literature, field surveys and vegetation and habitat mapping. Impact calculations and an assessment of the significance of impacts were undertaken to determine the effect of the proposed airport on terrestrial and aquatic flora and fauna.

16.2.1. Database and literature review

A desktop assessment was undertaken to identify Commonwealth and State-listed threatened and migratory species, populations and ecological communities that may be affected by the construction and operation of the proposed airport. Relevant biodiversity databases pertaining to the airport site and locality (defined as a 10 kilometre radius from the centre point of the airport site) were reviewed. The database searches included:

- DoE Protected Matters Search Tool – for matters of national environmental significance (MNES) listed under the EPBC Act that have been recorded in the locality (DoE 2015b);
- NSW Office of Environment and Heritage (OEH) BioNet (Atlas of NSW Wildlife) – for records of threatened species, populations and endangered ecological communities listed under the TSC Act that have been recorded within the locality (OEH 2015a); and
- NSW Department of Primary Industries (DPI) Fishing and Aquaculture Threatened and Protected Species Records Viewer – for records of threatened aquatic species listed under the EPBC Act and the Fisheries Management Act 1994 (NSW) (FM Act) that have been recorded within the locality (DPI 2015).

Additional databases that were reviewed to inform the terrestrial and aquatic ecological assessment are listed in Appendix K1 in Volume 4.

The results of previous ecological assessments and scientific publications were reviewed to determine the likely presence of terrestrial flora and fauna species and their habitats at the airport site. These included surveys conducted by Biosis Research for the *1997–1999 Second Sydney Airport Proposal Environmental Impact Statement* (1997–99 EIS) (PPK 1997) and the recent baseline surveys carried out for the referral (SMEC 2014). A list of the literature that was reviewed is provided in Appendix K1 in Volume 4.

The introduction of the EPBC Act following the completion of the 1997–99 EIS (PPK 1997) has provided a revised legislative framework with increased emphasis on biodiversity protection and consideration of offset requirements. The legislative description of threatened species has also broadened substantially at both the Commonwealth and State levels since 1999, reducing the currency of previous investigations.

16.2.2. Likelihood of occurrence

Following the collation of database records, species and community profiles, and the results of previous ecological assessments at the airport site and within the locality, a ‘likelihood of occurrence’ assessment was prepared with reference to the habitats contained at the airport site. This was further refined following field surveys and the identification and assessment of the habitats present.

16.2.3. Terrestrial flora surveys

Terrestrial flora surveys were undertaken between February and May 2015 and consisted of vegetation mapping and validation (via plot/transect surveys) and targeted threatened flora species searches. A summary of the survey effort is provided in Table 16–1. The locations of plot/transect surveys are shown on Figure 3 in Appendix K1 in Volume 4.

The surveys were designed with reference to the *BioBanking Assessment Methodology (BBAM) and Credit calculator operational manual* (DECC 2009b) and the *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* (Working Draft) (DEC 2004b), as appropriate. The terrestrial flora field surveys were undertaken across a number of seasons and varying weather conditions. Weather conditions (minimum and maximum temperatures and total rainfall) during the survey period are presented in Appendix K1 in Volume 4.

Table 16–1 – Survey effort (terrestrial flora surveys)

Survey method	Survey effort	Approximate field person hours
Vegetation mapping, plot/transect surveys	43 plot/transects	86
Targeted threatened flora surveys	18 days	360
Wetland assessments	Seven sites	7

16.2.3.1. Vegetation surveys and mapping

A high-level vegetation assessment and map was prepared by SMEC (2014) based on the regional mapping included in *Native Vegetation Maps of the Cumberland Plain, Western Sydney* (NPWS 2006). This vegetation mapping was ground-truthed in the field through driven and walked transects across the entire airport site and by walking the boundary of vegetation units, where possible.

Vegetation types were classified according to vegetation structure, species composition, soil type and landscape position. Terrestrial vegetation types were further split into broad condition classes to yield vegetation zones as follows:

- 'high condition', comprising moderate/good – high or moderate/good – medium condition vegetation which featured overstorey and midstorey vegetation at benchmark levels for the equivalent vegetation type (that is, woodland or forest structure);
- 'poor condition', comprising moderate/good – poor condition vegetation which featured overstorey and midstorey vegetation cover substantially below benchmark levels for the equivalent vegetation type, but greater than 50 per cent of the groundcover present was native species (that is, derived native grassland, shrubland or scrub structure);
- 'exotic grassland', comprising low or cleared condition vegetation which was dominated by perennial plant species and featured overstorey and midstorey vegetation cover substantially below benchmark levels for the expected native vegetation type, and less than 50 per cent of the groundcover present was native species (that is, exotic grassland, shrubland or scrub structure); and
- 'cleared land and cropland', comprising low or cleared condition vegetation which was dominated by annual plant species, bare earth or infrastructure and featured overstorey and midstorey vegetation cover substantially below benchmark levels for the expected native vegetation type, and less than 50 per cent of the groundcover present was native species or greater than 90 per cent of the ground surface was bare earth or infrastructure.

Wetlands were mapped as a native vegetation zone if they contained greater than 10 per cent cover of native plant species and/or habitat features such as standing dead trees, shallow marginal water or mudflats. Waterbodies that were free of native plants or habitat features (such as steep sided clay lined dams, concrete lined dams or flooded quarry pits) were included in the mapped area of 'cleared land and cropland'. Some smaller wetlands were also included in the mapped areas of woodland, forest or grassland if they could not be accurately separated and defined on an aerial photo.

16.2.3.2. Plot/transect surveys

Plot/transect surveys were conducted to confirm vegetation types and assess the condition of the airport site. The surveys were conducted in accordance with BBAM. Data recorded within each plot/transect generally included all vascular plant species present, cover abundance of each species, cover of each structural layer (canopy, midstorey, groundcover), weed abundance, presence of tree hollows, size classification length of fallen logs and a soil classification (colour and texture).

Plots were used to sample potential vegetation zones (that is, plant community types and broad condition classes) based on the initial site stratification. Forty-three plots were sampled within the airport site, as shown on Figure 3 in Appendix K1 in Volume 4.

16.2.3.3. Targeted threatened flora surveys

Targeted threatened flora surveys were undertaken for those species known or likely to occur at the airport site based on previous records (as found in the database and literature review) and the presence of suitable habitat. Areas of suitable habitat (that is, areas of near-intact native vegetation and with natural topsoil) were systematically traversed on foot and inspected for threatened plants.

16.2.3.4. Wetland assessments

Wetland vegetation was sampled by walking the margins of waterbodies and noting dominant plant species and percentage cover in each vegetation strata present (that is, trees, shrubs, emergent, aquatic and fringing plants). Wetlands were defined based on observed vegetation structure, species composition and whether they were natural or artificial, as inferred from geomorphic position and the presence of features such as dam walls. No natural freshwater wetlands were observed at the airport site. Artificial wetlands were matched to the closest equivalent native vegetation type.

16.2.4. Terrestrial fauna surveys

Terrestrial fauna surveys were undertaken between February and June 2015 and consisted of detailed habitat assessments and targeted fauna searches. A summary of the survey effort is provided in Table 16–2. The locations of the fauna surveys are shown on Figure 3 in Appendix K1 in Volume 4.

The fauna surveys were designed with reference to the guidelines administered by the DoE and OEH. A list of the relevant survey guidelines is provided in Appendix K1 in Volume 4.

Table 16–2 – Survey effort (terrestrial fauna surveys)

Survey method	Survey effort	Approximate field person hours
Habitat assessment	18 days	360
Early morning bird surveys	10 days	20
Microchiropteran bat surveys (Anabat)	11 nights	162.5
Frog surveys	Four afternoons and nights	80
Spotlighting (birds and mammals)	Eight nights	30
Call playback (owls)	Nine nights	11.25
Infrared cameras	Eight weeks	n/a
Cumberland Plain Land Snail searches	11 days	25
Koala scat searches	11 days	25
Opportunistic observations	18 days	360
Winter bird surveys	Two days	32

16.2.4.1. Fauna habitat assessments

Habitat assessments were conducted to describe the variety of native fauna likely to occur at the airport site. Particular attention was paid to habitat features and resources considered important for threatened species, including identification and assessment of:

- vegetation patch size, connectivity, age, disturbance and floristic and structural diversity, which is important for determining habitat suitability for many threatened birds and mammals;
- quality of substrate (including rocks, logs, peeling bark, leaf litter and native grassland) that provides foraging habitat and shelter for invertebrates, frogs, reptiles and ground-foraging birds;
- presence of feed trees important for threatened birds and mammals;
- hollow-bearing trees and logs which provide refuge, nest and den sites for a range of threatened fauna species;
- stags and other roost sites for raptors and owls; and
- wetlands, watercourses and moist grassland and other foraging or breeding habitat for waterbirds (including migratory birds), frogs, reptiles and mammals.

Evidence of animal presence was noted during the field surveys, including specific searches for mammal scats, tracks, nest/den sites, scratch marks on tree trunks, worn bark around tree hollows and animal remains.

Mapping of hollow-bearing trees was undertaken in areas within the airport site to provide an indication of the distribution and number of hollow-bearing trees, as well as sizes of hollows that would be removed by the construction of the proposed airport. Data collected included tree species, height, diameter at breast height, and number, size and location of hollows.

16.2.4.2. Targeted fauna searches

The targeted fauna searches undertaken at the airport site are summarised below with further detail provided in Appendix K1 in Volume 4. Threatened fauna surveys were undertaken for those species known or likely to occur at the airport site based on previous records (as found in the database and literature review) and the presence of suitable habitat.

Bird surveys comprised:

- diurnal surveys, which were performed in the early morning at the airport site. The surveys comprised area searches targeting larger woodland patches and wetland areas. Species were identified by sight and call. Threatened species targeted during these surveys included the Swift Parrot (*Lathamus discolor*) and Gang-gang Cockatoo (*Callocephalon fimbriatum*);
- wetlands (farm dams) surveys, which were observed during the early morning bird surveys as well as during general fauna surveys throughout the day; and
- slow driven transects, which were conducted to target Swift Parrots and Gang-gang Cockatoos. This method combined with targeted area searches ensured as much of the airport site was covered as possible.

Surveys for microchiropteran bats involved echolocation call recordings using Anabat units. Anabats were placed within the airport site and recordings were undertaken from dusk until the following morning. Calls were then analysed using specialised software (AnalogW, Version 3.8v).

Frog surveys comprised targeted and rapid surveys. Targeted surveys included both diurnal searches (searches for basking frogs and call playback) and nocturnal searches (spotlighting and call playback) in areas of suitable habitat. Rapid surveys included call playback and vocalisations broadcast at each rapid survey site. Species targeted during the frog surveys included the Green and Golden Bell Frog (*Litoria aurea*). The Green and Golden Bell Frog population at Homebush was used as a reference population for the survey to determine the level of frog activity and confirm that conditions were likely to be suitable for the detection of the targeted species.

Nocturnal bird and mammal surveys comprised call playback surveys and spotlighting surveys. The call playback surveys targeted threatened owl species in woodland areas and the spotlighting surveys targeted nocturnal birds and mammals along road reserves and in larger woodland areas. Species targeted during the nocturnal bird surveys included the Barking Owl (*Ninox connivens*), Powerful Owl (*Ninox strenua*) and Masked Owl (*Tyto novaehollandiae*).

Infrared cameras were placed in survey locations in woodland or near dams to target cryptic species. Cameras were baited and set for a minimum of three weeks. Cameras were set to take three pictures over one minute when triggered by movement, with at least five minutes between each set of photographs.

Searches for the Cumberland Plain Land Snail (*Meridolum corneovirens*) were carried out in larger patches of vegetation and along road reserves. Active searches in woodland patches were conducted in leaf litter at the base of trees and under rubbish and logs for between 30 minutes to an hour. Live snails were photographed and empty shells were collected for identification.

Koala scat searches focused on Forest Red Gum (*Eucalyptus tereticornis*), a primary feed tree for the Sydney area, and Grey Box (*Eucalyptus moluccana*), a secondary feed tree for the Sydney area (DECC 2008a). Searches were conducted in woodland patches for between 30 minutes to an hour, depending on the size of the patch.

Opportunistic and incidental observations of fauna species were recorded at all times during the field surveys. Scats, burrows and diggings were noted and mature trees were scanned for roosting birds.

16.2.5. Aquatic flora and fauna surveys

Aquatic flora and fauna surveys were undertaken in March and May 2015 and consisted of habitat assessments, water quality assessments, macroinvertebrate sampling and analysis, and fish surveys. The surveys were undertaken by two people over five days. The aquatic ecology surveys sampled stream and wetland (artificial dam) habitats within the airport site as well as upstream and downstream of the site (15 sites in total). The location of the survey sites are shown on Figure 3 in Appendix K1 in Volume 4.

16.2.5.1. Aquatic habitat assessment

An assessment of the in-stream physical habitat was conducted at all sites in accordance with the NSW Australian River Assessment System (AUSRIVAS) (Turak and Waddell 2002). This included detailed assessments of the substrata and water channels, hydraulic habitat features, and their suitability for threatened flora and fauna identified in the database searches and literature review.

16.2.5.2. Water quality assessment

Water quality parameters were measured at each survey site including temperature; electrical conductivity; dissolved oxygen; pH; turbidity; alkalinity; metals; nutrients; benzene, toluene, ethylbenzene, and xylenes (BTEX); additional hydrocarbons and other constituents. Water quality was compared to the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC/ARMCANZ 2000) and water pollution thresholds contained within the Airports (Environment Protection) Regulations 1997 (Cth).

16.2.5.3. Macroinvertebrate sampling and analysis

Macroinvertebrates were collected using mesh nets from edge, pool and riffle habitats at the survey sites. Macroinvertebrate samples were live-sorted in the field (for a minimum of 40 minutes and maximum of 60 minutes). Macroinvertebrates were then preserved and transferred to a laboratory for identification. The results were used to assess the biological condition or impairment at each survey site. Impairment was calculated using both AUSRIVAS Observed to Expected Ratio (O/E50) and Stream Invertebrate Grade Number – Average Level (SIGNAL 2) scores (defined in Appendix K1 in Volume 4). Other biological metrics used as descriptors of the surveys sites were taxa richness, Ephemeroptera-Plecoptera-Trichoptera richness and the community composition at each survey site.

16.2.5.4. Fish surveys

Fish were surveyed at each survey site using bait traps and/or fyke nets. Fish were identified and counted. Native species were released and non-native species were euthanised in accordance with ethics permit requirements. The sensitivity of key fish habitats and the functionality of waterways at the airport site were classified according to the *Policy and Guidelines for Fish Habitat Conservation and Management* (DPI 2013). Aquatic habitats were also compared with the habitat requirements of threatened aquatic fauna known to occur in the region according to the DPI threatened species profiles (DPI 2015).

16.2.6. Impact calculations

Direct impacts on terrestrial and aquatic flora and fauna (the removal of vegetation and habitat loss) were quantified to determine the potential impacts of the airport and the necessity of biodiversity offsets. The amount of each vegetation zone and fauna habitat type directly affected by the project was recorded in a geographic information system.

16.2.7. Assessment of significance of impacts

Assessments of significance were prepared for one endangered ecological community, six flora species and two fauna species listed under the EPBC Act and for the Greater Blue Mountains World Heritage Area in accordance with the *Significant Impact Guidelines 1.1 – Matters of National Environmental Significance* (DoE 2013a). An assessment of significance was also prepared for impacts on Commonwealth Land in accordance with the *Significant Impact Guidelines 1.2 – Actions on, or Impacting upon, Commonwealth Land and Actions by Commonwealth Agencies* (DoE 2013b).

16.2.8. Offsetting impacts

Biodiversity offsets to compensate for significant residual impacts on threatened species and communities listed under the EPBC Act were calculated using the offsets assessment guide under the EPBC Act *Environmental Offsets Policy* (DSEWPC 2012). Biodiversity offsets to compensate for significant residual impacts on the natural environment on Commonwealth land, including threatened species and communities listed under the TSC Act, were calculated with the *BioBanking Assessment Methodology and Credit Calculator Operational Manual 2014* (DECC 2009b) and the *Framework for Biodiversity Assessment* (OEH 2014b). Further detail regarding the methodology for offsetting impacts is provided in Appendix K2 in Volume 4.

16.3. Existing environment


This section describes the physical environment of the airport site and the existing terrestrial and aquatic flora, fauna and fauna habitat at the airport site. Threatened and migratory species, populations and endangered ecological communities known or predicted to occur within the airport site, along with their conservation status, are described.

16.3.1. Physical environment

The airport site is part of an elevated ridge system dividing the Nepean River and South Creek catchments on the Cumberland Plain. The site is characterised by rolling landscapes typical of Bringelly Shale with a prominent ridge in the west of the site, reaching an elevation of about 120 metres Australian Height Datum (AHD), and smaller ridge lines in the vicinity with elevations of about 100 metres AHD. The topography of the airport site generally slopes away from the ridges in the west, with elevations between 40 and 90 metres AHD.

The airport site features remnant patches of grassy woodland and narrow corridors of riparian forest within extensive areas of derived grassland, cropland, and cleared and developed land. The main land uses are agriculture and low density rural residential development.

The airport site is contained within the 'Cumberland Plain' Mitchell Landscape (DECC 2008b). This landscape is noted to be approximately 30 to 120 metres above sea level, and comprises low rolling hills and valleys in a rain shadow area between the Blue Mountains and the coast, with vegetation characterised by grassy woodlands and open forests dominated by Grey Box and Forest Red Gum, and poorly drained valley floors with forests of Cabbage Gum (*Eucalyptus amplifolia*) and Swamp Oak (*Casuarina glauca*) (DECC 2008b).



The airport site is within the catchment of South Creek which generally flows northward into the Hawkesbury River. Badgerys Creek flows along the southern and eastern boundary of the airport site and drains into South Creek. Oaky Creek originates in the centre of the site and flows northwards and then also drains into South Creek. There are a large number of small first and second order drainage lines across the site, many of which have been dammed and heavily modified resulting in isolated freshwater wetlands. These wetlands support varying degrees of in stream and riparian vegetation.

Several vegetation communities that occur at the airport site are 'high probability groundwater dependent ecosystems' (SMEC 2014).

The geology of the landscape consists of Triassic shales and lithic sandstones, with a small number of volcanic vent intrusions. Tertiary river gravels and sands partially cover much of the landscape, in addition to Quaternary alluvium along the main watercourses. The soils consist of red and brown texture-contrast soils on crests, grading to yellow harsh texture-contrast soils in valleys (DECC 2008c).

16.3.2. Terrestrial flora

16.3.2.1. Flora species

A total of 280 terrestrial plant species (of which 202 were native and 78 species were exotic) from 72 families were recorded at the airport site. A list of plant species recorded at the airport site is provided in Appendix K1 in Volume 4.

Due to the existence of residential gardens and cropland, the airport site is expected to contain a considerably greater diversity of exotic plant species than are listed in Appendix K1 in Volume 4. These areas were not a focus of the terrestrial and aquatic ecological impact assessment, beyond visual inspection to confirm that they did not contain native vegetation communities. There was no formal sampling of the plant species in these areas.

The majority of the native vegetation at the airport site has been previously cleared, grazed or otherwise modified and is in moderate or poor condition. One threatened plant species and one endangered population was recorded at the airport site and these are discussed in further detail below.

16.3.2.2. Weeds of national significance and noxious weeds

Of the 78 exotic species recorded at the airport site, nine are listed as weeds of national significance by the Australian Weeds Strategy (AWS 2015). Eight of the nine weeds of national significance recorded at the airport site are also listed as noxious weeds under the Noxious Weeds Act 1993 (NSW) for the Liverpool Local Government Area. An additional seven noxious weeds were recorded at the airport site. These weeds are listed in Table 16–3.

As discussed above, the airport site is likely to contain additional exotic plant species to those revealed by the field surveys. The list below should be considered a guide to the most serious and widespread of the weeds at the airport site.

Weeds of national significance and noxious weeds are present across the majority of the airport site. Particularly severe or extensive infestations include:

- Madeira Vine (*Anreadeira cordifolia*), Bridal Creeper (*Asparagus asparagoides*), Lantana (*Lantana camara*), African Olive (*Olea europa* subsp. *cuspidata*) and privet species in the riparian corridor of Badgerys Creek;
- African Olive and privet species in the riparian corridors of small drainage lines in the site's west;
- Alligator Weed (*Alternanthera philoxeroides*) in dammed sections of Oaky Creek and the adjoining floodplain in the site's north; and
- African Boxthorn (*Lycium ferocissimum*), African Olive, Common Prickly Pear (*Opuntia stricta*) and Blackberry (*Rubus fruticosus* species *aggregate*) on the margins of commercial farms in the centre of the airport site and on rural residential lots in the suburb of Badgerys Creek.

Weeds at the airport site would be managed in accordance with the mitigation measures listed in Section 16.7.2.

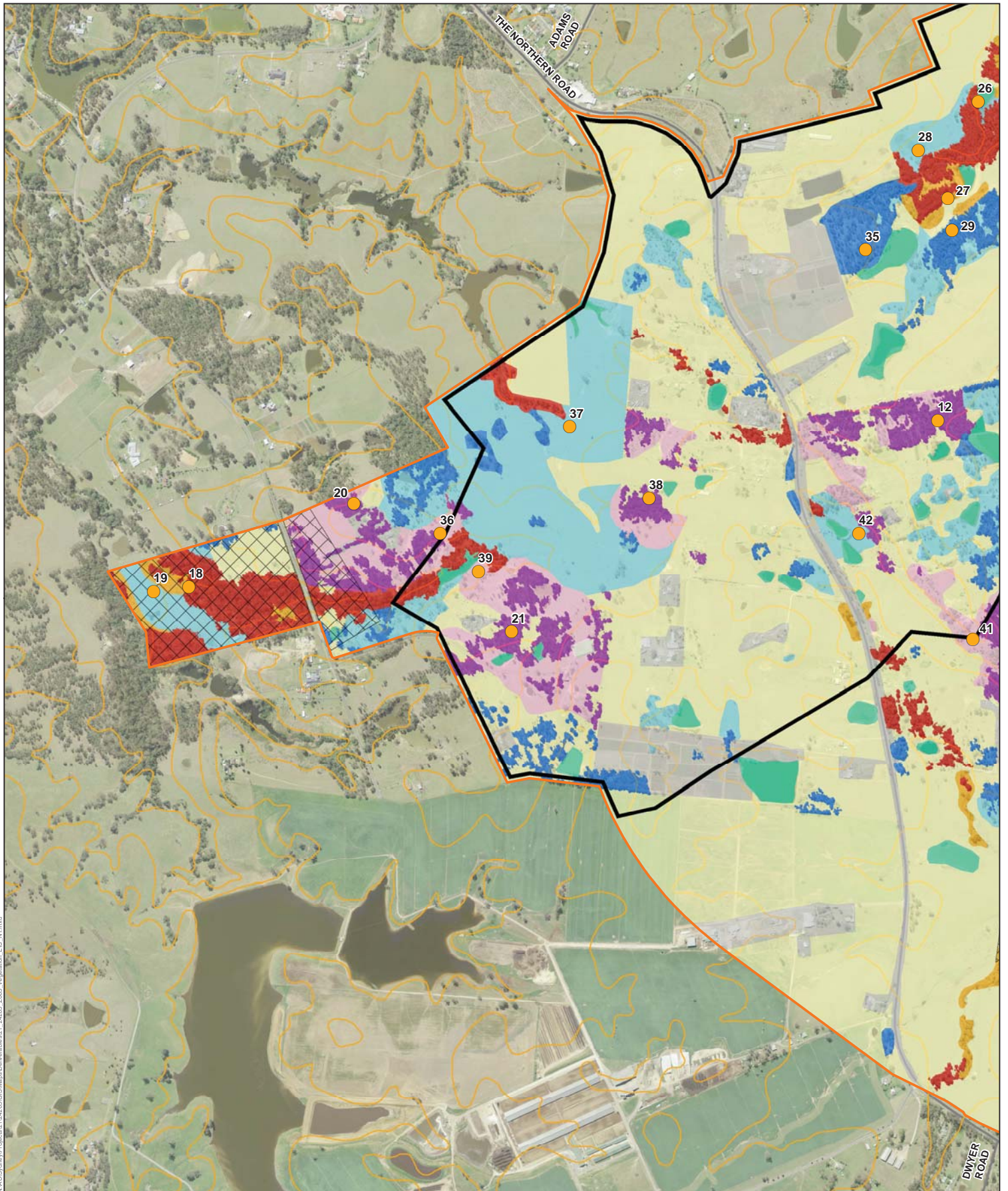
Table 16–3 – Weeds of national significance and noxious weeds recorded at the airport site

Scientific name	Common name	Weeds of national significance	Noxious weeds
<i>Alternanthera philoxeroides</i>	Alligator Weed	✓	✓
<i>Anreadeira cordifolia</i>	Madeira Vine	✓	x
<i>Asparagus asparagoides</i>	Bridal Creeper	✓	✓
<i>Bryophyllum species</i>	Mother of Millions	x	✓
<i>Cestrum parqui</i>	Green Cestrum	x	✓
<i>Cortaderia selloana</i>	Pampas Grass	x	✓
<i>Lantana camara</i>	Lantana	✓	✓
<i>Ligustrum lucidum</i>	Small-leaved Privet	x	✓
<i>Ligustrum sinense</i>	Broad-leaved Privet	x	✓
<i>Lycium ferocissimum</i>	African Boxthorn	✓	✓
<i>Olea europa</i> subsp. <i>cuspidata</i>	African Olive	x	✓
<i>Opuntia stricta</i>	Common Prickly Pear	✓	✓
<i>Ricinus communis</i>	Castor Oil Plant	x	✓
<i>Rubus fruticosus</i> species <i>aggregate</i>	Blackberry	✓	✓
<i>Salvinia molesta</i>	Salvinia	✓	✓
<i>Senecio madagascariensis</i>	Fireweed	✓	✓



16.3.2.3. Vegetation zones

Field surveys confirmed the presence and distribution of five native and two non-native plant community types at the airport site. Stands of these plant community types include a variety of disturbance levels including near-intact vegetation in 'moderate/good – high' condition, partially cleared or regrowth vegetation in 'moderate/good – poor' condition and extensively modified areas in 'cleared' condition. Accordingly, nine native and two non-native vegetation zones (plant community types and broad condition classes) were identified and mapped within the airport site, as shown in Figure 16–1. The attributes of these vegetation zones are summarised in Table 16–4 with further detail provided in Appendix K1 in Volume 4.



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<p>LEGEND</p> <ul style="list-style-type: none"> Airport site Stage 1 construction impact zone Environmental conservation Contour Roads Plot/transect Good condition Grey Box - Forest Red Gum grassy woodland on flats (HN528) Good condition Grey Box - Forest Red Gum grassy woodland on hills (HN529) Poor condition Grey Box - Forest Red Gum grassy woodland on hills (HN529) 	<ul style="list-style-type: none"> Poor condition Grey Box - Forest Red Gum grassy woodland on flats (HN528) Good condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526) Poor condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526) Good condition Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest (HN512) Poor condition Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest (HN512) 	<ul style="list-style-type: none"> Poor condition Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest (HN512) Good condition artificial freshwater wetland (HN630) Exotic grassland Cleared land or cropland
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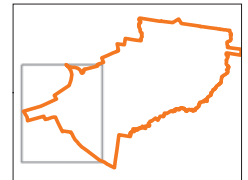
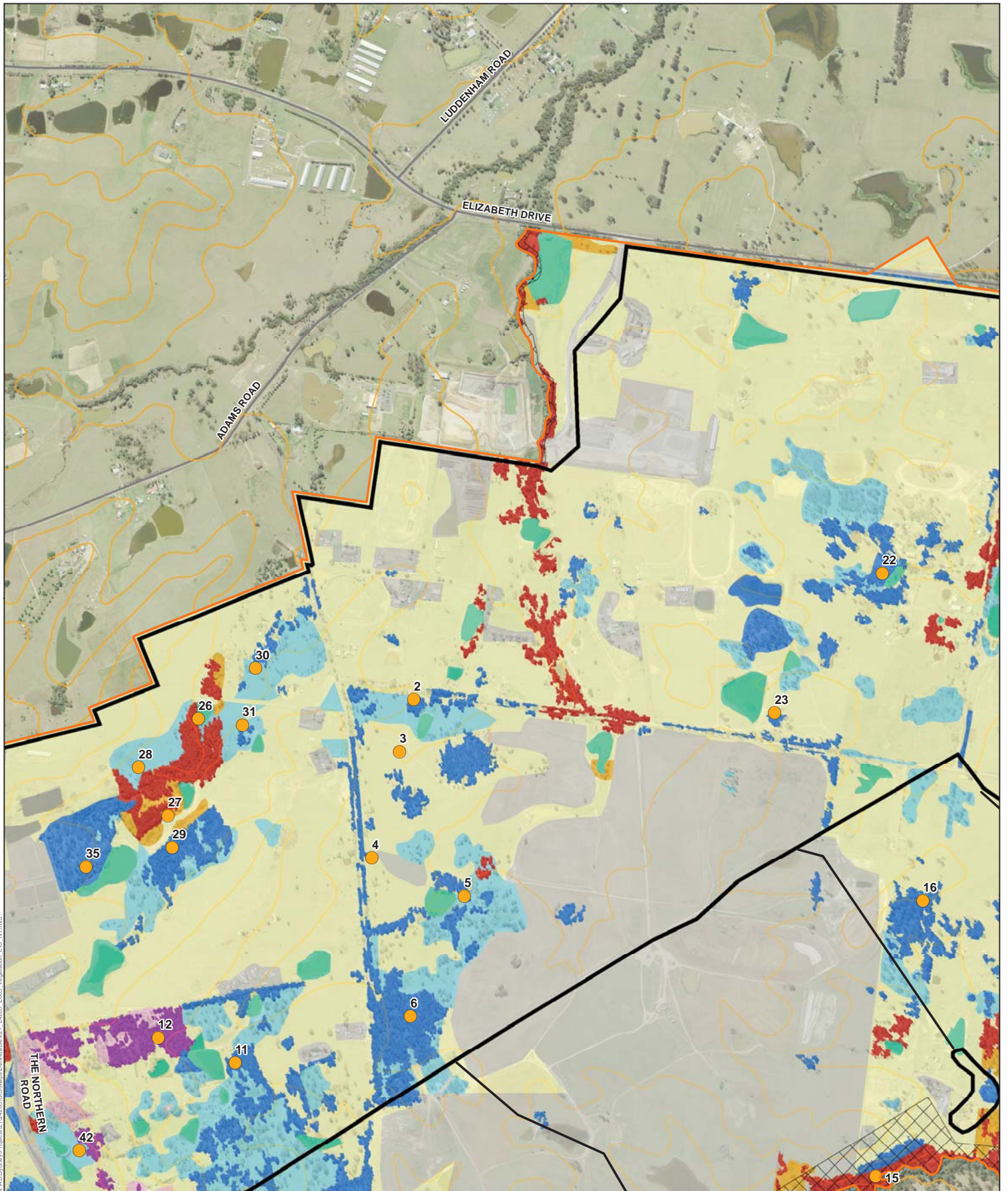


Figure 16-1A - Vegetation zones within the airport site



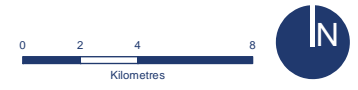
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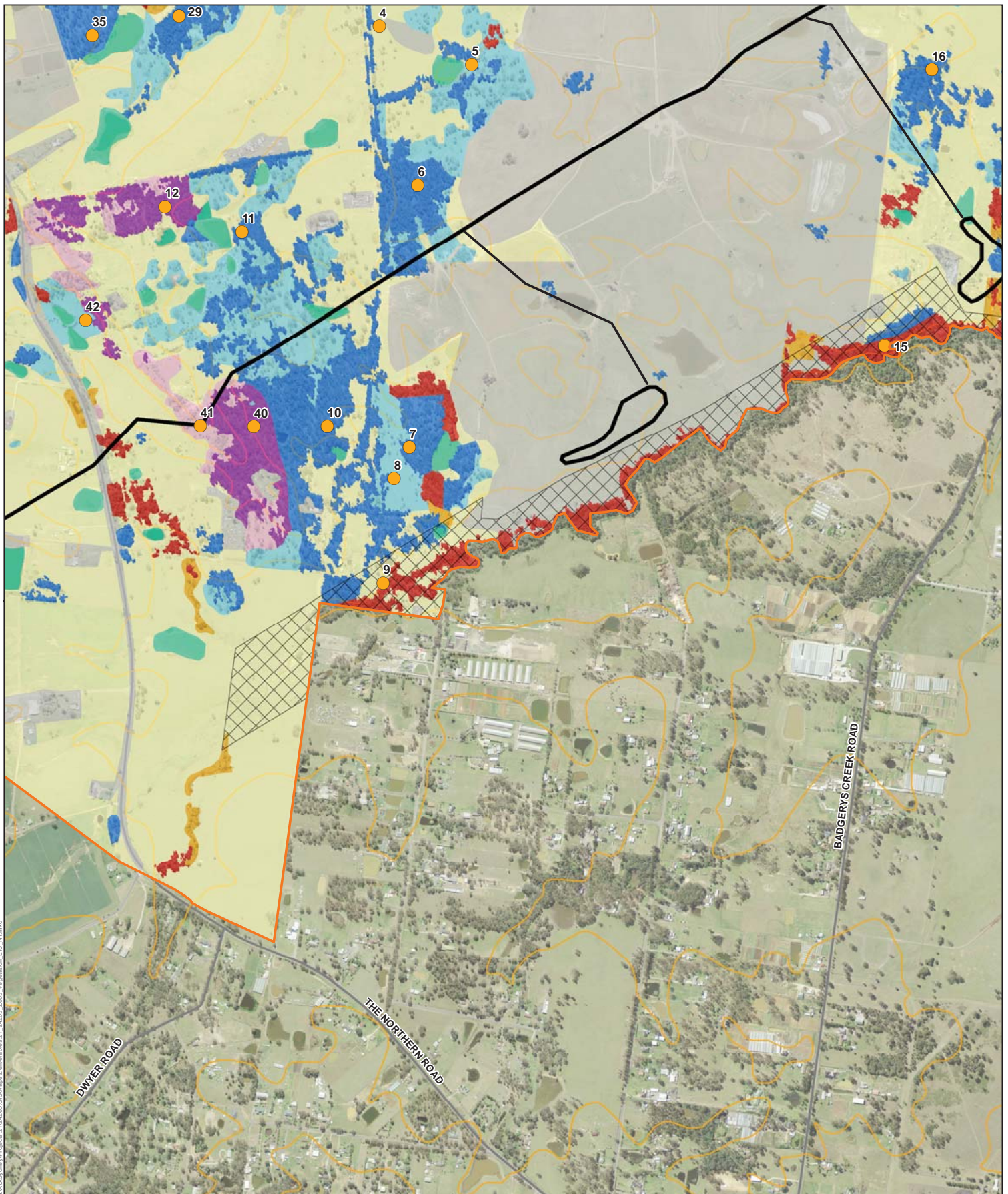
LEGEND

- Airport site
- Stage 1 construction impact zone
- Environmental conservation
- Contour
- Roads
- Plot/transect
- Good condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)
- Good condition Grey Box - Forest Red Gum grassy woodland on hills (HN529)
- Poor condition Grey Box - Forest Red Gum grassy woodland on hills (HN529)
- Poor condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)
- Good condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526)
- Poor condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526)
- Good condition Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest (HN512)
- Poor condition Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest (HN512)
- Good condition artificial freshwater wetland (HN630)
- Exotic grassland
- Cleared land or cropland

Data Source: Please refer to "Digital Data Sources" on the second page of the EIS

Figure 16-1B - Vegetation zones within the airport site



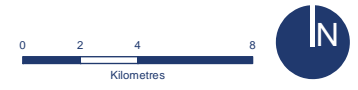


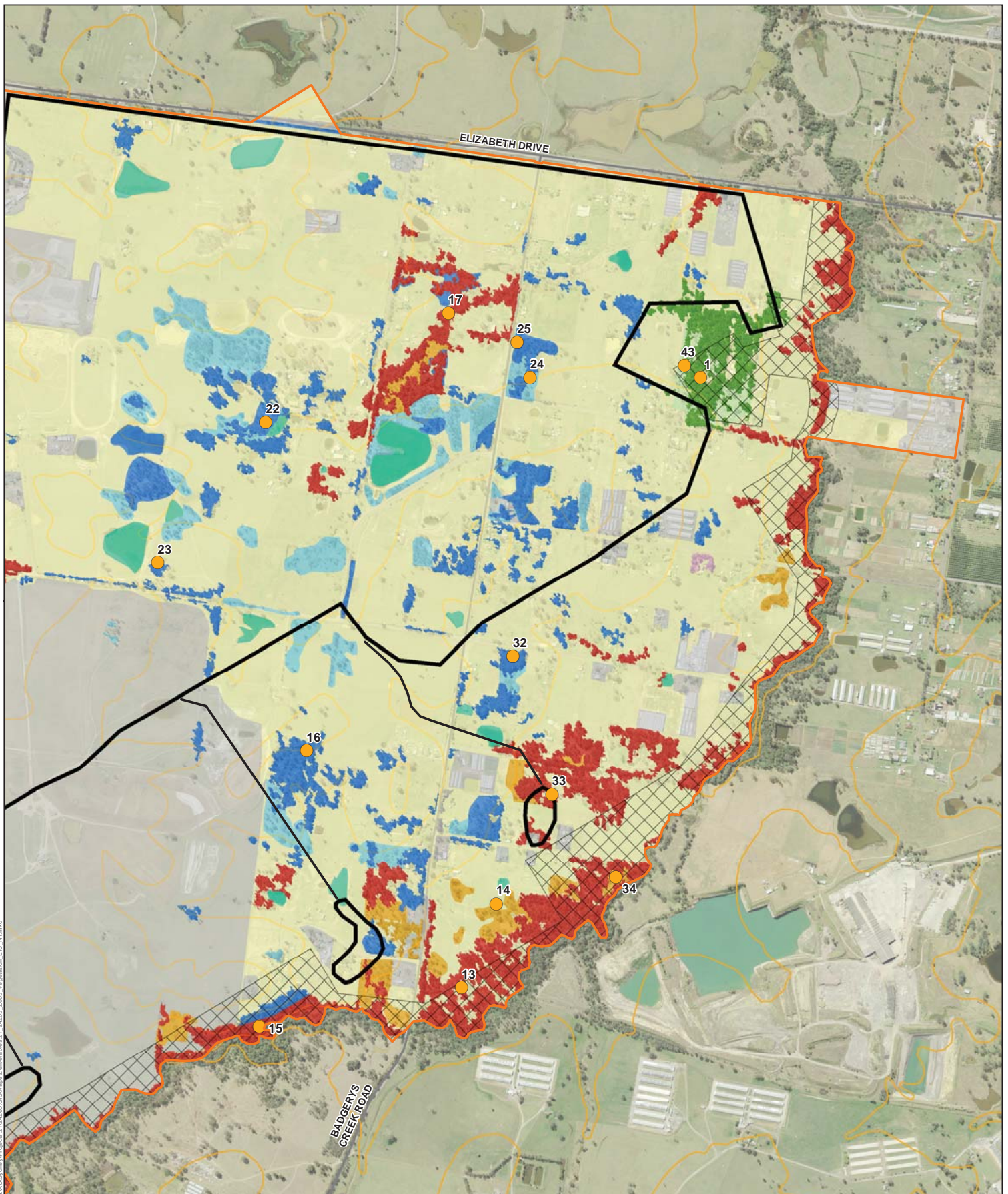
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Data Source: Please refer to "Digital Data Sources" on the second page of the EIS

LEGEND			
Airport site	Poor condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)	Good condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526)	Poor condition Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest (HN512)
Stage 1 construction impact zone	Good condition Grey Box - Forest Red Gum grassy woodland on hills (HN529)	Poor condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526)	Good condition artificial freshwater wetland (HN630)
Environmental conservation	Poor condition Grey Box - Forest Red Gum grassy woodland on hills (HN529)	Good condition Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest (HN512)	Exotic grassland
Contour	Good condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)	Cleared land or cropland	
Roads			
Plot/transect			

Figure 16-1C - Vegetation zones within the airport site





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LEGEND

Airport site	Poor condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)	Good condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526)	Poor condition Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest (HN512)
Stage 1 construction impact zone	Good condition Grey Box - Forest Red Gum grassy woodland on hills (HN529)	Poor condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526)	Good condition artificial freshwater wetland (HN630)
Environmental conservation	Poor condition Grey Box - Forest Red Gum grassy woodland on hills (HN529)	Good condition Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest (HN512)	Exotic grassland
Contour	Good condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)		Cleared land or cropland
Roads			
Plot/transect			

Data Source: Please refer to "Digital Data Sources" on the second page of the EIS

Figure 16-1D - Vegetation zones within the airport site

Table 16–4 – Vegetation zones within the airport site

Vegetation zone	Condition	Conservation status ¹		Area at the airport site (hectares)
		EPBC Act status	TSC Act status	
Native vegetation zones				
Good condition Grey Box – Forest Red Gum grassy woodland on flats (HN528)	Moderate/good – medium or high	Cumberland Plain Woodland and Shale-gravel Transition Forest (CEEC)	Cumberland Plain Woodland (CEEC)	177.2
Poor condition Grey Box – Forest Red Gum grassy woodland on flats (HN528)	Moderate/good – poor	-	Cumberland Plain Woodland (CEEC)	134.0
Good condition Grey Box – Forest Red Gum grassy woodland on hills (HN529)	Moderate/good – medium or high	Cumberland Plain Woodland and Shale-gravel Transition Forest (CEEC)	Cumberland Plain Woodland (CEEC)	30.2
Poor condition Grey Box – Forest Red Gum grassy woodland on hills (HN529)	Moderate/good – poor	-	Cumberland Plain Woodland (CEEC)	31.0
Good condition Forest Red Gum – Rough-barked Apple grassy woodland (HN526)	Moderate/good – medium or high	-	River Flat Eucalypt Forest (EEC)	92.3
Poor condition Forest Red Gum – Rough-barked Apple grassy woodland (HN526)	Moderate/good – poor	-	River Flat Eucalypt Forest (EEC)	18.4
Good condition Broad-leaved Ironbark – Grey Box – <i>Melaleuca decora</i> grassy open forest (HN512)	Moderate/good – medium or high	Cumberland Plain Woodland and Shale-gravel Transition Forest (CEEC)	Shale/gravel Transition Forest (EEC)	8.3
Poor condition Broad-leaved Ironbark – Grey Box – <i>Melaleuca decora</i> grassy open forest (HN512)	Moderate/good – poor	-	Shale/gravel Transition Forest (EEC)	2.3
Good condition artificial freshwater wetland on floodplain (HN630)	Moderate/good	-	-	35.4

Vegetation zone	Condition	Conservation status ¹		Area at the airport site (hectares)
		EPBC Act status	TSC Act status	
Non-native vegetation zones				
Exotic grassland	Cleared	-	-	956.4
Cleared land or cropland	Cleared	-	-	348.7
Total				1,774.3

Notes: 1. CEEC = Critically endangered ecological community, EEC = Endangered ecological community

The most extensive vegetation zone at the airport site is exotic grassland. This contains no native overstorey or midstorey vegetation and less than 50 per cent of the ground cover vegetation is native. Grassland areas contain occasional isolated paddock trees that are remnants of adjoining native woodland and forest. There are also extensive areas of buildings, hard stand, bare earth, cropland and waterbodies that feature minimal vegetation cover that have been collectively mapped as 'cleared land and cropland'. Exotic grassland at the airport site is shown in Photograph 16–1.




Photograph 16–1 – Heavily grazed exotic grassland (left) and ungrazed exotic grassland (right) at the airport site

Grey Box – Forest Red Gum grassy woodland on flats is associated with mid and lower slopes, on shale derived soils across the airport site, and is the most extensive native plant community type. It comprises an open forest or woodland of Forest Red Gum and Grey Box with a grassy understorey and occasional dense patches of the shrub species Native Blackthorn (*Bursaria spinosa spinosa*). Grey Box – Forest Red Gum grassy woodland on flats at the airport site is shown in Photograph 16–2



Photograph 16–2 – Good condition Grey Box – Forest Red Gum grassy woodland on flats (left) and poor condition (right)

There are small areas of tertiary gravel influenced soils in the east of the airport site 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 midstorey of Honey Myrtle (*Melaleuca decora*) and a shrub and grass understorey.



There is a volcanic intrusion in the central-western portion of the site which is associated with steeper terrain, rock fragments in soil profiles and some rock outcropping. In other parts of the Cumberland Plain this geology is often associated with Moist Shale Woodland and Western Sydney Dry Rainforest (NPWS 2002; Tozer et al. 2010), however at the airport site it contains Grey Box – Forest Red Gum grassy woodland on hills with relatively few species representative of these other communities. Plot/transect data was compared with Tozer et al. (2010) diagnostic species lists to confirm the identity of this vegetation type. The observed vegetation may be because of frequent and/or recent fire and other disturbance at the airport site, which has prevented a succession towards rainforest species.

The above vegetation types transition into Forest Red Gum – Rough-barked Apple grassy woodland along the riparian corridors of Badgerys Creek and other drainage lines through the airport site. This community is a closed woodland or forest of Forest Red Gum, Grey Box and Cabbage Gum (*Eucalyptus amplifolia*) along with Swamp Oak, Broad-leaved Apple (*Angophora subvelutina*) and paperbarks (*Melaleuca* spp.). Understorey vegetation is similar to Shale Plains Woodland along with additional moisture-loving species such as rushes and sedges.

The condition of these plant community types varies across the airport site as a result of previous land use and grazing intensity. Areas that have been historically cleared and/or heavily grazed now contain regrowth vegetation in poorer condition. There is moderate to severe weed infestation throughout, with linear remnants along roads and isolated patches in agricultural land that are the most severely affected. Notwithstanding the generally moderate to poor condition of vegetation at the airport site, it has high conservation significance as a result of the presence of threatened biota and the generally limited extent and quality of similar vegetation in Western Sydney.

There are patches of derived native grassland at the airport site that comprise poor condition forms of the native vegetation communities described above. These areas contain at least 50 per cent native groundcover, mainly comprising native grasses such as Kangaroo Grass (*Themeda australis*). There is a moderate species richness, but relative low cover and an abundance of understorey herbs associated with the woodlands and forests described above. Exotic grasses and herbs are present throughout.

There are a large number of dams and flooded depressions throughout the airport site formed by the construction of barriers across small drainage lines. These waterbodies contain a moderate diversity and abundance of native wetland plants.

There are local occurrences of one threatened ecological community listed under the EPBC Act and three threatened ecological communities listed under the TSC Act at the airport site, as described below.

16.3.2.4. Groundwater dependent ecosystems

The Atlas of Groundwater Dependent Ecosystems (BoM 2015c) maps the potential for creeks and vegetation to be either groundwater dependent or inflow dependent. No creeks at the airport site are mapped as being groundwater dependent ecosystems that are reliant on the surface expression of groundwater (rivers, springs, wetlands). South Creek to the east and the Nepean River to the west are both mapped as this type of groundwater dependent ecosystem but are not anticipated to be directly influenced by groundwater aquifers at the airport site.

Most large patches of native vegetation (including riparian vegetation) at the airport site are mapped as having a high potential for groundwater interaction (that is, they are likely to be groundwater dependent ecosystems that are reliant on subsurface groundwater). Some patches of native vegetation are mapped as having a low or moderate potential for groundwater interaction. Native vegetation along Badgerys Creek is also mapped as being highly likely to be an inflow dependent ecosystem (reliant on groundwater in addition to rainfall). Most other patches of native vegetation at the airport site are also mapped as being likely or highly likely to be inflow dependent (BOM 2015). According to Kuginis et al. (2012), all native vegetation communities present at the airport site are likely to be groundwater dependent ecosystems.

16.3.2.5. Threatened flora species and populations

Twenty-eight species of threatened flora listed under the EPBC Act and/or TSC Act have been recorded or are predicted to occur at the airport site or within the locality. These species are described in Appendix K1 in Volume 4. Only one species was recorded at the airport site during field surveys and an additional seven species are considered likely to occur at the airport site and may be affected by the proposed airport. These species are listed in Table 16–5 and their distribution at the airport site is shown on Figure 16–2. The species recorded during the field surveys are highlighted in bold text in Table 16–5. The remaining 20 species are considered unlikely to occur at the airport site due to a lack of suitable habitat, and therefore would not be affected by the proposed airport (refer to Appendix K1 in Volume 4).

Four individuals of *Pultenaea parviflora* were recorded on the southern side of Longleys Road between Ferndale Road and Taylors Road by SMEC (2014) and these records were verified during the field surveys. *Pultenaea parviflora* is listed as a vulnerable species under the EPBC Act and an endangered species under the TSC Act. This is a significant reduction from the 68 individuals previously recorded along both sides of Longleys Road in this location during the field surveys for the 1997–99 EIS (PPK 1997). The former locations of the other 64 individuals currently contain cleared, ploughed cropland or severely weed infested road edges and do not comprise occupied or potential habitat for this species.

In addition, 93 stems of *Marsdenia viridiflora* subsp. *viridiflora* have been recorded at the airport site, with the majority recorded in Grey Box – Forest Red Gum grassy woodland on flats adjacent to Longleys Road in the centre of the airport site (refer to Figure 16–2). These comprise part of 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 TSC Act.

Table 16–5 – Threatened flora known or likely to occur at the airport site (terrestrial)

Scientific name	Common name	Conservation status ¹	
		EPBC Act	TSC Act
<i>Acacia pubescens</i>	Downy Wattle	V	V
<i>Cynanchum elegans</i>	White-flowered Wax Plant	E	E
<i>Dillwynia tenuifolia</i>	-	-	V
<i>Grevillea juniperina</i> subsp. <i>juniperina</i>	Juniper-leaved Grevillea	-	V

Scientific name	Common name	Conservation status ¹	
		EPBC Act	TSC Act
<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	Small-flower Grevillea	V	V
<i>Pimelea spicata</i>	Spiked Rice-flower	E	E
<i>Pultenaea parviflora</i>	-	V	E
<i>Thesium australe</i>	Austral Toadflax	V	V

Notes: 1. Conservation status: V = Vulnerable, E = Endangered, **Bold** = recorded during field surveys

16.3.2.6. Threatened ecological communities

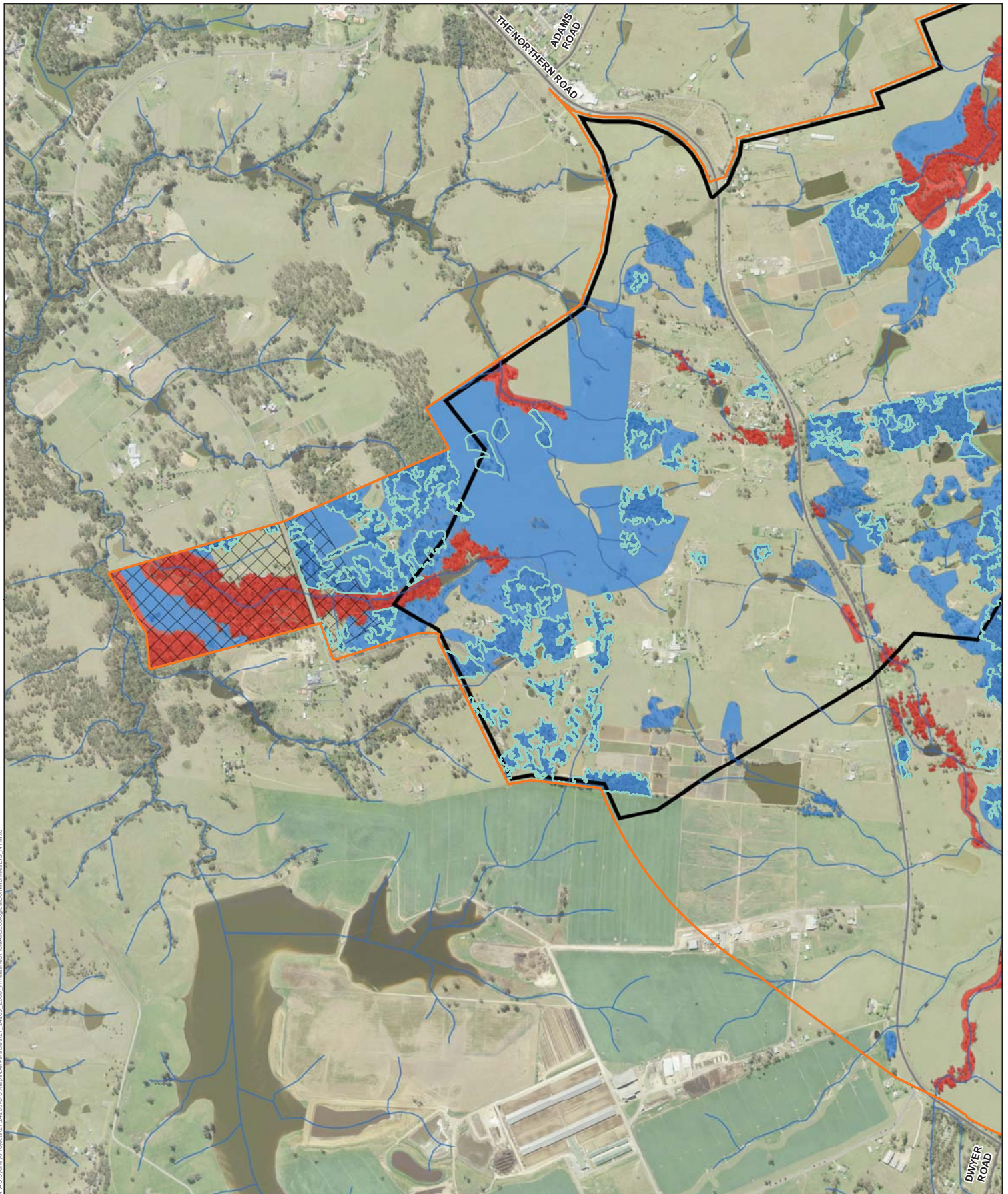
Larger and better condition patches of Grey Box – Forest Red Gum grassy woodland on flats, Grey Box – Forest Red Gum grassy woodland on hills and Broad-leaved Ironbark – Grey Box – *Melaleuca decora* grassy open forest at the airport site comprise occurrences of ‘Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest’ (Cumberland Plain Woodland) (refer to Table 16–4). Cumberland Plain Woodland is listed as a critically endangered ecological community under the EPBC Act and the TSC Act. There are approximately 155.7 hectares of Cumberland Plain Woodland as defined under the EPBC Act at the airport site, as shown on Figure 16–2.

Derived native grassland and moderate/good – poor condition vegetation at the airport site does not meet the condition criteria for a local occurrence of Cumberland Plain Woodland as defined under the EPBC Act and associated guidelines, but does meet the definition under the TSC Act.

All of the native woodland and forest vegetation at the airport site, including derived native grasslands, comprise local occurrences of threatened ecological communities listed under the TSC Act, 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 critically endangered ecological community ‘Cumberland Plain Woodland in the Sydney Basin Bioregion’ (Cumberland Plain Woodland);
- both good and poor condition patches of Broad-leaved Ironbark – Grey Box – *Melaleuca decora* grassy open forest comprise the endangered ecological community ‘Shale/Gravel Transition Forest in the Sydney Basin Bioregion’ (Shale-Gravel Transition Forest); and
- both good and poor condition patches of Forest Red Gum – Rough-barked Apple grassy woodland comprise the endangered ecological community ‘River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions’ (River Flat Eucalypt Forest) (refer to Table 16–4).

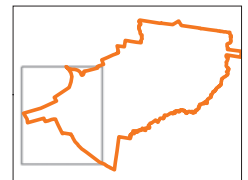
These communities are shown on Figure 16–2.



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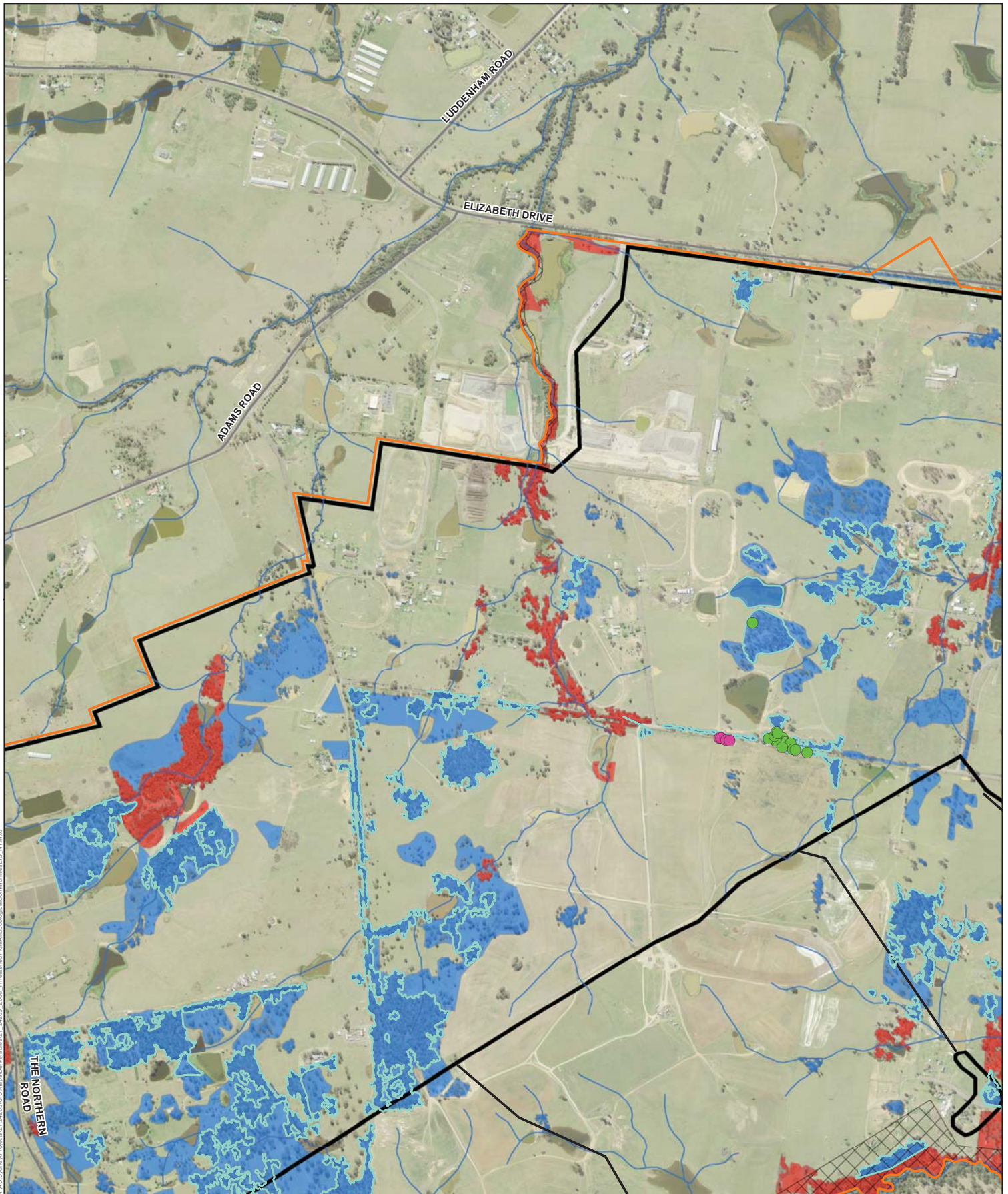
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| <p>LEGEND</p> <ul style="list-style-type: none"> Airport site Stage 1 construction impact zone Environmental conservation Watercourses Roads Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest (CEEC under EPBC Act and TSC Act) | <ul style="list-style-type: none"> Cumberland Plain Woodland (CEEC under the TSC Act) River Flat Eucalypt Forest (EEC under the TSC Act) Shale/gravel Transition Forest (EEC under the TSC Act) <i>Pultenaea parviflora</i> (endangered species under the EPBC Act and TSC Act) <i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i> (endangered population under the TSC Act) |
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Threatened flora species, populations
Figure 16-2A - and ecological communities at the airport site

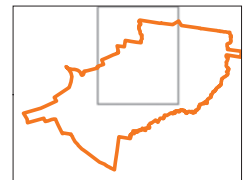




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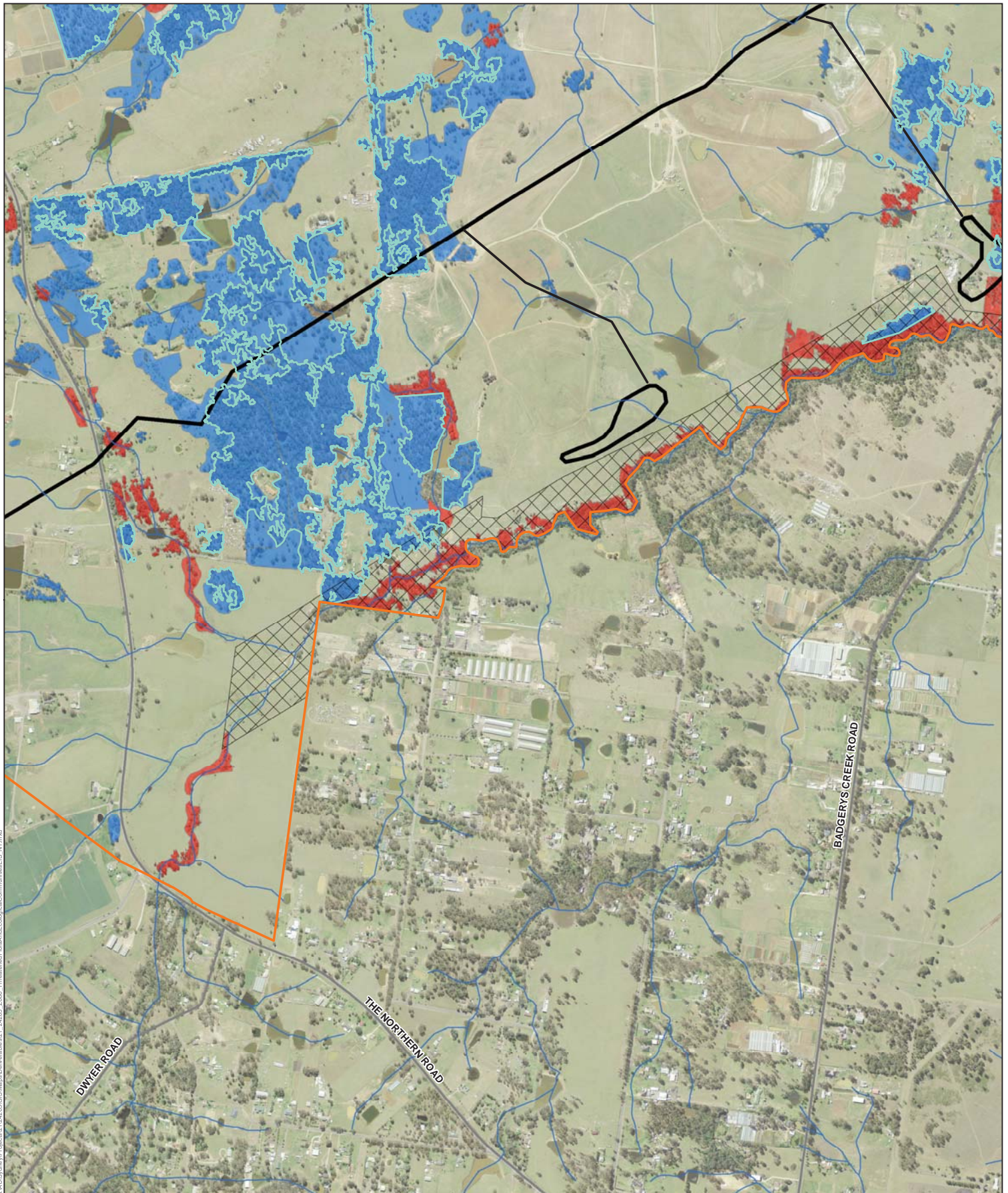
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| <p>LEGEND</p> <ul style="list-style-type: none"> Airport site Stage 1 construction impact zone Environmental conservation Watercourses Roads Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest (CEEC under EPBC Act and TSC Act) | <ul style="list-style-type: none"> Cumberland Plain Woodland (CEEC under the TSC Act) River Flat Eucalypt Forest (EEC under the TSC Act) Shale/gravel Transition Forest (EEC under the TSC Act) <i>Pultenaea parviflora</i> (endangered species under the EPBC Act and TSC Act) <i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i> (endangered population under the TSC Act) |
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Threatened flora species, populations
 Figure 16-2B - and ecological communities at the airport site

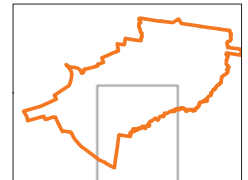




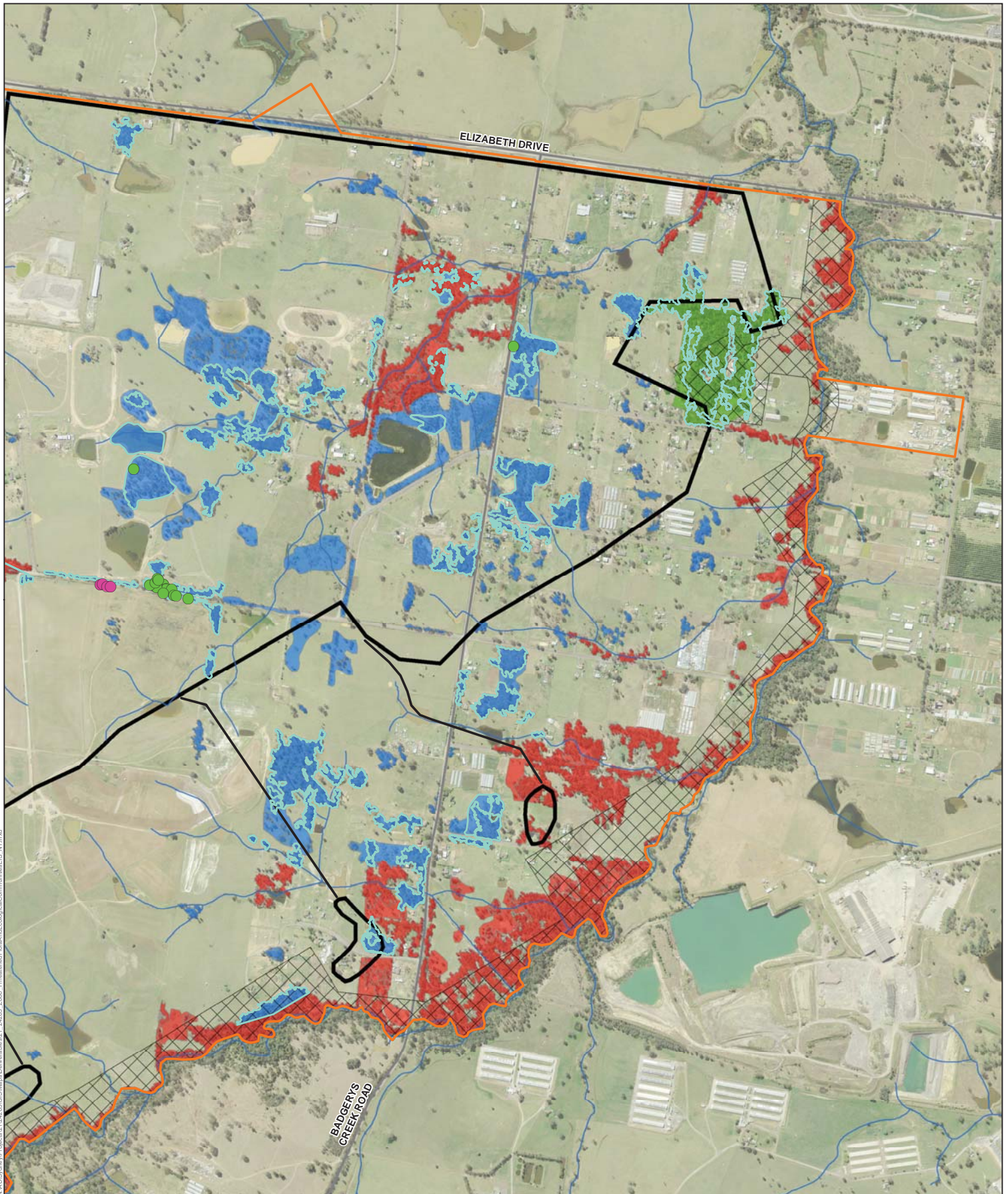
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| <p>LEGEND</p> <ul style="list-style-type: none"> Airport site Stage 1 construction impact zone Environmental conservation Watercourses Roads Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest (CEEC under EPBC Act and TSC Act) | <ul style="list-style-type: none"> Cumberland Plain Woodland (CEEC under the TSC Act) River Flat Eucalypt Forest (EEC under the TSC Act) Shale/gravel Transition Forest (EEC under the TSC Act) <i>Pultenaea parviflora</i> (endangered species under the EPBC Act and TSC Act) <i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i> (endangered population under the TSC Act) |
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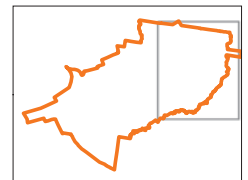
**Threatened flora species, populations
Figure 16-2C - and ecological communities at the airport site**



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Data Source: Please refer to "Digital Data Sources" on the second page of the EIS

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| <p>LEGEND</p> <ul style="list-style-type: none"> Airport site Stage 1 construction impact zone Environmental conservation Watercourses Roads Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest (CEEC under EPBC Act and TSC Act) | <ul style="list-style-type: none"> Cumberland Plain Woodland (CEEC under the TSC Act) River Flat Eucalypt Forest (EEC under the TSC Act) Shale/gravel Transition Forest (EEC under the TSC Act) <i>Pultenaea parviflora</i> (endangered species under the EPBC Act and TSC Act) <i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i> (endangered population under the TSC Act) |
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**Threatened flora species, populations
Figure 16-2D - and ecological communities at the airport site**



16.3.3. Terrestrial fauna

16.3.3.1. Fauna species

A total of 172 terrestrial fauna species (four invertebrate species, two fish species, 10 frog species, 10 reptile species, 126 bird species and 20 mammal species) were recorded at the airport site. As many as 10 other microchiropteran bat species may also have been recorded, but poor data quality and/or interspecific call similarities precluded reliable identification of additional species. A further 20 fauna species (10 bird species, seven mammal species, two reptile species and one frog species) were recorded by Biosis Research for the 1997–99 EIS (PPK 1997) and/or by SMEC (2014). The full list of animal species recorded at the airport site is provided in Appendix K1 in Volume 4.

One threatened fauna species listed under the EPBC Act was recorded at the airport site. The Grey-headed Flying-fox (*Pteropus poliocephalus*) was recorded during the recent surveys and the surveys for the 1997–99 EIS (PPK 1997). An additional eight threatened fauna species listed under the TSC Act have also been recorded at the airport site during both the recent surveys and the surveys for the 1997–99 EIS (PPK 1997). These are discussed in further detail below.

A number of introduced fauna species were recorded at the airport site. These included five bird species, six mammal species (including the Red Fox (*Vulpes vulpes*), Goat (*Capra hircus*) and Rabbit (*Oryctolagus cuniculus*)), one fish species (Mosquitofish (*Gambusia holbrooki*)), and two snail species.

16.3.3.2. Fauna habitat

Five broad fauna habitat types were recorded at the airport site:

Grassland and cropped areas

The majority of the airport site contains exotic grassland and cleared land or cropped areas. These would have historically supported native woodland vegetation but have been extensively modified by previous clearing and agriculture. 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 native fauna species that are relatively mobile and opportunistic.

Occasional paddock trees and shrubs (for example, Native Blackthorn or African Olive) also occur in these areas. Regrowth trees and shrubs would provide some foraging resources for native woodland birds.

Most of the species recorded in grassland areas would use these areas as an adjunct to the higher quality, more extensive areas of suitable habitat at and around the airport site. Some small fauna species such as lizards may rely on grassland habitat for their survival;

Native woodland

Native woodland at the airport site provides a moderate quality fauna habitat. Habitat resources include mature canopy trees 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 airport site forms some more extensive patches particularly where it is connected by riparian corridors, however the majority is fragmented and subject to edge effects (which are defined as changes in population or community structure that occur at the boundary of two habitats). There are roads, residences, agriculture and industry throughout the airport site creating associated noise and light disturbance as well as physical barriers to fauna movement. Grazing and the presence of exotic pest fauna would further reduce the habitat's value. There is only a moderate quantity of large, hollow-bearing trees at the airport site.

Eucalypts and other native flora species 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 provide year-round foraging resources for a range of native birds, bats and mammals.

Much of the shrub and ground layer vegetation and habitat features of the woodland and forest at the airport site have been removed for grazing. Woodland at the airport site generally contains low quantities of woody debris and leaf litter. Fallen timber and leaf litter provides shelter habitat for reptiles, snakes and small mammals.

Riparian forest

There is a relatively extensive network of drainage lines and waterbodies across the airport site. Most drainage lines feature near-intact geomorphology and good instream and riparian vegetation but with moderate to severe weed infestation and some evidence of degradation by cattle such as grazing, bank erosion, increased turbidity and likely also nutrient enrichment from waste.

Riparian forest at the airport site consists of a closed woodland or forest of eucalypts with Swamp Oak present along the margins of the creeks. 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 as rushes and sedges. Large, hollow-bearing trees tend to occur in higher densities along the riparian corridor than in other woodland patches at the airport site.

Similar to native woodland, eucalypts and other flora species provide foraging and shelter resources for a range of birds and mammals and fallen timber and leaf litter provides shelter habitat for small reptiles and mammals.

Drainage lines provide habitat for native fish and aquatic invertebrates and breeding habitat for a number of stream-breeding frogs.

Wetlands

There are a number of dams and flooded depressions at the airport site with varying growth of native wetland and aquatic plants, including some waterbodies with extensive reed beds. These range in habitat value for native fauna depending on their size, presence of emergent or aquatic vegetation and level of use by cattle and associated disturbance. Many dams contained a variety of aquatic vegetation, including *Typha orientalis*, *Eleocharis cylindrostachys* and *Eleocharis sphacelata*.

Buildings and other structures

A number of sheds and buildings are present at the airport site. These provide roosting habitat for birds and microbats. Sheds and buildings are also likely to provide shelter for rodents and snakes. Roosting microbats were observed under the Badgerys Creek bridge on Badgerys Creek Road.

These five habitats are shown on Figure 16–3. A list of species recorded in each habitat (including threatened, migratory and introduced species) is provided in Appendix K1 in Volume 4.

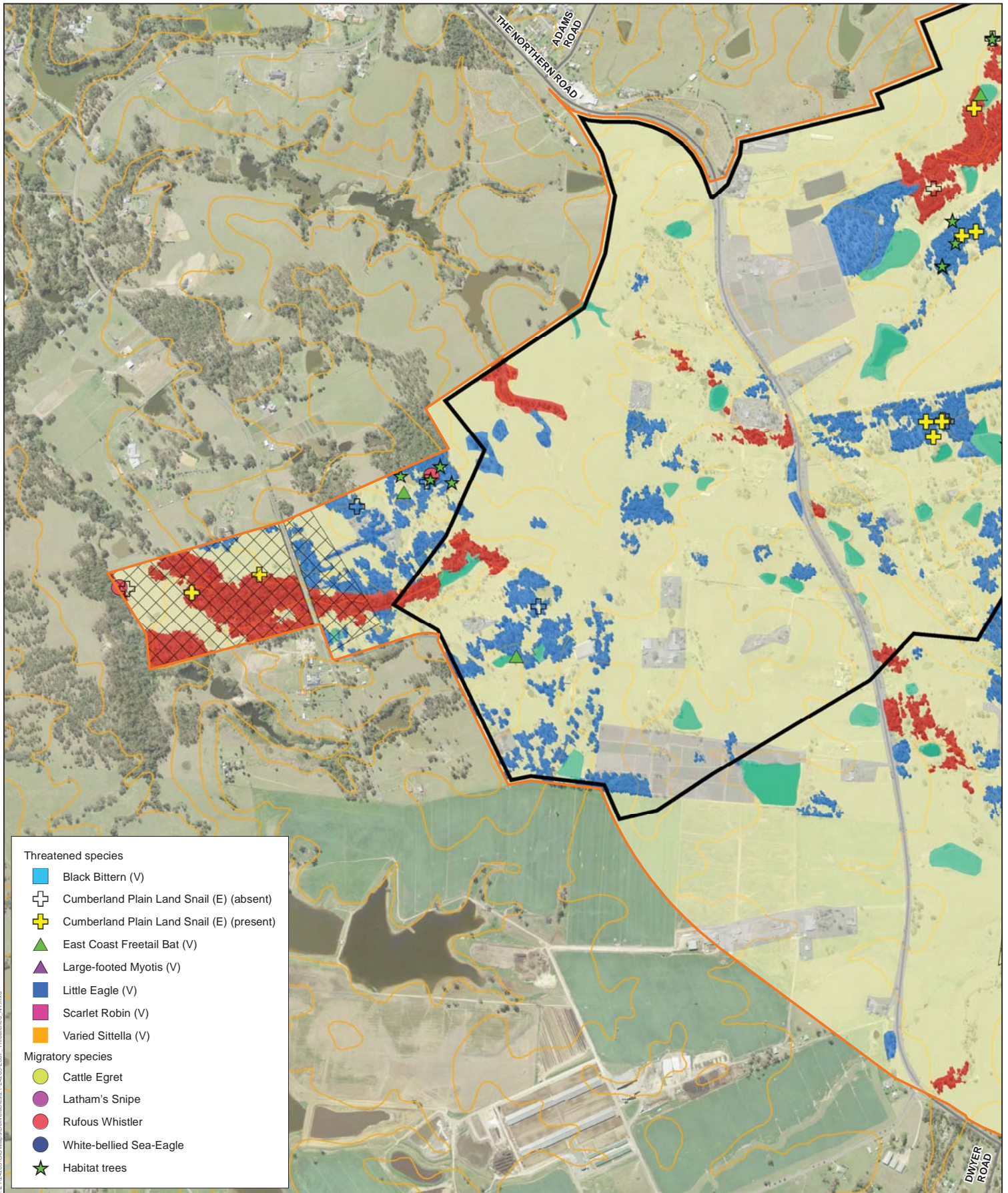
16.3.3.3. Habitat connectivity

Wildlife corridors are vital for the maintenance of ecological processes, including the movement of animals and the continuation of viable populations. Corridors can consist of a sequence of stepping stones across the landscape (discontinuous areas of habitat such as paddock trees, wetlands and roadside vegetation), continuous lineal strips of vegetation and habitat (such as riparian strips, ridge lines), or they may be parts of an extensive patch of vegetation (DEC 2004c).

Connectivity with vegetation outside the airport site is limited. Most vegetation in the locality occurs as small patches, with long linear patches of vegetation tending to occur along creek lines. The Badgerys Creek corridor remains generally vegetated to the north of the airport site, albeit with some gaps in vegetation cover and links to the vegetated corridors of South Creek and Cosgrove Creek. *The Western Sydney Urban Bushland Biodiversity Survey* (NPWS 1997) identified a number of riparian corridors as targets for conservation within the Liverpool Local Government Area, such as South Creek and Kemps Creek, but did not specifically include the Badgerys Creek corridor.

Most patches of native vegetation at the airport site were mapped by Ecological Australia (2012) as being linked and, therefore, having a patch size of greater than 100 hectares. There is only limited connectivity, however, with other patches of vegetation outside the airport site. Large expanses of cleared land occur along the northern edge of Elizabeth Drive and Adam's Road. Small patches of vegetation to the south and west provide 'stepping stones' to other patches of vegetation outside the airport site.

Connectivity for fauna species is, therefore, mainly along the Badgerys Creek riparian corridor or between closely linked patches within the airport site. Species with only limited mobility, such as the Cumberland Plain Land Snail, have minimal opportunities for dispersal. The Cumberland Plain Land Snail would generally be restricted to isolated patches of vegetation in which the local population occurs, with no opportunity for movement between patches that are separated by grassland or cleared land. Small woodland birds would tend to move along the riparian corridors or along roadside vegetation to access other areas of habitat. More mobile fauna, such as the Grey-headed Flying-fox and larger birds would move easily between patches of vegetation at the airport site and other areas of habitat in the locality.



- Threatened species**
- Black Bittern (V)
 - Cumberland Plain Land Snail (E) (absent)
 - Cumberland Plain Land Snail (E) (present)
 - East Coast Freetail Bat (V)
 - Large-footed Myotis (V)
 - Little Eagle (V)
 - Scarlet Robin (V)
 - Varied Sittella (V)
- Migratory species**
- Cattle Egret
 - Latham's Snipe
 - Rufous Whistler
 - White-bellied Sea-Eagle
 - Habitat trees

- LEGEND**
- Airport site
 - Stage 1 construction impact zone
 - Environmental conservation
 - Contour
 - Roads
- Habitat type**
- Cleared land
 - Grassland
 - Riparian forest
 - Wetland
 - Woodland

Notes:
 V - vulnerable species under the TSC Act;
 E - endangered species under the TSC Act;
 M - migratory species under the EPBC Act.

Data Source: Please refer to "Digital Data Sources" on the second page of the EIS

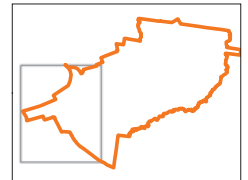


Figure 16-3A - Habitat types and threatened fauna species at the airport site

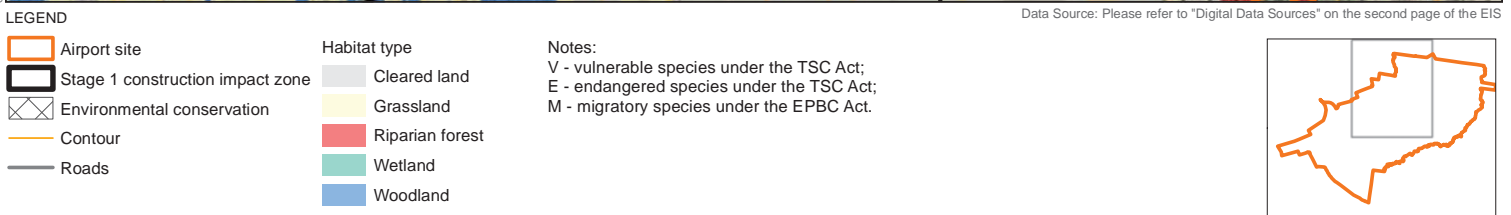
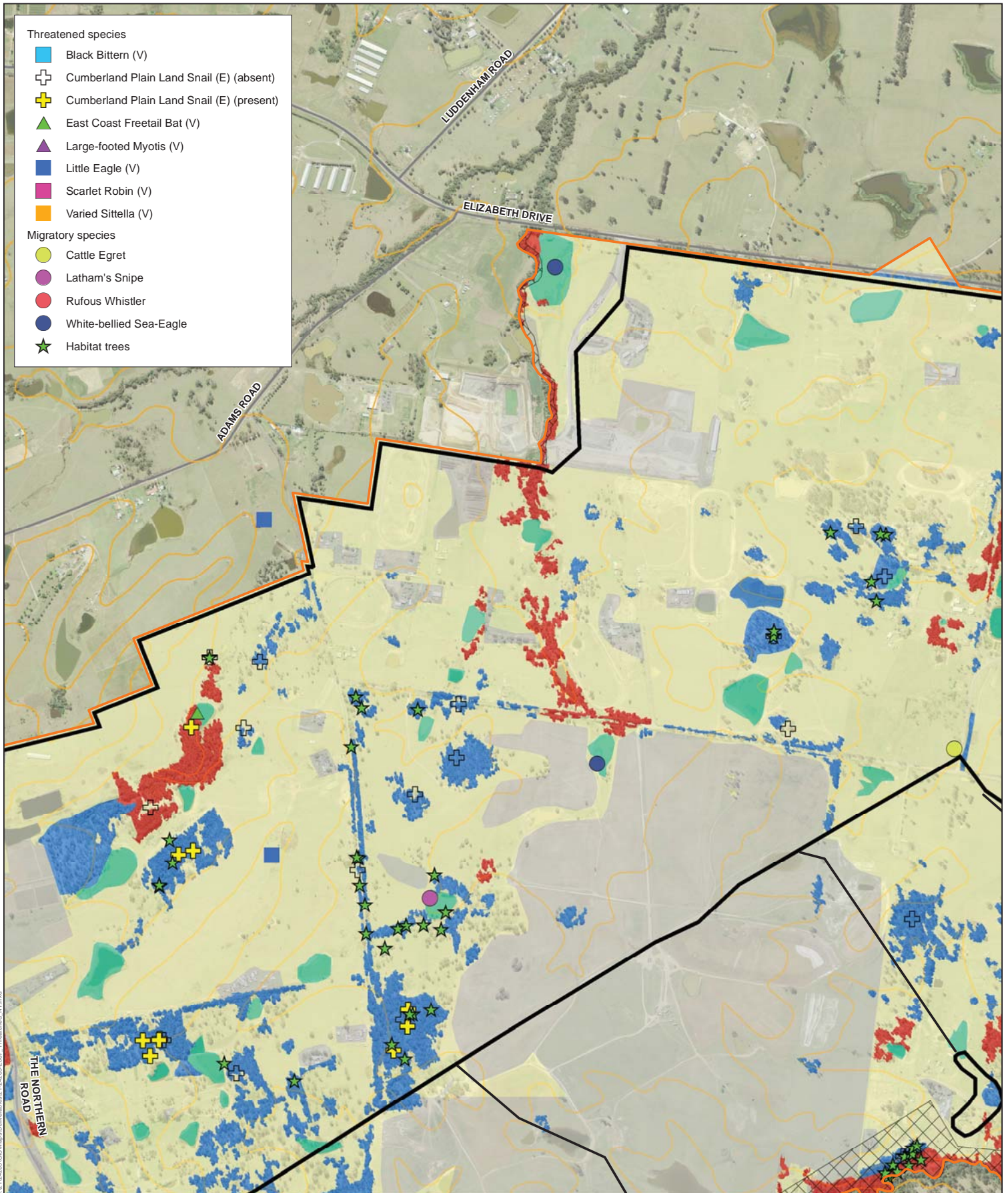
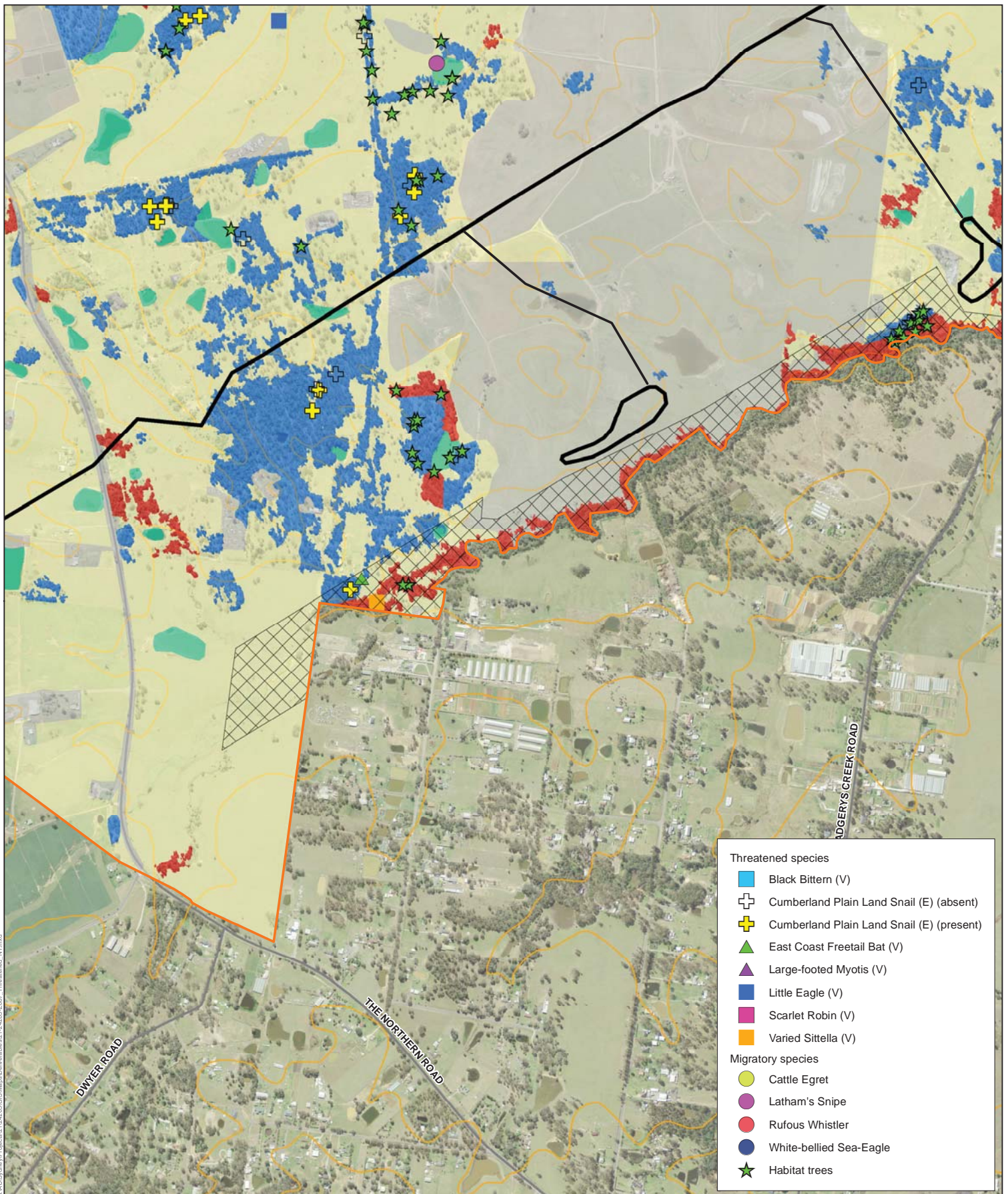


Figure 16-3B - Habitat types and threatened fauna species at the airport site





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- LEGEND**
- | | |
|----------------------------------|-----------------|
| Airport site | Cleared land |
| Stage 1 construction impact zone | Grassland |
| Environmental conservation | Riparian forest |
| Contour | Wetland |
| Roads | Woodland |

Notes:
 V - vulnerable species under the TSC Act;
 E - endangered species under the TSC Act;
 M - migratory species under the EPBC Act.

- Threatened species**
- Black Bittern (V)
 - Cumberland Plain Land Snail (E) (absent)
 - Cumberland Plain Land Snail (E) (present)
 - East Coast Freetail Bat (V)
 - Large-footed Myotis (V)
 - Little Eagle (V)
 - Scarlet Robin (V)
 - Varied Sittella (V)
- Migratory species**
- Cattle Egret
 - Latham's Snipe
 - Rufous Whistler
 - White-bellied Sea-Eagle
 - Habitat trees

Data Source: Please refer to "Digital Data Sources" on the second page of the EIS

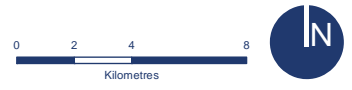
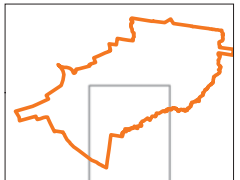
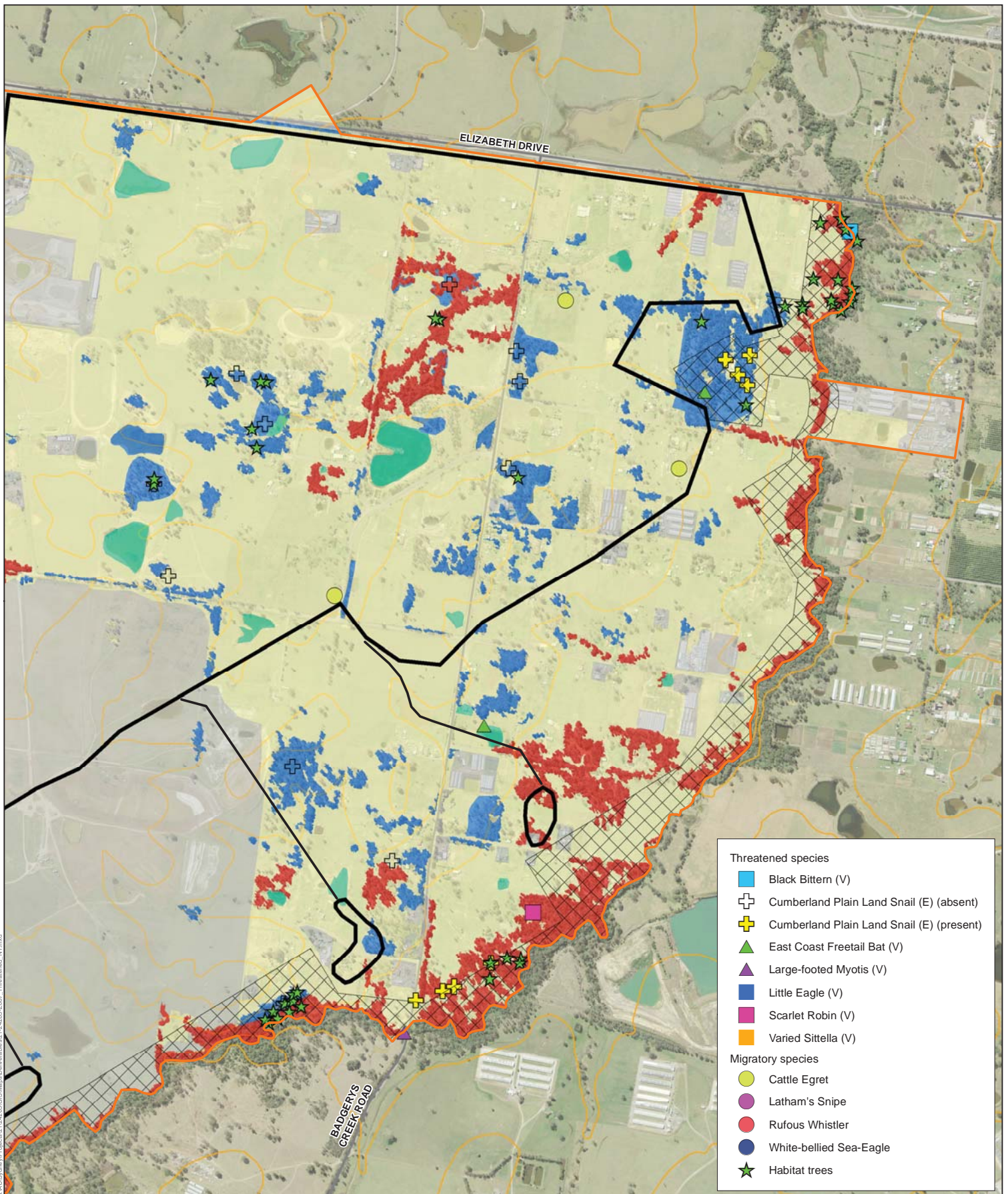


Figure 16-3C - Habitat types and threatened fauna species at the airport site



- Threatened species**
- Black Bittern (V)
 - + Cumberland Plain Land Snail (E) (absent)
 - + Cumberland Plain Land Snail (E) (present)
 - ▲ East Coast Freetail Bat (V)
 - ▲ Large-footed Myotis (V)
 - Little Eagle (V)
 - Scarlet Robin (V)
 - Varied Sittella (V)
- Migratory species**
- Cattle Egret
 - Latham's Snipe
 - Rufous Whistler
 - White-bellied Sea-Eagle
 - ★ Habitat trees

- LEGEND**
- Airport site
 - Stage 1 construction impact zone
 - Environmental conservation
 - Contour
 - Roads
- Habitat type**
- Cleared land
 - Grassland
 - Riparian forest
 - Wetland
 - Woodland

Notes:
 V - vulnerable species under the TSC Act;
 E - endangered species under the TSC Act;
 M - migratory species under the EPBC Act.

Data Source: Please refer to "Digital Data Sources" on the second page of the EIS

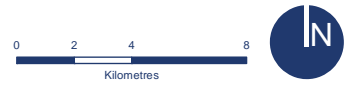
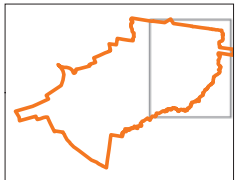


Figure 16-3D - Habitat types and threatened fauna species at the airport site

16.3.3.4. Threatened fauna species

Fifty-one species of threatened fauna (listed under the EPBC Act and/or TSC Act) have been recorded or are predicted to occur at the airport site or within the locality. This includes three invertebrates, three fish, four amphibians, one reptile, 26 birds and 14 mammals. These species are described in Appendix K1 in Volume 4. Of these, nine species (one invertebrate, six birds and two mammals) were recorded at the airport site during the field surveys and an additional 21 species (15 birds and six mammals) are considered likely to occur at the airport site and may be affected by the proposed airport. These species are listed in Table 16–6 and their distribution at the airport site is shown on Figure 16–3. Those species recorded during the field surveys are highlighted in bold text in Table 16–6. The remaining 21 species are considered unlikely to occur at the airport site and, therefore, would not be affected by the proposed airport (refer to Appendix K1 in Volume 4).

Table 16–6 – Threatened fauna known or likely occur at the airport site (terrestrial)

Scientific name	Common name	Conservation status ¹	
		EPBC Act	TSC Act
Invertebrates			
<i>Meridolum corneovirens</i>	Cumberland Plain Land Snail	-	E
Birds			
<i>Botaurus poiciloptilus</i>	Australasian Bittern	E	E
<i>Collocephalon fimbriatum</i>	Gang-gang Cockatoo	-	V
<i>Calyptorhynchus lathami</i>	Glossy Black-Cockatoo	-	V
<i>Chthonicola sagittata</i>	Speckled Warbler	-	V
<i>Daphoenositta chrysoptera</i>	Varied Sittella	-	V
<i>Glossopsitta pusilla</i>	Little Lorikeet	-	V
<i>Hieraaetus morphnoides</i>	Little Eagle	-	V
<i>Ixobrychus flavicollis</i>	Black Bittern	-	V
<i>Lathamus discolor</i>	Swift Parrot	E	E
<i>Lophoictinia isura</i>	Square-tailed Kite	-	V
<i>Melanodryas cucullata cucullata</i>	Hooded Robin (south-eastern form)	-	V
<i>Melithreptus gularis gularis</i>	Black-chinned Honeyeater (eastern subspecies)	-	V
<i>Ninox connivens</i>	Barking Owl	-	V
<i>Ninox strenua</i>	Powerful Owl	-	V
<i>Oxyura australis</i>	Blue-billed Duck	-	V
<i>Petroica boodang</i>	Scarlet Robin	-	V
<i>Petroica phoenicea</i>	Flame Robin	-	V
<i>Rostratula australis</i>	Australian Painted Snipe	E	E

Scientific name	Common name	Conservation status ¹	
		EPBC Act	TSC Act
<i>Stagonopleura guttata</i>	Diamond Firetail	-	V
<i>Stictonetta naevosa</i>	Freckled Duck	-	V
<i>Tyto novaehollandiae</i>	Masked Owl	-	V
Mammals			
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	-	V
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing-bat	-	V
<i>Mormopterus norfolkensis</i>	Eastern Freetail-bat	-	V
<i>Myotis macropus</i>	Southern Myotis	-	V
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V	V
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat	-	V
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	-	V
<i>Vespadelus troughtoni</i>	Eastern Cave Bat	-	V

Notes: 1. Conservation status: V = Vulnerable, E = Endangered, **Bold** = recorded during field surveys

One threatened fauna species listed under the EPBC Act was recorded at the airport site during the field surveys. This species, the Grey-headed Flying-fox, is listed as vulnerable under the EPBC Act and under the TSC Act. The Grey-headed Flying-fox was also recorded at the airport site during previous surveys for the 1997–99 EIS (PPK 1997). While there are no camps located at the airport site, there are seven known colonies within 20 kilometres of the site.

All native woodland and forest at the airport site provides foraging habitat for the Grey-headed Flying-fox. 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); however, none of these species are highly productive flowering species. 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’. Grey Box has low productivity and reliability, flowering in late summer and early autumn. Broad-leaved Ironbark has high productivity but is an unreliable flowerer (Eby and Law 2008). This species flowers in summer and early autumn, providing foraging habitat during the breeding period.

Habitat at the airport site is thus somewhat productive during food bottlenecks, and may be habitat critical to the survival of the species, as defined in the draft recovery plan (DECCW 2009a). The draft recovery plan also notes that it is not possible to predict what localities would be productive in which months and, therefore, which localities would provide essential habitat for the species. All foraging habitat has the potential to be productive during general food shortages and to therefore provide a resource critical to survival (DECCW 2009a).

Three other threatened fauna species listed under the EPBC Act may occur at the airport site, although they were not detected during the field surveys. These species include:

- Australasian Bittern (*Botaurus poiciloptilus*). The Australasian Bittern is listed as endangered under the EPBC Act and the TSC Act. Farm dams and creeks at the airport site may provide potential foraging and breeding habitat for this species;
- Swift Parrot (*Lathamus discolor*). The Swift Parrot is listed as endangered under the EPBC Act and the TSC Act. This species may occur at the airport site on occasion during its winter migration. Although the airport site does not provide core winter foraging resources for this species, it may provide shelter or supplementary foraging resources for migrating individuals; and
- Australian Painted Snipe (*Rostratula australis*). The Australian Painted Snipe is listed as endangered under the EPBC Act and the TSC Act. Wetlands and nearby flooded grasslands at the airport site may provide potential foraging and breeding habitat for this species.

Eight threatened fauna species listed under the TSC Act were recorded at the airport site during the field surveys:

- Cumberland Plain Land Snail (*Meridolum corneovirens*). The Cumberland Plain Land Snail is listed as endangered under the TSC Act. Habitat for the Cumberland Plain Land Snail occurs in larger patches with remnant trees. Live snails and shells of this species were recorded in a variety of locations where moist, deep leaf litter was present. In general, this species was recorded in locations where it had previously been recorded for the 1997–99 EIS (PPK 1997), as well as some additional locations. In some locations, including some where the species had previously been recorded, appropriate potential habitat with good leaf litter was present but no individuals were found. This may have been as a result of individuals burrowing deep into the soil and not being found, or previous local extinction of a population. Where leaf litter was shallow, woodland patches were small and no remnant trees were present, this species was not detected. It is likely the species has not been able to recolonise due to distances between patches in regrowth woodland areas;
- Varied Sittella (*Daphoenositta chrysoptera*). The Varied Sittella is listed as vulnerable under the TSC Act. About three or so individuals were recorded foraging in River-flat Eucalypt Forest near Badgerys Creek, and may also occur in larger patches of Cumberland Plain Woodland. This species is likely to breed and forage in larger woodland patches at the airport site;
- Little Lorikeet (*Glossopsitta pusilla*). The Little Lorikeet is listed as vulnerable under the TSC Act. A pair of Little Lorikeets was observed flying over the western portion of the airport site. This species is likely to forage throughout the airport site when eucalypts are in flower. While hollow-bearing trees are present in some locations, the species is unlikely to breed at the airport site given the level of fragmentation;
- Little Eagle (*Hieratus morphnoides*). The Little Eagle is listed as vulnerable under the TSC Act. The Little Eagle was observed on a number of occasions flying above open grassland at the airport site. The Little Eagle would prey upon small to medium-sized mammals such as rodents and rabbits that occur in grassland habitats at the airport site. It is likely that the airport site is part of the home range of a number of breeding pairs. The species may use tall trees to nest in, although no raptor nests were observed during the field surveys;


- Black Bittern (*Ixobrychus flavicollis*). The Black Bittern is listed as vulnerable under the TSC Act. One individual was observed in the northern section of Badgerys Creek. This species may breed and forage in the riparian corridor and at dams with good cover at the airport site;
- Scarlet Robin (*Petroica boodang*). The Scarlet Robin is listed as vulnerable under the TSC Act. One individual was recorded foraging in River-flat Eucalypt Forest near Badgerys Creek and may also occur in larger patches of Cumberland Plain Woodland. This species may breed and forage in larger woodland patches at the airport site, although it tends to breed in woodland on foothills and ridges, moving to lower more open habitats in winter;
- Blue-billed Duck (*Oxyura australis*). The Blue-billed Duck is listed as vulnerable under the TSC Act. Three individuals were observed on the large, deep constructed dam on Taylors Road. This species only rarely occurs east of the Great Dividing Range, occurring as vagrants generally during times of drought. This species is unlikely to rely on habitats present at the airport site; and
- Eastern Freetail-bat (*Mormopterus norfolkensis*). The Eastern Freetail-bat is listed as vulnerable under the TSC Act. This species was recorded at many locations at the airport site, and was often the most common bat species recorded. This species may roost and breed in hollow-bearing trees at the airport site and would forage in woodland and open areas at the airport site.

Two additional threatened bat species listed under the TSC Act were recorded at the airport site during the surveys for the 1997–99 EIS (PPK 1997). These species were also possibly recorded at the airport site during the recent field surveys based on echolocation call analysis (though poor data quality and/or interspecific call similarities precluded the definitive identification of these species). These species included:

- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*). The Eastern False Pipistrelle is listed as vulnerable under the TSC Act. Possible calls of the species were recorded during the recent field surveys. This species prefers large tracts of vegetation, and would mainly occur along the Badgerys Creek riparian corridor and nearby large patches of vegetation; and
- Eastern Bentwing Bat (*Miniopterus schreibersii oceanensis*). The Eastern Bentwing Bat is listed as vulnerable under the TSC Act. Possible calls of the species were recorded during the recent field surveys. No breeding habitat for this species is present at the airport site, although it may roost under bridges and in buildings. This species forages in cleared and wooded areas, and could forage throughout the airport site.

Three more threatened bat species were also possibly recorded at the airport site during the recent field surveys based on echolocation call analysis. These species included:

- Southern Myotis (*Myotis macropus*) listed as vulnerable under the TSC Act;
- Greater Broad-nosed Bat (*Scoteanax rueppellii*) listed as vulnerable under the TSC Act; and
- Eastern Cave Bat (*Vespadelus troughtoni*), listed as vulnerable under the TSC Act.



A number of other threatened fauna species listed under the TSC Act are likely to occur at the airport site, based on a combination of recent records in the locality and the presence of suitable habitat (refer to Table 16–6). The airport site contains extensive areas of habitat in moderate to good condition for each of these species and is likely to support viable local populations or would provide foraging habitat for transient species.

Two threatened fauna species were identified as potentially being significantly affected by the proposed airport in the EIS guidelines. However, these species are considered to have a low likelihood of occurrence at the airport site and are, therefore, unlikely to be significantly affected by the airport. These species include:

- Large-eared Pied Bat (*Chalinolobus dwyeri*). The Large-eared Pied Bat is listed as vulnerable under the EPBC Act and the TSC Act. It appears to roost predominantly in caves and overhangs in sandstone cliffs and forages in nearby high-fertility forest or woodland near watercourses. This species was not recorded at the airport site during the recent field surveys, nor has it been recorded during previous field surveys undertaken at the airport site. The species has been recorded at Bents Basin State Conservation Area to the south-west of the site. Large expanses of suitable habitat are present to the west in the Blue Mountains National Park, however, extensive areas of cleared agricultural land between these areas and the airport site make it unlikely that this species would occur at the airport site other than on a very occasional basis. In addition, there is no suitable roosting habitat at the airport site or in the immediate vicinity; and
- Green and Golden Bell Frog (*Litoria aurea*). The Green and Golden Bell Frog is listed as vulnerable under the EPBC Act and endangered under the TSC Act. No Green and Golden Bell Frogs were recorded during the recent, targeted searches, despite the presence of suitable habitat at the airport site. Similarly, none were recorded during the surveys conducted for the 1997–99 EIS (PPK 1997) and there are no other previous records of this species at the airport site (OEH 2015a). Numerous farm dams are present at the airport site and many of these appear to provide good quality potential habitat. Surrounding grassland would also provide good basking sites for frogs (if present). Mosquitofish (*Gambusia holbrooki*) were observed at many of the dams, potentially reducing the habitat quality for this species.

Large numbers of other species of frogs were recorded during the recent field surveys at the airport site, showing that frogs in general were active at this time and suggesting that if Green and Golden Bell Frogs were present, they would have been recorded. It is likely that the Green and Golden Bell Frog does not occur at the airport site. According to Lemckert (1999) this is a typical situation for this species, as it appears to have become extinct through most of its range, despite the presence of apparently suitable habitat. Many populations in Western Sydney have become extinct over recent decades. According to White and Pyke (2008), the populations at Liverpool, Merrylands, Milperra, and Mount Druitt, also in Western Sydney, are extinct or probably extinct.

The Giant Burrowing Frog (*Heleioporus australiacus*), listed as vulnerable under the EPBC Act and the TSC Act, was identified in the assessment process notice following determination of the airport as a controlled action as potentially being significantly affected by the proposed airport (DoE 2015c). This species has a strong habitat association with sandstone geology, especially the Hawkesbury Sandstone plateaus surrounding Sydney where it occurs on sandy soils supporting heath, woodland or open forest. It does not occur on the shale and alluvium substrates of the Cumberland Plain and would not occur at the airport site.

The Koala (*Phascolarctos cinereus*) is listed as vulnerable under the EPBC Act and the TSC Act. There are few records of the species in the locality. It has been recorded to the west in the Blue Mountains National Park, and to the east in the Western Sydney Parklands, however there is minimal connectivity between these areas and the airport site. Koalas were not observed at the airport site, and no scats were recorded during the recent, targeted searches for the species. Potential habitat at the airport site does not constitute ‘habitat critical to the survival of the species’, as defined in the referral guidelines (DoE 2014c).

16.3.3.5. Migratory species


Eight migratory bird species listed under the EPBC Act have been recorded or are predicted to occur at the airport site or within the locality and may be affected by the proposed airport. These species are described in Appendix K1 in Volume 4 and are listed in Table 16–7. Their distribution at the airport site is shown on Figure 16–3. Those species recorded during the field surveys are highlighted in bold text in Table 16–7.

Table 16–7 – Migratory species known or likely occur at the airport site

Scientific name	Common name	Conservation status ¹	
		TSC Act	EPBC Act
<i>Apus pacificus</i>	Fork-tailed Swift	-	M,C,J,K
<i>Ardea alba</i>	Great Egret	-	M,C,J
<i>Ardea ibis</i>	Cattle Egret	-	M,C,J
<i>Gallinago hardwickii</i>	Latham's Snipe	-	M,C,J,K
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	-	M,C
<i>Hirundapus caudacutus</i>	White-throated Needletail	-	M,C,J,K
<i>Merops ornatus</i>	Rainbow Bee-eater	-	M,J
<i>Rhipidura rufifrons</i>	Rufous fantail	-	M

Notes: 1. Conservation status: M = Migratory; C = China-Australia Migratory Bird Agreement (CAMBA), J = Japan-Australian Migratory Bird Agreement (JAMBA) and K = Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA), **Bold** = recorded during field surveys

Seven migratory bird species listed under the EPBC Act were recorded at the airport site during the field surveys. Cattle Egrets (*Ardea ibis*) were observed at a number of locations in paddocks and near dams, and on several occasions flocks of about 30 individuals were recorded. Occasional individual Great Egrets (*Ardea alba*) were observed at dams and one Latham’s Snipe (*Gallinago hardwickii*) was disturbed from exotic grassland adjacent to a dam.



The White-bellied Sea-eagle (*Haliaeetus leucogaster*) was observed either flying over dams or perching on large trees near dams. A flock of White-throated Needletails (*Hirundapus caudacudatus*) was also recorded foraging high above the airport site. The Rainbow Bee-eater (*Merops ornatus*) was heard on a number of occasions in patchy woodland remnants in the vicinity of Badgerys Creek. The Rufous Fantail (*Rhipidura rufifrons*) was observed foraging in grassy woodland at a number of locations across the airport site.

In addition to the seven migratory bird species recorded at the airport site, a flock of about 40 shorebirds was observed during the field surveys. While these were not able to be identified, they were likely to be a type of sandpiper. Potential species include the Marsh Sandpiper (*Tringa stagnatilis*) and the Sharp-tailed Sandpiper (*Calidris acuminata*), which are known to occur on farm dams or the Common Greenshank (*Tringa nebularia*), previously recorded in the locality.

The EPBC Act lists families of birds (such as ducks, waders, eagles and hawks) that are also known to be migratory but are not listed under international agreements. A range of waterfowl and waders have been recorded at the airport site. Other seasonally migratory or nomadic species would also be likely to occasionally use habitats at the airport site.

The airport site is not considered important habitat for any of these migratory species, according to the significant impact criteria for migratory species. The airport site would not support an ecologically significant proportion of the population of these species, is not of critical importance to these species at particular life-cycle stages, is not at the limit of these species ranges, and is not within an area where these species are declining (DEWHA 2009).

16.3.4. Aquatic flora, fauna and habitat

16.3.4.1. Aquatic flora

Thirteen aquatic plant species were recorded within the waterbodies (wetlands and creeks) sampled at the airport site and in the locality. This included 10 native species and three exotic species (two of which are declared noxious weeds – Salvinia (*Salvinia molesta*) and Water Hyacinth (*Eichhornia crassipes*)). The list of aquatic plant species recorded within waterbodies at the airport site is provided in Appendix K1 in Volume 4. Where exotic or declared noxious weed species were found, they tended to dominate the waterbody.

16.3.4.2. Aquatic fauna

Eight fish species were recorded within the waterbodies sampled at the airport site and in the locality. These included five native species and three exotic species. Of the native fish species collected, the Firetail Gudgeon (*Hypseleotris galii*) was the most widespread. Exotic species were present at almost all survey sites and accounted for the majority of the species sampled. These included Eastern Gambusia (*Gambusia holbrooki*), Common Carp (*Cyprinus carpio*) and Goldfish (*Carassius auratus*). Eastern Gambusia and Common Carp are both listed as noxious fish under the FM Act. The presence and overwhelming abundance of exotic fish species recorded during the field surveys indicates that aquatic habitat at the airport site and in the locality is highly modified and degraded.

A total of 1,075 individual macroinvertebrates from 15 taxonomic groups were identified within the waterbodies sampled at the airport site and in the locality. The macroinvertebrate communities were dominated by Dipterans (true flies) (31 per cent), Acarina (water mites) (25 per cent) and Odonata (dragonflies) (10 per cent). The taxonomic groups recorded during the field surveys were generally made up of groups that have a high tolerance to moderate to severe pollution.

All survey sites had very low SIGNAL 2 scores (ranging from 1.31 to 3.75). These scores indicate that waterbodies at the airport site and in the locality have been subject to or are consistently exposed to severe pollution.

The survey sites had AUSRIVAS classifications indicating the waterbody is significantly to extremely impaired and highly degraded with very low water quality and habitat quality.

No threatened fish species listed under the EPBC Act and/or the FM Act identified in the database searches as potentially occurring in the locality were collected during the surveys. No suitable habitat for these species was observed during the site visits, which is in agreement with the findings of the SMEC (2014).

16.3.4.3. Aquatic habitat

As discussed above, the presence and abundance of exotic fish species and the variety of macroinvertebrates recorded during the field surveys indicates that aquatic habitat at the airport site and in the locality is severely modified and degraded.

The results from the fish habitat assessment indicates that 22 per cent of sites are classified as Class 2 (moderate habitat), 71 per cent of sites are classified as Class 3 (minimal fish habitat), and seven per cent as Class 4 (unlikely habitat) (DPI 2013). The majority of the survey sites were intermittent in nature with some indication of semi-permanent pools existing throughout the reaches surveyed, which may provide refuge during periods of stress for some fish species. The intermittent nature of these systems also suggests that they are unlikely to be suitable habitat for the listed threatened species recorded in the database search.

The results of the water quality assessment also indicate that aquatic habitats at the airport site and in the locality are affected by poor water quality. Electrical conductivity was high at all survey sites (factors that contributed to this could include the influence of local geology, groundwater input during periods of low flow, salinity issues due to agricultural practices, or a combination of these factors). Dissolved oxygen levels were generally low, likely due to a combination of low flow conditions and nutrient enrichment. Alkalinity levels indicated moderate to very hard waters. Survey sites with high alkalinity were also those with elevated electrical conductivity, so some of the high electrical conductivity at those sites relates to elevated calcium and carbonate ion levels.

High levels of zinc, nickel and copper were recorded at the survey sites. While these metals occur naturally, high levels of each can indicate specific catchment-related impacts such as industry, fertilisers and runoff from roads. Total nitrogen and total phosphorous concentrations were high at all survey sites, consistent with the agricultural land use at the airport site and in the locality.

16.3.4.4. Threatened species, populations and ecological communities

No threatened aquatic flora or fauna species, populations or ecological communities listed under the EPBC Act or the FM Act were recorded at the airport site or in adjoining downstream areas and none are likely to occur given known distributions and the absence of suitable habitat.

16.3.5. Additional matters of national environmental significance

There are several matters of national environmental significance (MNES) that are protected under the EPBC Act. Among these are threatened species, populations and ecological communities plus migratory species protected under international agreements (addressed in Section 16.3.2, Section 16.3.3 and Section 16.3.4). Other MNES include world heritage areas.

The Greater Blue Mountains Area is listed as a declared World Heritage Area and a National Heritage Place under the EPBC Act. The Greater Blue Mountains Area is located approximately eight kilometres to the west of the airport site and is separated from the airport site by extensive areas of residential and agricultural land, fragmented patches of native vegetation, roads and the Nepean River.

The Greater Blue Mountains World Heritage Area consists of approximately 1.03 million hectares of sandstone plateaus, escarpments and gorges dominated by temperate eucalypt forests. The area is noted for its diversity of eucalypts, which are associated with its wide range of habitats as well as significant numbers of rare or threatened species, including endemic and evolutionary relict species. A significant proportion of the Australian continent's biodiversity occurs in the area (UNESCO 2015). The Greater Blue Mountains World Heritage Area protects a large number of pristine and relatively undisturbed catchment areas, some of which make a substantial contribution to maintaining high water quality in a series of water storage reservoirs supplying Sydney and adjacent rural areas (DECC 2009c).

There are no other MNES (for example wetlands of international importance, marine areas, nuclear actions, etc.) at the airport site or in the locality.

16.4. Assessment of impacts during construction

This section presents the anticipated impacts of the Stage 1 development on terrestrial and aquatic flora and fauna at the airport site and in the locality during construction. Construction of the Stage 1 development would result in both direct and indirect impacts on terrestrial and aquatic flora and fauna, as discussed below. Mitigation measures to avoid or reduce these impacts are discussed in Section 16.7.

16.4.1. Direct impacts

Direct impacts on terrestrial and aquatic flora and fauna during construction of the Stage 1 development include the removal of vegetation and the loss of terrestrial, wetland and aquatic fauna habitat.

16.4.1.1. Removal of vegetation

Construction of the Stage 1 development would result in the removal of approximately 1,065 hectares of vegetation. The majority of this vegetation consists of exotic grassland and cleared land or cropland, dominated by exotic species and noxious and environmental weeds. Vegetation removal by vegetation zone is summarised in Table 16–8.

Approximately 784.2 hectares of exotic grassland and cleared land or cropland would be removed. These vegetation zones contain little native vegetation cover and have limited habitat value for native plants. Vegetation clearing in these areas would remove a small number of non-threatened native plants, and noxious and environmental weeds.

Approximately 280.8 hectares of native vegetation would be removed, comprising around 146.1 hectares of good condition native vegetation (occurring in small, fragmented patches with moderate weed infestation) and a further 134.7 hectares of poor condition native vegetation (occurring as derived native grassland or scrub with moderate to severe weed infestation).

As discussed in Section 16.3.2, native vegetation at the airport site constitutes a local occurrence of Cumberland Plain Woodland, patches of which are commensurate with the EPBC Act listed form of this threatened ecological community. Native vegetation at the airport site also constitutes a number of threatened ecological communities listed under the TSC Act. Populations of threatened plants listed under the EPBC Act and/or TSC Act also occur at the airport site. The impacts of vegetation removal on threatened species, populations and ecological communities are discussed in Section 16.6.

Vegetation clearance would include the loss of woodland and forest vegetation that contains an overstorey of mature trees (approximately 120.6 hectares). Mature trees have particular value within plant populations because they take longer to replace and are sources of pollen and seed. There are moderate areas of these vegetation types and plant species in the locality, including around 12,568 hectares of similar woodland and forest on shale or alluvial substrates within a 10 kilometre radius of the airport site. Around 61 hectares of native vegetation would also be retained in the environmental conservation zone at the airport site, as shown in the draft Airport Plan.

These zones contain representative areas of each of the vegetation types at the airport site and would support many of the plant species in the construction impact zone. The environmental conservation zone is located around Badgerys Creek along the southern perimeter of the airport site, around Oaky Creek along the north-western perimeter of the airport site and along the south-western part of the airport site. These would help maintain vegetation connectivity and allow pollination, seed fall and other ecological processes that are necessary to maintain plant populations. Flora populations are also likely to persist within adjoining areas of alternative habitat beyond the airport site.

Plant species with a limited distribution in the locality would be most affected by the removal of vegetation. Notably, the population of *Marsdenia viridiflora* subsp. *viridiflora* at the airport site would be removed, which would comprise a significant impact at the local scale (refer to Section 16.6).

The removal of native vegetation at the airport site is less significant at the regional scale and is unlikely to threaten the persistence of any populations of native plants or vegetation communities. It is unlikely that an ecologically significant proportion of any regional plant population would be located entirely within the airport site. At the regional scale, flora populations would persist in habitat that is conserved in Kemps Creek Nature Reserve, Mulgoa Nature Reserve, existing and proposed BioBank sites at Mulgoa and in the Ropes and South Creek riparian corridors, the Western Sydney Parklands and other offset sites linked to the North and South West Growth Centres. Notably, there is a parcel of land with shale/gravel transition habitat located at Kemps Creek around three kilometres to the east of the airport site that will be set aside as an offset for the South West Growth Centres. This site contains local populations of *Pultenaea parviflora* and other threatened plant species that may be affected by the construction of the Stage 1 development.

Table 16–8 – Estimated vegetation removal by vegetation zone (Stage 1 development)

Vegetation zone	Conservation status ¹		Direct impact (hectares)
	EPBC Act	TSC Act	
Native vegetation zones			
Good condition Grey Box – Forest Red Gum grassy woodland on flats (HN528)	CEEC	CEEC	71.3
Poor condition Grey Box – Forest Red Gum grassy woodland on flats (HN528)		CEEC	107.8
Good condition Grey Box – Forest Red Gum grassy woodland on hills (HN529)	CEEC	CEEC	17.3
Poor condition Grey Box – Forest Red Gum grassy woodland on hills (HN529)		CEEC	22.3
Good condition Forest Red Gum – Rough-barked Apple grassy woodland (HN526)		EEC	29.8
Poor condition Forest Red Gum – Rough-barked Apple grassy woodland (HN526)		EEC	4.2
Good condition Broad-leaved Ironbark – Grey Box – <i>Melaleuca decora</i> grassy open forest (HN512)	CEEC	EEC	2.2
Poor condition Broad-leaved Ironbark – Grey Box – <i>Melaleuca decora</i> grassy open forest (HN512)		EEC	0.4
Good condition artificial freshwater wetland on floodplain (HN630)			25.4
Total removal native vegetation			280.8
Non-native vegetation zones			
Exotic grassland			628.8
Cleared land or cropland			155.4
Total removal non-native vegetation			784.2
Total vegetation removal			1,064.9

Notes: 1. CEEC = Critically endangered ecological community, EEC = Endangered ecological community

16.4.1.2. Loss of terrestrial and wetland fauna habitat

The airport site provides habitat for a range of fauna groups including species of macropods, flying-foxes and bats, a wide variety of birds, reptiles (including goannas, snakes and lizards), frogs and small fish. The removal of vegetation at the airport site would result in the loss of fauna foraging, breeding, roosting, sheltering and/or dispersal habitat. The loss of terrestrial and wetland fauna habitat is summarised in Table 16–9 and is shown on Figure 16–3. The impacts of vegetation removal on threatened and migratory fauna habitat are discussed in Section 16.6.

Fauna species that would be most affected during construction of the Stage 1 development include those that occur in grassland areas, artificial wetlands (in the form of farm dams) and those that can use fragmented patches of woodland vegetation (the airport site does not provide habitat for species that need extensive patches of vegetation). Exotic grassland and cleared land or cropland provides only limited habitat values for fauna. The loss of these areas would remove foraging, breeding and shelter habitat for small grassland animals such as skinks, and would potentially result in the loss of local populations of these species. The loss of this habitat would also remove foraging habitat for macropods, open-country microchiropteran bats, and bird species such as the Australian Magpie (*Gymnorhina tibicen*), Australian Raven (*Corvus coronoides*), Magpie-lark (*Grallina cyanoleuca*), Straw-necked Ibis (*Threskiornis spinicollis*) and Cattle Egret (*Ardea ibis*), in particular.

Artificial wetlands, minor drainage lines and associated damp soaks would be removed. This would potentially result in the loss of local populations of frog species and the loss of habitat for waterbirds and microchiropteran bat species. Construction would also require the removal of woodland and riparian forest habitat. Clearing this vegetation would permanently remove foraging and breeding resources for native fauna, including birds and arboreal mammal species including bats.

Construction of the Stage 1 development would result in the loss of about 50 hollow-bearing trees, which occur as scattered trees across the airport site. The loss of hollow-bearing trees at the airport site would result in a loss of roosting and nesting habitat for birds and arboreal mammals such as possums and bats.

Shrub layers and leaf litter would also be removed during construction of the Stage 1 development. This would result in the loss of habitat for small woodland birds that rely on these resources for foraging and breeding. In addition, the loss of leaf litter would remove habitat for small reptiles and invertebrates that rely on this feature for shelter, breeding and foraging.

Table 16–9 – Estimated loss of terrestrial and wetland fauna habitat (Stage 1 development)

Habitat type	Area in Stage 1 construction impact zone (hectares)	Estimated extent in the locality (hectares) ¹	Percentage of the estimated extent in the locality
Woodland	90.8	10,014	0.91%
Riparian forest	29.8	2,555	1.16%
Total woodland and forest	120.6	17,393	0.69%
Artificial wetlands (farm dams) ²	25.4	-	-
Grassland ²	763.5	-	-
Cleared land and cropland	155.4	-	-
Total	1,064.9	-	-

Notes:

1. Based on mapping within the airport site and on a composite of Tozer et al. (2010) and NPWS (2002) mapping in the locality.
2. Wetland and grassland vegetation has not been mapped by Tozer et al. (2010) or NPWS (2002).

16.4.1.3. Loss of aquatic fauna habitat

Construction of the Stage 1 development would involve the infilling of stream reaches, including the upper reaches of Oaky Creek and smaller drainage lines that feed into Badgerys, Cosgroves and Duncans creeks within the construction impact zone, and the permanent loss of riparian and aquatic habitats associated with these features. All of the affected reaches are small and largely intermittent. All are highly modified and in poor condition as a result of historical and current land use and disturbance. Water quality is poor and the macroinvertebrate and fish communities are dominated by species indicative of disturbed habitats. Fish habitat is moderate or minimal at most sites and the habitats present are not suitable for threatened fish or invertebrate species (dragonflies) known or predicted to occur in the locality.

Badgerys Creek, which comprises the largest watercourse at the airport site, would be retained within an environmental conservation zone, as outlined in the draft Airport Plan.

A large number of artificial wetlands (farm dams) would be removed. In total, approximately 25.4 hectares of wetland habitat would be removed. These provide only limited habitat for native fish species, with most dams dominated by the exotic Eastern Gambusia. Farm dams are not key fish habitat and do not provide habitat for threatened species listed under the EPBC Act or the FM Act.

16.4.2. Indirect impacts

Construction of the Stage 1 development may result in indirect impacts such as habitat fragmentation; fauna displacement, injury or mortality; edge effects; altered hydrology; erosion, increased sedimentation and contamination; dust; increased light, noise and vibration; the spread of pests and pathogens; and an increased incidence of fire at the airport site. These impacts are discussed below.

16.4.2.1. Habitat fragmentation

Habitat fragmentation would increase at the airport site and in the locality as a result of the proposed airport. Habitat fragmentation can result in reduced dispersal and reproductive success of biota, a decline in populations resulting from increased predation by introduced species or native species that do not normally occur in the community, and an increased probability that stochastic events (for example, fire) may reduce some population numbers below critical levels required for their survival at the airport site. Past land use, including clearing for agriculture, rural-residential buildings and linear infrastructure such as transmission lines and roads, has resulted in a highly fragmented rural landscape at the airport site. This fragmentation has created barriers for some fauna species, particularly those that have limited dispersal capability and habitat preferences.

More mobile species such as birds and bats can readily traverse the landscape, which is reflected in the variety of fauna species recorded in field surveys. The proposed environmental conservation zone would retain woodland along Badgerys Creek, Oaky Creek and Duncans Creek riparian corridors and would assist in maintaining vegetated fauna movement corridors and habitat stepping stones around the airport site.

16.4.2.2. Fauna displacement, injury or mortality

The removal of vegetation has potential to result in fauna displacement, injury or mortality. This would be particularly the case for less mobile species such as invertebrates (snails), amphibians, small reptiles and terrestrial mammals. More mobile species such as birds, macropods and larger terrestrial mammals would be able to avoid vegetation removal and other construction activities, seeking refuge in nearby alternative habitat outside the airport site. Fauna displacement to nearby habitat may result in increased competition for resources with existing resident fauna. Breeding success may also be disrupted for one or more seasons. There would be mortality of aquatic fauna (including fish, eels, turtles and frogs) associated with the infilling of streams and artificial wetlands.

16.4.2.3. Edge effects

'Edge effects' refer to factors including weed invasion, increased noise and light, and erosion and sedimentation at the interface of intact vegetation and cleared areas. Edge effects may result in impacts such as changes to plant community type and structure, increased growth of exotic plants, increased predation of native fauna or avoidance of habitat by native fauna. Construction activities could result in the dispersal of weed propagules into areas of native vegetation through vegetation clearing, erosion and from the movement of workers and vehicles. The effects of erosion and sedimentation and increased light and noise are discussed below.

Given the fragmented nature of habitat in the locality and the extent of exotic plant cover, construction activities would have a minor effect on the extent and seriousness of edge effects in the locality and would be unlikely to introduce any new weed species or increase the prevalence of weed infestations.

16.4.2.4. Altered hydrology

The existing landform and hydrology within the construction impact zone would be altered at the airport site. These alterations have the potential to affect the hydrological regime downstream of the airport site, impacting aquatic and riparian communities. A water management system has been developed for the Stage 1 development, which would include establishing a series of seven detention basins on the periphery of the airport site to retain stormwater runoff prior to discharge into nearby creeks. The basins have been sized to manage post-development flows to pre-development levels, and would be sited to allow discharge points consistent with existing drainage lines to minimise impacts on downstream hydrology.

16.4.2.5. Erosion, sedimentation and contamination

Erosion, sedimentation and potential contamination may occur from activities such as vegetation removal, excavations and earthworks, and the accidental release of fuel, oil or other chemicals. This could result in reduced habitat quality and the potential mortality of aquatic flora and fauna downstream of the airport site.

16.4.2.6. Dust

Dust from vegetation removal, excavation and earthworks could reduce plant and animal health. Dust may affect photosynthesis, respiration and transpiration in plants, and allow the penetration of gaseous pollutants. This could then lead to decreased productivity and in the long term could alter community structure. Dust could also impact the health of fauna, such as through respiratory disease, and the reduction in health of animals could be exacerbated by changes to plant health and community structure.

16.4.2.7. Light, noise and vibration

An increase in light at the airport site from vehicles and machinery could affect nocturnal fauna, potentially disrupting movement and behaviour. Construction activities would also result in an increase in noise levels at the airport site, which may affect fauna species. Some fauna species would likely tolerate an increase in noise, while others may not, causing them to leave the affected area or making the area less desirable for foraging, nesting and breeding.

Vibration from construction activities such as heavy vehicle movements may deter native fauna from using the area near vibration sources. This may potentially interrupt dispersal within the locality if an individual is unwilling to travel through an area where vibration is detectable, or may cause some species to abandon an area in search of areas where vibration is not detectable.

16.4.2.8. Spread of pests and pathogens

There is the potential to introduce or spread pathogens such as Phytophthora (*Phytophthora cinnamomi*), Myrtle Rust (*Uredo rangeli*) and Chytrid fungus (*Batrachochytrium dendrobatidis*) into adjacent native vegetation through vegetation disturbance and increased visitation. Phytophthora and Myrtle Rust may result in the dieback or modification of native vegetation and damage to fauna habitats. Chytrid fungus affects both tadpoles and adult frogs and can cause mortality in some populations once introduced into an area.

16.4.2.9. Fire

There may be an increase in the incidence of fire at the airport site from the accidental ignition of combustible fuels. An increase of fire could result in the injury or mortality of flora and fauna at the airport site or locality.

16.5. Assessment of impacts during operation

This section presents the anticipated impacts of the Stage 1 development on terrestrial and aquatic flora and fauna at the airport site and in the locality during operation. Similar to construction, operation of the Stage 1 development would result in both direct and indirect impacts on terrestrial and aquatic flora and fauna, as discussed below. Mitigation measures to avoid or reduce these impacts are discussed in Section 16.7.

16.5.1. Direct impacts

Direct impacts on terrestrial and aquatic flora and fauna during operation of the Stage 1 development include bird and bat strike and terrestrial fauna strike from aircraft and ground transportation vehicles.

16.5.1.1. Bird and bat strike


Operation of the Stage 1 development would create a risk of mortality for birds and bats at or near the airport site. Birds are often attracted to airports because of the presence of grass, lights, water, feeding trees, or roosts, while bats (particularly flying-foxes) tend to come in contact with aircraft while transiting between roosting sites (camps) and foraging areas (Parsons et al. 2009).

Although potentially moderate and high risk species were recorded during the field surveys, their numbers were not unusually large and there were limited transits through the air. While birds are likely to be struck on occasion, management measures would minimise the risk of this occurring and, as such, the viability of populations in the local area is not likely to be threatened.

A high diversity of bird species were recorded at the airport site, including many that occur in large flocks or that would fly at heights where aircraft strike is a risk. A small number of large raptors were observed at the airport site, including Wedge-tailed Eagles (*Aquila audax*), White-bellied Sea-eagles (*Haliaeetus leucogaster*), Little Eagles (*Hieraaetus morphnoides*), Black Kites (*Milvus migrans*) and Whistling Kites (*Haliastur sphenurus*). It is most likely that one or two pairs of each species occur at or near the airport site. Large flocks of ibis and herons occur at or in the vicinity of the airport site, due to the large number of farm dams and fertilised crop fields, as do a wide variety of ducks and other waterbirds. Few migratory wader species are likely to occur at or in the vicinity of the airport site, although at least two species were recorded. A wide range of other bird species is also likely to be at risk of aircraft strike, including magpies, swallows, ducks and ravens.

The bird and bat strike risk assessment found these bird species would present at least a moderate strike risk during operation of the Stage 1 development. Farm dams are common in the surrounding area and present the greatest bird hazard for the airport. Nearby landfills also support high numbers of large birds, which may result in birds transiting the operational airspace.

There are at least seven flying-fox camps located within 20 kilometres of the airport site. Bats travelling from local camps to foraging areas may fly across the airport site and approaches and be



at risk from aircraft strike. While occasional bats may be killed by aircraft strike, this is not likely to substantially change the population numbers in nearby camps.

16.5.1.2. Other terrestrial fauna strike

Movement of aircraft and support vehicles on the tarmac has the potential to result in the injury or mortality of fauna that reside or forage in cleared areas alongside the tarmac. These fauna species may attempt to cross the tarmac and be struck by aircraft and support vehicles. The final design of the proposed airport would consider deterrence measures such as fencing of the airport site, which would likely prevent large mammals such as kangaroos and wallabies entering the airport site, thus minimising the potential for impact.

There would be an increase in general traffic in the area surrounding the airport site that could result in an increased risk of fauna injury or mortality on surrounding roads. Vehicle strike on surrounding roads is already likely to be high, given the presence of vegetated and agricultural areas. As Western Sydney continues to grow and more areas of agricultural and forested land are removed, fauna mortality from vehicle strike would reduce.

16.5.2. Indirect impacts

Operation of the Stage 1 development may result in indirect impacts such as increased light noise and vibration; an increased incidence of fire; contamination of aquatic habitats; decreased water quality and changes to the hydrology of waterbodies; and the introduction of exotic species. These impacts are discussed below.

16.5.2.1. Light, noise and vibration

Increased light associated with tarmac and terminal lighting and from aircraft and ground transportation vehicles could affect fauna species at the airport site and in the locality. Many fauna individuals and species that are currently resident at the airport site would already be accustomed to existing residential and road lighting. The increased light may, however, result in the displacement of less tolerant species, but could also attract some birds and bats that forage on insects attracted to light. These species may then be susceptible to aircraft strike in the absence of mitigation.

Aircraft and vehicle movements at the airport site would result in increased noise and vibration. Fauna most at risk would be those residing in close proximity to the airport site. Most fauna species are likely to become accustomed to increased noise and vibration, as many species that occur in the surrounding area are already accustomed to noise from roads and agricultural areas. Increased noise and vibration, however, may result in impacts to foraging and breeding behaviours and/or the displacement of less tolerant species.

16.5.2.2. Fire

There may be an increase in the incidence of fire at the airport site from the accidental ignition of combustible fuels or from aircraft incidents. An increase of fire could result in the injury or mortality of flora and fauna at the airport site or in the locality.

16.5.2.3. Contamination

Spills of fuel, oil or other chemicals such as pesticides and/or herbicides could reduce habitat quality and potentially harm or kill aquatic flora and fauna downstream of the airport site.

16.5.2.4. Water quality and hydrology

Water quality at the airport site is poor, with high levels of nutrients and suspended solids and elevated electrical conductivity levels due to salinity issues. Dissolved oxygen levels are also low. It is likely that water released downstream of the airport site during operation would be improved compared to current catchment discharges. This should have a net beneficial effect on aquatic flora and fauna in waterbodies close to the airport site.

Operation of the Stage 1 development would likely affect flows in receiving waterbodies both upstream and downstream of the airport site. Hydrologic and hydraulic modelling indicates that duration, volume and velocity of surface water flows in watercourses would generally be similar or reduced when compared to existing flow conditions (refer to Chapter 18 Surface water and groundwater). Impacts on aquatic habitat and key fish habitat may, therefore, occur as a result of this changed hydrology. These impacts are likely to be restricted to reaches close to the airport site. Further downstream, inflow from other creeks would dissipate these changes. Few native species (gudgeons) were recorded at the airport site, and these were generally located in the Oaky Creek sites. Eels were recorded at dams and in Badgerys Creek. Given the generally poor quality of aquatic habitats in and downstream of the airport site, it is unlikely that the proposed airport would have a substantial impact on fish habitat in downstream areas.

Further resolution of appropriate management and mitigation measures would be provided in the final EIS having regards to the potential for impacts upon any downstream threatened species.

16.5.2.5. Introduction of exotic species

As with any international airport, there is the potential for the introduction of exotic species as a result of the transport of goods on aircraft. Any escaped exotic species could potentially establish in nearby vegetated areas, or be unintentionally transported to other areas of native vegetation and impact the local native flora and fauna. These risks are managed through the biosecurity regulatory framework.

16.5.2.6. Fuel jettisoning

As discussed in Chapter 7, fuel jettisoning is extremely rare worldwide and generally only occurs during an emergency, as a safety precaution when a plane must land prematurely. Airservices Australia indicates that of the 730,201 aircraft movements in Australia in 2014, there were only 10 instances of fuel jettisoning. There are currently no recorded cases of fuel from civilian aircraft reaching the ground.

There are specific protocols in place to regulate fuel jettisoning in Australia. For example, pilots must obtain authority from air traffic control before commencing a fuel jettison and must receive instruction on where the fuel jettison is to be performed. Fuel jettisons are required to occur in clear air at 6,000 feet (approximately 2,000 metres) above ground level, and in an area nominated by air traffic control to ensure that all fuel is vaporised before reaching the ground. Reasonable precautions must also be taken to ensure the safety of persons and property in the air and on the ground.

Due to improvements in fuel efficiency and lightweight aircraft material, the amount of fuel jettisoned from an aircraft under emergency situations has decreased substantially, with this trend anticipated to continue. As fuel efficiency, technology and airspace management continue to improve, volumes of fuel required to be carried on planes will steadily decline in the future. This will, in turn, reduce the amount of fuel jettisoned in the event of an emergency.

The effects of fuel jettisoning on local air quality would be limited due to the inability of many aircraft to perform fuel jettisons, the rapid vaporisation and wide dispersion of jettisoned fuel, the strict guidelines on fuel jettisoning altitudes and locations, and the anticipated reduction in fuel jettisoning events and volumes in the future. For these reasons, fuel jettisoning is not considered likely to have a significant immediate or future impact on local air quality or on biodiversity values.

16.6. Assessments of significance

This section lists key threatening processes of relevance to the Stage 1 development and discusses impacts on MNES and on State-listed threatened species, populations and ecological communities from the construction and operation of the Stage 1 development. Impacts of the long term development are also discussed.

16.6.1. Key threatening processes

Key threatening processes threaten, or have the potential to threaten, the survival or evolutionary development of a species, population or ecological community. They are listed under the EPBC Act, TSC Act and/or FM Act. The key threatening processes of relevance to the Stage 1 development are listed in Table 16–10. Key threatening processes have been considered in the assessment of impacts and tests of significance for the listed species, populations and ecological communities potentially present at the airport site and mitigation measures to limit the potential impacts are discussed in Section 16.7.

Table 16–10 – Key threatening processes

Key threatening process	Status
EPBC Act key threatening processes	
Clearing of native vegetation	EPBC Act/TSC Act
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants	EPBC Act/TSC Act
Novel biota and their impact on biodiversity	EPBC Act
Infection of native plants by <i>Phytophthora cinnamomi</i>	EPBC Act/TSC Act
Infection of frogs by amphibian chytrid causing the disease chytridiomycosis	EPBC Act/TSC Act
Aggressive exclusion of birds from potential woodland and forest habitat by over-abundant Noisy Miners (<i>Manorina melanocephala</i>)	EPBC Act/TSC Act
Predation by the European red fox	EPBC Act/TSC Act
Predation by feral cats	EPBC Act/TSC Act
Competition and land degradation by rabbits	EPBC Act/TSC Act

Key threatening process	Status
Human-caused climate change	EPBC Act/TSC Act
TSC Act and FM Act key threatening processes	
Clearing of hollow-bearing trees	TSC Act
Removal of dead wood and dead trees	TSC Act
Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae	TSC Act
Invasion of plant communities by perennial exotic grasses	TSC Act
Forest eucalypt dieback associated with over-abundant psyllids and Bell Miners	TSC Act
Invasion of native plant communities by African Olive <i>Olea europaea</i> subsp. <i>cuspidata</i> (Wall. ex G. Don) Cif.	TSC Act
Invasion of the Yellow Crazy Ant <i>Anoplolepis gracilipes</i> (Fr. Smith) into NSW	TSC Act
Predation by the Plague Minnow (<i>Gambusia holbrooki</i>)	TSC Act
Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands	TSC Act/FM Act
The degradation of native riparian vegetation along NSW water courses	FM Act
The removal of large woody debris from NSW rivers and streams	FM Act

16.6.2. Impacts on matters of national environmental significance

Assessments of significance for MNES have been prepared in accordance with the *Significant Impact Guidelines 1.1 – Matters of National Environmental Significance* (DoE 2013a) and the *Significant Impact Guidelines 1.2 – Actions on, or Impacting upon, Commonwealth Land and Actions by Commonwealth Agencies* (DoE 2013b). The assessments of significance are included in Appendix K1 in Volume 4.

This assessment was based on the Stage 1 development but also considered cumulative impacts that would occur with the long term development.

A significant impact was determined for Cumberland Plain Woodland and the Grey-headed Flying-fox. Construction and operation of the proposed airport would also have a significant impact on plants and animals on Commonwealth land. The key findings of the assessments are summarised below.

16.6.2.1. Threatened flora species

One threatened flora species listed under the EPBC Act was recorded at the airport site during the field surveys – *Pultenaea parviflora*. An additional five species listed under the EPBC Act are considered likely to occur at the airport site and include Downy Wattle (*Acacia pubescens*), White-flowered Wax Plant (*Cynanchum elegans*), Small-flower Grevillea (*Grevillea parviflora* subsp. *parviflora*), Spiked Rice-flower (*Pimelea spicata*) and Austral Toadflax (*Thesium australe*) (refer to Table 16–5). Assessments of significance were prepared for these threatened flora species, the results of which are summarised below with further detail provided in Appendix K1 in Volume 4.

Pultenaea parviflora

Construction of the Stage 1 development would require the removal of four *Pultenaea parviflora* individuals which would be the entire known local population at the airport site. Construction of the airport would also require the removal of approximately 90.8 hectares of potential habitat for the Stage 1 development and up to approximately 57 hectares of additional potential habitat for the long term development. The *Significant Impact Guidelines 1.1 – Matters of National Environmental Significance* (DoE 2013a) include specific criteria for assessing impacts on a vulnerable species, which primarily relate to impacts on an important population.

The population of *Pultenaea parviflora* at the airport site is not an important population because:

- it is not identified in a recovery plan;
- it would not be important for breeding or dispersal as it includes only four plants and it is in a comparatively isolated and poor quality patch of habitat surrounded by extensive areas of cleared cropland or grazing country;
- it is not important for maintaining genetic diversity because it comprises only four plants that are in close proximity and as such would be unlikely to contain much genetic diversity. Further, this genetic material has already been retained via the Royal Botanic Gardens Trust sampling and propagation programme (RBGS 1992); and
- this population is near the limit of the species range as it is at the western extent of recognised outlier populations near Kemps Creek (OEH 2015b). The majority of the known population at Kemps Creek is associated with a parcel of land within tertiary gravel and shale/gravel transition habitat located around three kilometres to the east of the site (OEH 2015a). This land parcel is to be set aside as an offset for the South West Growth Centres. The population at the airport site would probably make a very minor contribution to the viability of this population.

Therefore, construction of the proposed airport would not result in any direct impacts on an important population of the species and would not substantially interfere with the recovery of *Pultenaea parviflora*. The proposed airport would not result in a significant impact on *Pultenaea parviflora*.

Other threatened flora species

Construction and operation of the airport would not affect any known populations of the endangered White-flowered Wax Plant or Spiked Rice-flower, nor would it affect the vulnerable species Downy Wattle, Small-flower Grevillea or Austral Toadflax. Despite targeted surveys for these species, there is no evidence that the airport site or any adjoining areas of vegetation contain populations of these threatened plants (PPK 1997; SMEC 2014; OEH 2015a). Any populations of these threatened plant species at the airport site are likely to have relatively low viability since they are not abundant or extensive enough to have been detected by surveys. The airport site is also extensively degraded and modified and there is limited potential for either recruitment or population expansion given the extent of habitat fragmentation.

Any local populations of these species (if present) would probably make a minor contribution to the maintenance or recovery of these species. Given these considerations, the proposed airport is unlikely to interfere with the recovery of any of these threatened plant species. The airport would not result in a significant impact on Downy Wattle, White-flowered Wax Plant, Small-flower Grevillea, Spiked Rice-flower or Austral Toadflax.

Since the proposed airport is not likely to result in a significant impact on these threatened species, there is no requirement to calculate or deliver direct biodiversity offsets in accordance with the *Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy* (DSEWPaC 2012) (EPBC Act Offsets Policy). However, any potential impacts on these threatened plant species would be substantially offset through the biodiversity offset package for the proposed airport (refer to Section 16.8).

16.6.2.2. Threatened ecological communities

One threatened ecological community listed under the EPBC Act was recorded at the airport site – Cumberland Plain Woodland (refer to Section 16.3.2). An assessment of significance was undertaken for Cumberland Plain Woodland. Construction of the proposed airport would require the removal of approximately 90.8 hectares of this community for the Stage 1 development and an additional 57 hectares for the long term development. Construction of the proposed airport is likely to have a significant impact on the local and regional occurrence of Cumberland Plain Woodland. A significant impact would occur through a substantial reduction in the extent of the community and increase in the degree of fragmentation which would in turn result in a negative effect on the potential for recovery of the community.

A biodiversity offset package has been prepared to compensate for these significant impacts (refer to Section 16.8). This includes the protection and management of Cumberland Plain Woodland at offset sites in perpetuity.

16.6.2.3. Threatened fauna species

One threatened fauna species listed under the EPBC Act was recorded at the airport site during the field surveys – the Grey-headed Flying-fox. Three additional species listed under the EPBC Act are considered likely to occur at the airport site and include the Australasian Bittern, Swift Parrot and Australian Painted Snipe (refer to Table 16–6). Assessments of significance were prepared for the Grey-headed Flying-fox and the Swift Parrot, the results of which are provided below. The Australasian Bittern and Australian Painted Snipe may occur at the airport site on a transient basis and only low quality potential habitat is present at the airport site for these species. The construction and operation of the airport is highly unlikely to have a significant impact on these species and, as such, assessments of significance were not prepared for these species.

Grey-headed Flying-fox

The airport site may provide foraging habitat during food bottlenecks for the Grey-headed Flying-fox. Much of the foraging habitat in the locality would be of a similar nature and may comprise habitat critical to the survival of the species, as defined in the draft recovery plan for the Grey-headed Flying-fox (DECCW 2009). Construction of the Stage 1 development would require the removal of approximately 120.6 hectares of foraging habitat and 78.6 hectares of foraging habitat for the long term development, which is a large area of foraging habitat in a fragmented rural landscape.

These areas of habitat contribute to the availability of foraging resources for local camps when resources are scarce and at critical life stages. In addition, development of the locality would likely follow as a result of the construction of the airport, resulting in additional clearing of foraging habitat for the species. Furthermore, individuals may be at risk of mortality from aircraft strike during operation, though this is unlikely to substantially impact the population as a whole. For these reasons, the airport may interfere with the recovery of the species and is likely to have a significant impact on the Grey-headed Flying-fox.

A biodiversity offset strategy has been prepared for the airport to compensate for these significant impacts (refer to Section 16.8). This would include the protection and management of Grey-headed Flying-fox habitat at offset sites in perpetuity.

Swift Parrot

Dominant canopy species at the airport site include Grey Box and Forest Red Gum, which may provide foraging resources for migrating Swift Parrots. However, much of the airport site is vegetated with relatively young regrowth, which is not the preferred foraging habitat of the species. A range of aggressive competitors such as the Noisy Miner (*Manorina melanocephala*) and the Bell Miner (*Manorina melanophrys*) are common at the airport site, potentially further reducing habitat suitability for the Swift Parrot. The construction of the airport would require the removal of approximately 120.6 hectares of highly fragmented, relatively low quality potential foraging habitat for the Stage 1 development and an additional 78.6 hectares of foraging habitat for the long term development. Approximately 61 hectares of potential habitat would be retained within the environmental conservation zone along Badgerys Creek. A total of about 17,393 hectares of potential foraging habitat (woody native vegetation) is mapped in the locality, although not all of this vegetation is likely to be suitable for the species. There is a low risk of aircraft strike for this species given the low numbers that may forage in the area, and lack of good quality foraging habitat in surrounding areas. The proposed airport is unlikely to result in a significant impact on the Swift Parrot.

16.6.2.4. Migratory species

Eight migratory species listed under the EPBC Act have been recorded or are predicted to occur at the airport site (refer to Table 16–7). The Stage 1 development would require the removal of approximately 25.4 hectares of artificial wetlands (habitat for the Great Egret, Cattle Egret, Latham’s Snipe and White-bellied Sea-eagle), 120.6 hectares of woodland and forest vegetation (habitat for the Rufous Fantail and Rainbow Bee-eater), and 628.8 hectares of exotic grassland (habitat for the Cattle Egret). No habitat for the White-throated Needletail would be removed as this species forages in the air, well above the ground. The long term development would require the removal of a further 9.6 hectares of artificial wetland, 78.5 hectares of woodland and forest and 279.2 hectares of exotic grassland. While birds are likely to be struck by aircraft on occasion during operation, management measures would minimise the risk of this occurring and, as such, the viability of populations in the local area are not likely to be threatened.

The airport site is not considered important habitat for any of these species, according to the significant impact criteria for migratory species (DEWHA 2009). Construction and operation of the proposed airport is, therefore, unlikely to result in significant impacts on these migratory fauna species. No assessments of significance have been prepared for these species.

16.6.2.5. Greater Blue Mountains World Heritage Area

An assessment of significance has been prepared in accordance with the *Significant Impact Guidelines 1.1 – Matters of National Environmental Significance* (DoE 2013a) for impacts on the Greater Blue Mountains World Heritage Area. The results of this assessment are summarised below with further detail provided in Appendix K1 in Volume 4. The assessment focused on biodiversity values, in particular.

It is unlikely that construction and subsequent operation of the proposed airport would have a significant impact on biodiversity values of the Greater Blue Mountains World Heritage Area for the following reasons:

- there would be no direct impact on the Greater Blue Mountains World Heritage Area;
- the construction and operation of the proposed airport is unlikely to result in the loss of biological diversity or biological processes within the Greater Blue Mountains World Heritage Area;
- potential impacts on the Greater Blue Mountains World Heritage Area as a result of changes to air quality are likely to be negligible given the distance to the Greater Blue Mountains World Heritage Area and prevailing wind conditions;
- the airport design and land use plan includes measures to manage surface water that have been purposefully designed to capture water on-site and to avoid substantial alteration of surface water drainage patterns outside of the airport site; and
- while greenhouse gas emissions would increase as a result of the construction and operation of the proposed airport, this is unlikely to directly result in the loss of biological diversity or biological processes within the Greater Blue Mountains World Heritage Area.

Impacts on the Greater Blue Mountains World Heritage Area are discussed further in Chapter 26 (Greater Blue Mountains World Heritage Area).

16.6.2.6. Commonwealth land

An assessment of significance was prepared for impacts on 'plants' and 'animals' in an area of Commonwealth land. The outcome of this assessment is that the proposed airport would likely have a significant impact on:

- flora – through large-scale native vegetation clearance, especially of vegetation containing an endangered population of *Marsdenia viridiflora* subsp. *viridiflora* that would threaten the viability of the regional population of the species; and
- fauna – by displacing animals, reducing or fragmenting available habitat and causing a long-term decrease or extinction of local populations of small, less mobile animals such as frogs, reptiles and the Cumberland Plain Land Snail.

16.6.3. Impacts on State-listed threatened species, populations and ecological communities

An assessment of impacts was undertaken for threatened species, populations and ecological communities listed under the TSC Act. This assessment was based on the Stage 1 development but also considered cumulative impacts that would occur with the long term development.

A significant impact was determined for one threatened flora population (*Marsdenia viridiflora* subsp. *viridiflora*) and for three threatened ecological communities (Cumberland Plain Woodland, River Flat Eucalypt Forest and Shale-Gravel Transition Forest). In addition, a significant impact was determined for one threatened invertebrate (the Cumberland Plain Land Snail) and four threatened bat species (the Eastern False Pipistrelle, Eastern Freetail-bat, Greater Broad-nosed Bat and Yellow-bellied Sheath-tail-bat). The key findings of the assessment are summarised below.

16.6.3.1. Threatened flora species and populations

The majority of the flora species listed as a threatened under the TSC Act that may occur at the airport site are also listed as threatened species under the EPBC Act. Impacts on these species have been assessed in Section 16.6.2 There is potential habitat at the airport site for two additional threatened plant species (*Dillwynia tenuifolia* and *Grevillea juniperina* subsp. *juniperina*) and one threatened population (*Marsdenia viridiflora* subsp. *viridiflora*) listed under the TSC Act.

There is no evidence of a viable local population of *Grevillea juniperina* subsp. *juniperina* or *Dillwynia tenuifolia* at the airport site or in nearby vegetation despite weeks of targeted surveys in multiple seasons (PPK 1997; SMEC 2014; OEH 2015a). There is a possibility that these species may be present at the airport site in low numbers in areas that were not directly observed or in the soil seed bank. There is also a chance that these species could colonise this habitat at some point in the future. As such, there is a risk of affecting a possible local population of these threatened plants through the removal, modification or fragmentation of potential habitat at the airport site.

Construction of the Stage 1 development would remove up to 221 hectares of potential habitat for *Grevillea juniperina* subsp. *juniperina*. There is no evidence that this habitat is of particular value or significance to the species and there are around 10,014 hectares of similar shale woodland habitat and relatively abundant populations in the locality (NPWS 2006, Tozer 2010, OEH 2015a).

Construction of the Stage 1 development would remove up to 2.6 hectares of potential habitat for *Dillwynia tenuifolia* which is likely to have minor value compared to the relatively extensive areas of shale/gravel transition and alluvial habitat supporting thousands of individuals at Kemps Creek, around three kilometres to the east of the airport site (OEH 2015b). The long term development would remove additional areas of lower quality, potential habitat but the removal of any known individuals of these threatened plants is not likely. The proposed airport is, therefore, not likely to result in a significant impact on a local population of these threatened plant species (if present at the airport site).

Construction of the Stage 1 development would completely remove the known local population of *Marsdenia viridiflora* subsp. *viridiflora* and its occupied and potential habitat. No stems of *Marsdenia viridiflora* subsp. *viridiflora* were recorded in the environmental conservation zone or in the long term development area. The closest known records of the species are around five kilometres away near Bringelly and Mulgoa (OEH 2015a). Construction of the Stage 1 development would result in a significant impact on the local population of *Marsdenia viridiflora* subsp. *viridiflora*. Impacts to the population may be partially mitigated by the proposed translocation programme and the retention of some potential habitat in the environmental conservation zone (refer to Section 16.8).

Offsets for threatened flora listed under the TSC Act have been calculated using the BioBanking methodology for a major project as part of the assessment of offsets for impacts on the environment (refer to Section 16.8).

16.6.3.2. Threatened ecological communities

All of the native woodland and forest vegetation at the airport site, including derived native grasslands, comprise local occurrences of threatened ecological communities listed under the TSC Act (Cumberland Plain Woodland, River Flat Eucalypt Forest and Shale-Gravel Transition Forest).

Construction of the Stage 1 development would comprise a significant reduction in the extent and increase in the degree of fragmentation of Cumberland Plain Woodland, River Flat Eucalypt Forest and Shale-Gravel Transition Forest. The Stage 1 development would result in the removal of approximately 221.3 hectares of Cumberland Plain Woodland, 34 hectares of River Flat Eucalypt Forest and 2.6 hectares of Shale-Gravel Transition Forest. The Stage 1 development would, therefore, likely result in a significant impact on these threatened ecological communities. The long term development at the airport site would further reduce the extent and increase the degree of fragmentation of Cumberland Plain Woodland and River Flat Eucalypt Forest. The long term development would not result in any direct impacts on Shale-Gravel Transition Forest.

Offsets for threatened ecological communities listed under the TSC Act have been calculated using the BioBanking methodology for a major project as part of the assessment of offsets for impacts on the environment (refer to Section 16.8).

16.6.3.3. Threatened fauna species

The Australasian Bittern, Swift Parrot and Grey-headed Flying-fox are listed under both the EPBC Act and the TSC Act. Impacts on these species have been assessed in Section 16.6.2. Eight species listed under the TSC Act have been recorded at the airport site. There is also potential habitat for an additional 18 species listed under the TSC Act (refer to Table 16–6). The potential impacts on these threatened species are summarised below.

The loss of approximately 120.6 hectares of woodland and forest habitat for construction of the Stage 1 development would have a significant impact on the Cumberland Plain Land Snail. The removal of good quality occupied patches of vegetation would remove local populations/subpopulations and would reduce the genetic diversity of the species in the locality of the airport site.


Construction of the Stage 1 development would not result in a significant impact on any of the threatened bird species recorded or considered likely to occur at the airport site. The loss of approximately 120.6 hectares of woodland and forest vegetation would reduce the total area of habitat for threatened woodland bird species in the locality (for example, the Scarlet Robin and Varied Sittella). However, many of these species require large patches of intact vegetation for their survival and may only occur at the airport site on a transient basis (if at all). These woodland bird species are also highly unlikely to breed at the airport site.

The construction of the Stage 1 development would remove approximately 882.5 hectares of potential foraging and breeding habitat for the Little Eagle. This species may continue to forage above the southern portion of the airport site prior to this area being developed (the long term development). Given the large home range of this species and the large area of potential habitat present in the locality, the loss of this habitat is unlikely to have a significant impact on the species. Individuals would be at risk of mortality from aircraft strike during operation, however, this is unlikely to significantly affect the population of this species in the locality.

Three Blue-billed Ducks were observed at a large artificial dam at the airport site. The Blue-Billed Duck would be a rare visitor to the airport site, and would not breed there. The construction of the proposed airport would remove approximately 25.4 hectares of artificial wetlands that provide only occasional foraging habitat for a few individuals. No breeding habitat would be removed.

There is a very low risk of mortality from aircraft strike give the low numbers of individuals that may occur in the area. Given these points, the construction and operation of the proposed airport is unlikely to have a significant impact on this species.

Threatened owls may forage at the airport site on occasion. These include the Powerful Owl, Masked Owl and Barking Owl. Given the large areas of cleared land in the area, the airport site is not likely to contain core habitat for these species. Large, hollow-bearing trees are present that would be suitable for breeding, however, given the lack of good quality foraging habitat, breeding is unlikely to occur at the airport site. Construction of the proposed airport is unlikely to have a significant impact on these species.



The Gang-gang Cockatoo was not recorded during targeted surveys, but may forage at the airport site. Most local records of this species are associated with well vegetated areas such as the Blue Mountains. This species often moves to lower altitudes during autumn and winter, occurring in drier, more open eucalypt forests and woodlands and is often recorded in urban areas. During spring and summer it moves to tall mountain forests and woodlands for breeding. As such, it is unlikely to breed at the airport site. The proposed airport would remove around 120.6 hectares of woodland and forest, which is potential foraging habitat for the species. Approximately 61 hectares of potential habitat would be retained within the environmental conservation zone along Badgerys Creek. Given the lack of evidence of this species at the airport site, the patchy nature of the vegetation to be removed, and that breeding at the airport site is unlikely, construction of the proposed airport is unlikely to have a significant impact on this species.

The Little Lorikeet was recorded flying over woodland at the airport site. The airport site is likely to provide foraging habitat for occasional transient individuals. The Little Lorikeet is unlikely to breed at the airport site given the patchy nature of the vegetation, low density of hollow-bearing trees, and because most breeding occurs west of the Great Dividing Range. Construction of the proposed airport would remove about 120.6 hectares of woodland and forest, which is potential foraging habitat for the species. Approximately 61 hectares of potential habitat would be retained within the environmental conservation zone along Badgerys Creek. Given the lack of evidence of this species at the airport site, the patchy nature of the vegetation to be removed, and that breeding at the site is unlikely, construction of the proposed airport is unlikely to have a significant impact on this species.

The Black Bittern was recorded within the riparian corridor of Badgerys Creek, near Elizabeth Drive. Preferred habitat for this species at the airport site is primarily located along this riparian corridor, which would mostly be retained within the environmental conservation zone. Habitat for this species could also occur at wetlands at the airport site where there is suitable cover and the riparian corridors of Duncans Creek and Oaky Creek. Approximately 55.3 hectares of wetland and riparian vegetation would be removed for the Stage 1 development. Not all of this area would be suitable for the species, as it requires dense vegetation for cover. About 61 hectares of potential habitat would be retained within the environmental conservation zone along Badgerys Creek. Given the protection of the riparian corridor along Badgerys Creek and the large numbers of artificial wetlands present in the locality, construction of the proposed airport is unlikely to have a significant impact on this species.

The construction of the proposed airport is likely to result in a significant impact on four obligate hollow-breeding bat species (the Eastern False Pipistrelle, Eastern Freetail-bat, Greater Broad-nosed Bat and Yellow-bellied Sheathtail-bat) through direct impacts on individual bats and from the removal of a substantial area of foraging and roosting habitat (approximately 120.6 hectares of woodland and forest vegetation and hollow-bearing trees). The proposed airport may also have a significant impact on the Large-footed Myotis if it uses tree hollows in the airport site for breeding. This species mainly breeds in caves and man-made structures. The construction of the proposed airport is unlikely to impact the Eastern Bentwing Bat and Eastern Cave Bat because it would only remove foraging resources and less valuable roost sites such as buildings and culverts. While individuals may be at risk of mortality from aircraft strike during operation, this is unlikely to substantially impact any populations of threatened bats.

Offsets for threatened fauna listed under the TSC Act have been calculated using the BioBanking methodology for a major project as part of the assessment of offsets for impacts on the environment (refer to Section 16.8).


16.7. Mitigation and management measures

Measures to mitigate impacts on terrestrial and aquatic flora and fauna (including threatened and migratory species, threatened populations and threatened ecological communities) from the construction and operation of the proposed airport are presented below, according to the hierarchy of avoidance, minimisation and mitigation of impacts. Offsetting of impacts is discussed in Section 16.8. Mitigation measures and biodiversity offsets would be further developed with reference to relevant conservation advice and recovery plans for threatened biota potentially affected by the proposed airport.

16.7.1. Avoidance and minimisation of impacts

A number of avoidance and minimisation measures would be included in the design of the proposed airport in order to minimise the potential impacts on flora and fauna at the airport site and in the locality, where practicable. These measures would include:

- designing the airport to minimise its attractiveness to fauna, minimising bird and bat strike risk and other terrestrial fauna strike risk, including measures such as:
 - designing and building the airfield, drains and water basins to reduce the availability of water;
 - installing fencing to restrict terrestrial animal access to the airfield; and
 - designing airside access roads to facilitate wildlife management;
- designing the surface water management system to minimise the potential for adverse impacts on downstream environments, including measures such as:
 - separating 'clean' and 'dirty' water and retaining and treating any surface water generated on hard stand areas before discharge from the airport site;
 - avoiding substantial alteration of surface water drainage patterns and the volume of downstream flows;
- designing and locating new waterway crossings or upgrades of existing crossings (if required) to minimise impacts on riparian and aquatic habitats. Crossings would be designed to minimise potential impacts on watercourse functionality, in particular impacts on aquatic and riparian habitats and fish passage; and
- designing airport lighting to avoid unnecessary light spill into adjoining areas of retained vegetation (such as in the environmental conservation area) as far as practicable given operational and security requirements.



Approximately 122 hectares of land in the environmental conservation zone would be protected. The environmental conservation zone includes around 61 hectares of native vegetation and representative areas of each of the vegetation types at the airport site. The 61 hectares of land within the environmental conservation zone that does not currently contain native vegetation would be revegetated. The environmental conservation zone is well placed, primarily around the southern perimeter of the airport site to maintain vegetation connectivity and to provide opportunity for fauna movement and other ecological processes that are necessary to maintain biodiversity values.

The long term development area (that is, the parts of the airport site outside the construction impact zone of the Stage 1 development) would not be cleared until required for construction of the second runway or other infrastructure, except to the extent necessary or relevant for Stage 1 (for example, drainage and services lines, fire protection and other ancillary purposes), or subsequent development of the airport site. This approach means that impacts on biodiversity values would be avoided for as long as is practicable. Where practical, biodiversity values would be maintained in the long term development area through:

- retention of native vegetation and flora and fauna populations in areas not subject to development. This would help maintain the viability of populations outside the airport site by providing source populations for ecological processes such as pollination, reproduction and recruitment as well as helping to maintain genetic variability;
- retention of habitat resources, including potential refuge habitat and resources such as tree-hollows in areas not subject to development for fauna displaced by clearing for the Stage 1 development; and
- maintenance of habitat connectivity, including locally important vegetated corridors linking larger patches of Cumberland Plain Woodland at the airport site with riparian corridors extending away from the airport site.

A staged vegetation clearing process would be implemented during construction of the Stage 1 development. This would provide the opportunity for fauna that are resident in the construction impact zone to seek refuge in alternative habitat in the environmental conservation zone, long term development area or outside the airport site. Vegetation clearing would commence in the north-east of the airport site and proceed south and west. Subject to safety and security requirements, this clearing would be undertaken before the construction of the southern perimeter fence to allow fauna to relocate towards the environmental conservation zone and off-site. This approach would be taken to maximise the opportunity for resident fauna to vacate the clearing footprint via vegetated remnants and move toward alternative habitat.

16.7.2. Mitigation and management of impacts

Mitigation and management measures proposed to minimise the impacts on terrestrial flora and fauna are listed in Table 16–11. These measures would be incorporated into a biodiversity management plan for the proposed airport and implemented as far as practicable.

The mitigation and management measures listed in Chapter 12 (Air quality and greenhouse gases), Chapter 17 (Topography, geology and soils) and Chapter 18 (Surface water, groundwater and water quality) would be implemented, as far as practicable, to minimise the impacts associated with dust, erosion and sedimentation on terrestrial and aquatic flora and fauna at the airport site.

Table 16–11 – Mitigation and management measures (biodiversity)

ID	Issue	Mitigation/management measure	Timing
16.1	Biodiversity management plan	A biodiversity management plan would be developed prior to construction of the proposed airport as part of the construction environmental management framework. The plan would collate measures to mitigate and manage potential impacts on biodiversity.	Pre-construction
16.2	Worker inductions	All workers are to be provided with an environmental induction prior to starting construction activities on site. This would include information on the ecological values of the airport site and protection measures to be implemented to protect biodiversity during construction.	Pre-construction Construction
16.3	Vegetation clearance and habitat loss	<p>Reduce the potential for adverse impacts on ecologically sensitive areas by:</p> <ul style="list-style-type: none"> • deferring vegetation removal until necessary; • locating site offices and stockpiles in already cleared and disturbed areas, to avoid further unnecessary removal or disturbance of native vegetation and hollow-bearing trees, where possible; • providing maps to construction staff clearly showing vegetation clearing boundaries and exclusion/no-go zones; and • engaging a suitably qualified ecologist or environmental officer prior to any clearing works to clearly demarcate vegetation protection areas. 	Pre-construction Construction
16.4	Disease management	Management of plant disease (such as Phytophthora, Myrtle Rust and Chytrid fungus) would be a principal consideration in the development of the construction environmental management plans, with particular regard to protection of environmental conservation zones.	Pre-construction Construction
16.5	Threatened fauna management plans	Prepare and implement a threatened fauna species management plans to reduce the potential for impacts on relevant species. These would include maps identifying locations of threatened species, scope and requirements for targeted surveys and pre-clearing surveys, unexpected finds protocol, salvage and translocation of threatened species as per the measures recommended below, clearing protocols, and reporting and adaptive management measures.	Pre-construction Construction
16.6	Threatened flora translocation plan	Prepare and implement a threatened flora salvage and/or translocation plan in consultation with the Australian Botanic Garden Mount Annan. This would include the salvage and propagation or transplanting of the known local populations of <i>Pultenaea parviflora</i> and <i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i> and any other threatened plants detected at the airport site. The translocation plan will build upon conservation activities previously undertaken for <i>Pultenaea parviflora</i> following the 1997-99 EIS. The plan would consider the suitability of sites within the environmental conservation zone and any biodiversity offset sites that are within the vicinity of the airport site in order to maintain populations of these species as close to their original location as is possible.	Pre-construction Construction

ID	Issue	Mitigation/management measure	Timing
16.7	Pre-clearance surveys for threatened species	<p>Undertake pre-clearance surveys for threatened species by a qualified ecologist. Specific management plans would be prepared to manage impacts on threatened flora and fauna species. Surveys would include:</p> <ul style="list-style-type: none"> • additional targeted searches of the airport site for the Green and Golden Bell Frog (in suitable conditions) to confirm that they are not present at the site. Should this species be located during targeted surveys a management plan would be prepared to provide detail on Green and Golden Bell Frog relocation and habitat management. Frog collection and relocation would need to be conducted by appropriately experienced ecologists; • targeted searches of the airport site for the Cumberland Plain Land Snail (in suitable conditions) and salvage and relocation of any snails and/or suitable shelter sites that are detected. A management plan would be prepared to provide more detail on Cumberland Plain Land Snail relocation and habitat management. Snails and/or suitable shelter sites would be relocated to appropriate habitat near the airport site. Snail collection and relocation would need to be conducted by appropriately experienced ecologists; • surveying any bridges or culverts that need removal to search for roosting bats; • pre-clearing surveys for larger birds' nests, particularly the White-bellied Sea-Eagle and Little Eagle; and • targeted searches for threatened flora species in areas of appropriate habitat. 	Pre-construction
16.8	Habitat clearing and fauna management protocol	<p>Develop measures for the management of impacts on fauna species during clearing activities. Measures would include:</p> <ul style="list-style-type: none"> • preparing a nest box strategy, including provisions for the: <ul style="list-style-type: none"> ▪ installation of nest-boxes within conservation areas prior to clearing areas of native vegetation on the airport site to provide a safe location for hollow-dwelling fauna to be transferred to during clearing operations; and ▪ salvage of native fauna from existing nest boxes on the airport site prior to their removal and translocation of fauna to newly established nest box sites; • pre-clearing surveys undertaken by a suitably qualified ecologist to mark and map hollow-bearing trees, logs and existing nest boxes that would require fauna management during removal; • establishing protocols for the staged clearing vegetation and safe tree felling and log remove to reduce the risk of fauna mortality; • establishing protocols for the capture and relocation of less mobile fauna (such as nestling birds and nocturnal fauna) by a trained fauna handler; and • establishing protocols for the appropriate management of injured or deceased individuals. 	Pre-construction

ID	Issue	Mitigation/management measure	Timing
16.9	Weeds	<p>Prepare and implement a weed management plan that would include:</p> <ul style="list-style-type: none"> • implementing soil erosion and sediment control measures; • mapping of weed infestations; • removing and controlling noxious weed species; • appropriate disposal of weeds and weed-infested soils; • stabilising disturbed areas following clearing to prevent weed spread; • monitoring and adaptive management of weeds; and • reporting on the extent, composition and severity of weed infestations and adaptive management measures. 	Pre-construction Construction
16.10	Unexpected finds	<p>Establish an unexpected finds protocol to detail measures to be undertaken if threatened flora and fauna not previously recorded at the airport site are detected during clearing or construction activities.</p>	Pre-construction
16.11	Dam decommissioning	<p>Establish a protocol for the decommissioning of dams in consultation with relevant agencies, to include:</p> <ul style="list-style-type: none"> • dam removal following any requirements of a Green and Golden Bell Frog management plan; • eradication of Alligator Weed infestation on the dammed section of Oaky Creek near Elizabeth Drive prior to any works in the vicinity; • progressively emptying dams over a number of days to allow fauna to relocate; • avoiding nesting season of waterbirds, where possible. A pre-removal survey would be conducted to identify bird breeding locations; • salvaging and relocating aquatic vertebrate fauna, including frogs, turtles and eels, to areas of suitable habitat retained at the airport site or nearby habitats where practicable, with regard to numbers and identification of suitable release sites; • preventing the release of Eastern Gambusia (<i>Gambusia holbrooki</i>) and other noxious fish into local waterways as a result of draining of farm dams. Eastern Gambusia would be eradicated from dams using humane methods; and • establishing protocols for the humane euthanasia of aquatic fauna, including fish. 	Pre-construction

ID	Issue	Mitigation/management measure	Timing
16.12	Fire	<p>Prepare a bushfire management plan in consultation with NSW Rural Fire Service to minimise the risk of bushfire and associated impacts on adjoining areas of native vegetation, including the proposed environmental conservation area. This would include:</p> <ul style="list-style-type: none"> • identifying activities likely to generate sparks and putting in place appropriate restrictions based on the forecasted fire danger; • preparing pre-planned fire response action plans. The action plans would be issued as part of the site induction for all site personnel; • developing limitations on relevant construction procedures which would be applied during the fire season based on specific fire danger ratings. An example of such restrictions would include the halting of all construction works during extreme or catastrophic fire danger days; and • managing the airport site to maintain a low overall fuel hazard. <p>Measures to achieve this would include:</p> <ul style="list-style-type: none"> • a combination of herbicide application, slashing, low intensity prescribed burning and hand removal; and • ensuring that fuel-reduction measures are appropriate to biodiversity values in each area e.g. low intensity prescribed burns rather than slashing would be used in native woodland and forest. 	Pre-construction
16.13	Lighting	Avoid unnecessary light spill into nearby areas of retained vegetation (such as in the environmental conservation areas) as much as possible.	Construction
16.14	Fauna management	<p>Subject to safety and security, implement measures for the management of impacts on fauna species during clearing activities, including:</p> <ul style="list-style-type: none"> • implementing a staged vegetation clearing process. This would provide opportunity for fauna that are resident in the Stage 1 development construction impact zone to seek refuge in alternative habitat in the environmental conservation zone, long term development impact zone or outside the airport site. Clearing would commence in the north-east of the site and proceed south and west. Subject to safety and security requirements, the clearing would be undertaken before the construction of the southern perimeter fence to allow fauna to relocate offsite and towards the environmental conservation zones. This approach has been identified to maximise the opportunity for resident fauna to vacate the clearing footprint via vegetated remnants and move toward alternative habitat; • identifying and assessing potential habitat trees and logs through a fauna spotter, prior to the commencement of clearing. These would be clearly identified with spray paint. A dozer would then clear the undergrowth and trees not identified as potential habitat trees. An excavator would follow several days behind the dozer to give resident fauna the opportunity to vacate habitat trees. The excavator would drop trees in a manner to increase the likelihood of survival of any fauna present; and • engaging an experienced fauna spotter-catcher, licenced wildlife carer or ecologist to supervise native vegetation clearing or removal/disturbance of other habitat features (e.g. culverts), and to capture and relocate fauna, if required. Any injured native fauna would be transferred to the care of a licenced wildlife carer. 	Construction

ID	Issue	Mitigation/management measure	Timing
16.15	Vegetation	<p>Prepare and implement a vegetation management plan. The vegetation management plan would apply to open space within the airport site and the environmental conservation zone and would include:</p> <ul style="list-style-type: none"> • retaining native vegetation and/or supplementary replanting with local native species; • slashing of grassland to manage fuel loads and bushfire risk; • identifying threatened flora populations and measures to avoid impacts from activities such as weed control or bushfire hazard reduction; • identifying measures for the management of weeds; • planting schedules; • monitoring of the success of revegetation, weed control and adaptive management; and • reporting. 	Construction Operation
16.16	Fire	<p>Review, update and implement the bushfire management plan in response to the transition to the airport operation phase, including in response to changes to changes to locations of building envelopes, fuel loads, ignition sources etc.</p>	Operation

16.8. Offsetting impacts

Biodiversity offsets are required to compensate for significant residual impacts arising from the proposed airport in accordance with the EPBC Act Offsets Policy and the EIS guidelines. An offset package has been prepared to compensate for the removal of approximately 90.8 hectares of Cumberland Plain Woodland; the removal of about 120.6 hectares of foraging habitat for the Grey-headed Flying-fox; and on features of the natural environment including plant populations, fauna populations and several species and communities listed under NSW legislation. The details of the offset package are described below. Further information is provided in Appendix K2 in Volume 4.

16.8.1. Overview


The EIS guidelines state that the proposed airport will require biodiversity offsets calculated with reference to the EPBC Act Offsets Policy. The key considerations included in the policy are that:

- offsets are required for significant residual impacts on matters protected by the EPBC Act including (as relevant for this report), threatened species and communities listed under the EPBC Act and the environment, where Commonwealth agencies are proposing to take an action;
- the amount of offset required for threatened species and communities listed under the EPBC Act must be calculated using the 'offset assessment guide' spreadsheet. The Offset Assessment Guide uses a balance sheet approach to calculate the percentage of the proposal's impacts that would be directly offset;
- at least 90 per cent of the proposed airport's impacts must be directly offset and the offset site must be identified, assessed and securely conserved under a covenant and management plan, preferably prior to the impact occurring; and
- up to 10 per cent of the proposed airport's impacts may be indirectly offset through contribution to a research fund or a conservation program.

Following consultation with the DoE, it is considered appropriate that the estimate of offsets for residual impacts on the environment, including threatened biota and their habitats listed under the TSC Act, should be calculated using the NSW Biodiversity Banking and Offsets Scheme (BioBanking) assessment methodology.

The EPBC Act Offsets Policy requires biodiversity offset sites to be securely titled under a legally binding conservation covenant and actively managed under a fully funded plan. There are a variety of mechanisms for achieving this, including BioBanking, Voluntary Conservation Agreements or dedication of land to the National Parks estate.

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



This biodiversity offset package report has been prepared using the EPBC Act Offsets Policy, the offsets assessment guide and BioBanking assessment methodology and is included as Appendix K2 in Volume 4. The biodiversity offset package comprises the first stages in the delivery of biodiversity offsets for the proposed airport.

16.8.2. Summary of impacts requiring offsets

According to the EPBC Act Offsets Policy, biodiversity offsets are required for significant residual impacts on matters protected by the EPBC Act after any proposed avoidance and mitigation measures have been taken into account. The proposed airport is likely to have a significant impact on:

- Cumberland Plain Woodland, which is listed as a critically endangered ecological community under the EPBC Act and occurs at the airport site. Offsets are required for the removal of approximately 90 hectares of vegetation within the local occurrence of the community;
- the Grey-headed Flying-fox which is listed as a vulnerable species under the EPBC Act and which has been observed at the airport site. Offsets are required for the removal of approximately 120 hectares of foraging habitat; and
- on features of the natural environment including plant populations, fauna populations and several species and communities listed under NSW legislation. Offset requirements have been estimated using the BioBanking assessment methodology for a major project.

Impacts on EPBC Act-listed biota have been entered in the EPBC Act offset assessment guide (refer to Section 16.8.4). The offset assessment guide can only be used to calculate offsets for threatened biota listed under the EPBC Act and so an alternative approach is required for impacts on other protected matters. The EPBC Act Offsets Policy requires that the approach to calculating offsets must be in proportion to the level of statutory protection that applies to the protected matter, be of a size and scale proportionate to the residual impacts on the protected matter and be scientifically robust and reasonable (DSEWPC 2012). The BioBanking assessment methodology meets each of these criteria and is supported by DoE for this purpose.

BioBanking credit calculations using the assessment methodology for a major project in NSW have been used to estimate offsets for impacts on the environment, including species and communities listed under NSW legislation. The outcome of the BioBanking credit calculations is that the ecosystem credits summarised in Table 16–12 and the species credits summarised in Table 16–13 would be required to offset significant residual impacts of the proposed airport on the natural environment.

Table 16–12 – Ecosystem credits required to offset impacts of the proposed airport

Plant community type name	Condition	Conservation status		Management zone area	Ecosystem credit requirement	Offset options – Plant community types
		EPBC Act Status	TSC Act Status			
Good condition Grey Box – Forest Red Gum grassy woodland on flats (HN528)	Moderate/ Good	CEEC	CEEC	71.27	3,555	HN528, HH526 ¹
Poor condition Grey Box – Forest Red Gum grassy woodland on flats (HN528)	Moderate/ Good_Poor		CEEC	107.79	3,208	HN528, HH526
Good condition Grey Box – Forest Red Gum grassy woodland on hills (HN529)	Moderate/ Good	CEEC	CEEC	17.32	751	HN529, HN528, HN526 ¹
Poor condition Grey Box – Forest Red Gum grassy woodland on hills (HN529)	Moderate/ Good_Poor		CEEC	22.29	647	HN529, HN528, HN526
Good condition Forest Red Gum – Rough-barked Apple grassy woodland (HN526)	Moderate/ Good		EEC	29.83	1,530	HN526, HN528
Poor condition Forest Red Gum – Rough-barked Apple grassy woodland (HN526)	Moderate/ Good_Poor		EEC	4.22	127	HN526, HN528
Good condition Broad-leaved Ironbark – Grey Box – <i>Melaleuca decora</i> grassy open forest (HN512)	Moderate/ Good	CEEC	EEC	2.19	161	HN512, HN513, HN604, HN556 ¹
Poor condition Broad-leaved Ironbark – Grey Box – <i>Melaleuca decora</i> grassy open forest (HN512)	Moderate/ Good_Poor		EEC	0.39	20	HN512, HN513, HN604, HN556
Good condition artificial freshwater wetland on floodplain (HN630)	Moderate/ Good			25.44	700	HN630, HN520

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

Table 16–13 – Species credits required to offset impacts of the proposed airport

Common name	Scientific name	Threatened species multiplier	Species credits required
Black Bittern	<i>Ixobrychus flavicollis</i>	1.3	719
Cumberland Plain Land Snail	<i>Meridolum corneovirens</i>	1.3	1,568
<i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i> in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	<i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i> – endangered population	4.0	3,720
<i>Pultenaea parviflora</i>	<i>Pultenaea parviflora</i>	1.5	60
Southern Myotis	<i>Myotis macropus</i>	2.2	656

16.8.3. Proposed offsets

16.8.3.1. Proposed offset strategy

The proposed biodiversity offset strategy for the airport is to conserve habitat for the affected threatened biota in suitable offset sites. The offsets would be secured by ensuring that they would be securely titled and managed for conservation in perpetuity.

Biobanking provides a market-based biodiversity offset scheme in Australia. It is established under the TSC Act. Biobanking enables a project proponent to deliver biodiversity offsets for its project by purchasing and then retiring (that is, delivering to the OEH) biodiversity credits of a sufficient number and type to offset the impacts of that project. Biodiversity credits are generated under the Biobanking scheme, by owners of land committing to management actions which will enhance biodiversity values on their land, under a binding BioBanking agreement with the NSW Minister for the Environment. That agreement establishes the land as a biobank site. The BioBanking agreement is registered on the title to the land and operates in perpetuity.

The number and type of biodiversity credits required to offset the proposed airport’s impacts as calculated by the offset assessment guide would be purchased and retired from offset sites. Additional biodiversity credits would be purchased to offset impacts on the natural environment.

The land use plan for the airport site contained within the draft Airport Plan includes around 122 hectares of land that is zoned ‘EC 1 Environmental conservation’ and that would be managed for biodiversity conservation. While the present intent is to allow only environmental conservation activities within the environmental conservation zone, it would not be securely titled for conservation purposes and so has not been included as a formal offset site within the offset package. The likely increase in biodiversity value that would be achieved through management of the environmental conservation zone may be recognised through a reduction in the quantum of offset that would otherwise be required for the proposed airport.

The EPBC Act Offsets Policy requires that a minimum of 90 per cent of the airport’s impacts must be directly offset as calculated with the Offset Assessment Guide. Depending on the project, DoE may require more than 90 per cent direct offsets. Therefore, the remaining offset requirement, which may be up to 10 per cent, is able to be met by alternative contributions such as a financial contribution to research or conservation.

16.8.3.2. Potential offset sites

A desktop assessment was performed to identify and describe potential offset sites for the proposed airport. Candidate sites would be secured by under a BioBanking agreement that would ensure that the offset sites would be securely titled for conservation as a biobank in perpetuity. The sources that were considered in the desktop assessment include BioBanking online registers administered by OEH, BioBanking assessment reports for existing and potential biobank sites and consultation with private landowners and agencies

The desktop assessment revealed suitable offset sites that contain Cumberland Plain Woodland and/or Grey-headed Flying-fox habitat. Potential offset sites that contain habitat for the affected threatened biota and that could be included in the offset package are detailed in Table 16–14. Portions of four of these potential offset sites (Williamstown, Montpelier Stages 1 and 2 and Durham biobanks), are located in Cumberland Plain Priority Conservation Lands identified in the recovery plan for Cumberland Plain Woodland (DECC 2010).

Table 16–14 – Potential offset sites

Potential offset site	Location	Total area (hectares)	Status and ownership
Williamstown biobank	Mount Hunter	104.4	Established biobank, private owner.
Durham biobank	Oxley Park (Ropes Creek riparian corridor)	46.85	Potential biobank, DPE.
Mamre biobank	Mamre Park (South Creek riparian corridor)	98.1	Potential biobank, DPE.
Luddenham biobank	Mamre Park (South Creek riparian corridor)	42	Potential biobank, DPE.
Roper biobank	Minchinbury (Ropes Creek riparian corridor)	14.05	Potential biobank, DPE.
Caddens biobank	Claremont Meadows (South Creek riparian corridor)	36.08	Potential biobank, DPE.
Dunheved biobank	Werrington County (South Creek riparian corridor)	90.17	Potential biobank, DPE.
Forrester biobank	Tregear (Ropes Creek riparian corridor)	9.16	Potential biobank, DPE.
Stage 1 Montpelier biobank	The Oaks	76.24	Potential biobank, private owner.
Stage 2 Montpelier biobank	The Oaks	79.5	Potential biobank, private owner
Menangle Road biobank	The Oaks	57.07	Potential biobank, private owner
Bruelle biobank	Mulgoa	27.5	Potential biobank, private owner

Potential offset site	Location	Total area (hectares)	Status and ownership
The Oaks	Mowbray Park	40	Established biobank, private owner
Western Sydney Parklands ID 120	Cecil Park	19.4	Established biobank, Western Sydney Parklands Trust
Western Sydney Parklands ID 70	Cecil Park and Chandos West	40.5	Established biobank, Western Sydney Parklands Trust

There are local occurrences of each of the threatened ecological communities that would be removed for construction of the proposed airport and known or potential habitat for many of the threatened species that would be affected at the offset sites.

The potential offset sites described above contain some areas of native vegetation and habitat that is not an appropriate 'like for like' match for impacts on the EPBC Act listed affected threatened biota or is associated with biodiversity credits that have already been sold. A subset of the habitat available at the potential offset sites has been selected that would directly offset impacts on the affected threatened biota. The DoE would require these specific areas to be clearly documented and mapped in the final offset package.

The criteria for selecting the proposed offset areas are:

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

The 'proposed offset areas' (that is, the specific areas of habitat at potential offset sites that would be included in the offset package to offset impacts on the affected threatened biota) are summarised in Table 16–15.

The area of Grey-headed Flying-fox habitat available in the proposed offset areas (around 401 hectares) is substantially greater than the estimated area required to meet this species' offset requirement. This area would also contribute offsets for impacts on the environment and so the full area has been included in the Offset assessment guide calculations.

Table 16–15 – Proposed offset areas

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

Potential offset site	Total area (hectares)	Extent of available EPBC Act Cumberland Plain Woodland (hectares) ¹	Extent of available poorer quality Cumberland Plain Woodland (hectares) ²	Grey-headed Flying fox habitat (hectares) ³	Notes
Dunheved biobank	65.0	3.8	8.7	23.0	EPBC Act Cumberland Plain Woodland linked to credits that are available for sale, which also comprises Grey-headed Flying-fox habitat. Additional poorer quality Cumberland Plain Woodland. Biodiversity credits for other impacts on the environment.
Forrester biobank	9.2	0.0	0.0	5.9	Grey-headed Flying-fox habitat associated with River Flat Eucalypt Forest and linked to biodiversity credits that area available for sale.
Stage 1 Montpelier biobank	76.2	34.1	11.4	40.9	EPBC Act Cumberland Plain Woodland linked to credits that are available for sale, which also comprises Grey-headed Flying-fox habitat. Additional poorer quality Cumberland Plain Woodland. Biodiversity credits for other impacts on the environment.
Stage 2 Montpelier biobank	79.5	20.9	9.2	48.5	EPBC Act Cumberland Plain Woodland linked to credits that are available for sale, which also comprises Grey-headed Flying-fox habitat. Additional poorer quality Cumberland Plain Woodland. Biodiversity credits for other impacts on the environment.
Menangle Road biobank	57.1	27.0	21.1	36.0	EPBC Act Cumberland Plain Woodland linked to credits that are available for sale, which also comprises Grey-headed Flying-fox habitat. Additional poorer quality Cumberland Plain Woodland. Biodiversity credits for other impacts on the environment.
Bruelle biobank	26.8	14.4	0.0	27.5	EPBC Act Cumberland Plain Woodland linked to credits that are available for sale, which also comprises Grey-headed Flying-fox habitat. Biodiversity credits for other impacts on the environment.
Western Sydney Parklands ID 120	19.4	18.2	0.0	18.2	EPBC Act Cumberland Plain Woodland linked to credits that are available for sale, which also comprises Grey-headed Flying-fox habitat. Biodiversity credits for other impacts on the environment.

Potential offset site	Total area (hectares)	Extent of available EPBC Act Cumberland Plain Woodland (hectares) ¹	Extent of available poorer quality Cumberland Plain Woodland (hectares) ²	Grey-headed Flying fox habitat (hectares) ³	Notes
Western Sydney Parklands ID 70	40.5	5.2	0.0	5.2	EPBC Act Cumberland Plain Woodland linked to credits that are available for sale, which also comprises Grey-headed Flying-fox habitat. Biodiversity credits for other impacts on the environment.
	786.2	180.3	78.6	401.2	

16.8.4. Preliminary Offset Assessment Guide calculations

16.8.4.1. Overview

The EPBC Act Offsets Policy requires a formal assessment of impacts and offset contributions for EPBC Act-listed species and communities using the 'offsets assessment guide'. The Offsets Assessment Guide utilises a balance sheet approach to measure impacts and offsets. According to the EPBC Act Offsets Policy, controlled actions requiring offsets must achieve a minimum 90 per cent 'direct offset'.

Offset Assessment Guide calculations have been performed based on the significant residual impacts documented in this chapter and the likely conservation and management of the potential offset sites. A detailed description of the calculations is provided in the Biodiversity Offsets Package (refer to Appendix K2 in Volume 4). The output of this preliminary assessment is an estimate of the percentage of the proposed airport impacts that would be 'directly offset' by the potential offset sites.

Once the final offset sites have been identified, a 90 per cent direct offset may be acceptable under the EPBC Act Offsets Policy with up to 10 per cent of the offset able to be achieved through 'other compensatory measures'. These measures are defined as actions that are anticipated to lead to benefits for the impacted protected matter, for example funding for research or educational programs.

16.8.4.2. Preliminary Offset Assessment Guide calculations

Preliminary Offset Assessment Guide calculations were performed for the affected threatened biota based on the following:

- removal of approximately 90 hectares of EPBC Act Cumberland Plain Woodland with a site quality score of 6/10;
- removal of approximately 120.8 hectares of habitat for the Grey-headed Flying-fox with a site quality score of 7/10; and
- the conservation and management of offset sites to achieve increased site quality, containing:
 - EPBC Act Cumberland Plain Woodland;
 - poorer quality Cumberland Plain Woodland; and
 - Grey-headed Flying-fox habitat.

The outcome of these preliminary Offset Assessment Guide calculations is that:

- The proposed offset areas contain around 180 hectares of EPBC Act Cumberland Plain Woodland and an additional 79 hectares in poor condition that would collectively offset approximately 74 per cent of the impact of the proposed airport on the community;
- The proposed offset areas containing up to 401 hectares of habitat for the Grey-headed Flying-fox would offset around 136 per cent of the proposed airport's impacts on this vulnerable species.

16.8.5. Delivery of offsets

16.8.5.1. Biodiversity credits

Biodiversity credits would be purchased to secure the proposed offset areas for EPBC Act-listed biota. Subject to confirmation of the overall offset requirement for the proposed airport, additional biodiversity credits would be purchased to offset the proposal's impacts on the environment.

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

The BioBanking assessment 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 (that is, have the same or greater conservation significance). BioBanking also allows trading of ecosystem credits associated with low condition vegetation at a Biobank site, including vegetation that could not meet the standard of EPBC Act Cumberland Plain Woodland. This flexibility should be considered along with the fact that BioBanking requires the calculation of biodiversity offsets for poorer condition vegetation. A substantial area of poor condition vegetation at the airport site has contributed to the amount of offset required for residual significant impacts on the environment. Species credits should be traded on a like for like basis.

The number and type of biodiversity credits that would be required to offset the proposed airport's impacts on the environment are specified in the BioBanking credit report (refer to Appendix K2 in Volume 4). Table 16–16 includes a comparison of the credits available at the proposed offset sites and the ecosystem credit requirement to offset the proposed airport's impacts on the natural environment as estimated with BioBanking credit calculations. There would be sufficient ecosystem credits available to offset impacts on Grey Box – Forest Red Gum grassy woodland on shale (HN529) and Forest Red Gum – Rough-barked Apple grassy woodland (HN526). The 'Credit balance' in Table 16–16 shows that additional ecosystem credits would be required to offset impacts on other vegetation types and associated predicted threatened species. The credit shortfall for Grey Box – Forest Red Gum grassy woodland on flats (HN528) could be partially met by trading surplus HN526 credits, which is permitted by the BioBanking credit trading rules.

Table 16–16 – Ecosystem credits for impacts on the natural environment

Potential offset site	Total area (hectares)	Available HN528 credits	Available HN529 credits	Available HN526 credits	Available HN512 credits	Available HN630 credits	Available HN524 credits
Williamswood biobank	104.5	0	694	280	0	0	38
Durham biobank	42.7	31	0	246	0	0	0
Mamre biobank	98.1	0	0	680	0	7	0
Luddenham biobank	40.0	34	0	246	0	0	0
Roper biobank	13.3	48	0	20	25	0	0
Caddens biobank	33.3	47	0	181	0	5	0
Dunheved biobank	65.0	93	0	362	0	0	0
Forrester biobank	9.2	0	0	56	0	0	0
Stage 1 Montpelier biobank	76.2	119	442	0	0	0	153
Stage 2 Montpelier biobank	79.5	0	363	0	0	0	118
Menangle Road biobank	57.1	0	454	36	0	0	29
Bruelle biobank	26.8	0	141	0	0	0	0
The Oaks	40.0	0	261	11	0	0	69
Western Sydney Parklands ID 120	19.4	120	0	61	0	0	0
Western Sydney Parklands ID 70	40.5	49	0	10	0	0	0
Total	892.8	542	2355	2188	25	12	407
Ecosystem credit requirement		6763	1398	1657	181	700	0
Credit balance		-6221	957	531	-156	-688	407
Total including trading of matching credits		1074¹		1657			
Credit balance including trading of matching credits		-5689	957	0	-156	-688	407

Notes: 1) includes 531 HN526 credits which may be traded with HN528.

No species credits have been calculated at any of the existing or proposed biobank sites included in the offset package. Species credits may be generated once targeted surveys have been undertaken to confirm the presence of threatened species and the numbers of individuals of plants and area of habitat for fauna. Based on the assessments undertaken to date, the proposed offset sites contain known or potential habitat for each of the species credit-type threatened species affected by the proposed airport. Table 16–17 summarises the species credits required to offset the impacts of the proposed airport, the equivalent area of fauna habitat or number of plants required to generate these credits at an offset site and a summary of the potential habitat available at offset sites.

Sufficient *Pultenaea parviflora* has already been recorded at the Dunheved biobank site to generate the required number of species credits. Based on the site surveys and habitat assessments undertaken, it is likely that supplementary surveys would confirm the presence of the species at these offset sites and allow the calculation of species credits. *Marsdenia viridiflora* subsp. *viridiflora* is very sparsely and sporadically distributed within its range and so it is likely to be difficult to locate a population of the required size at offset sites. The proposed translocation program would be important in avoiding or minimising impacts on this endangered population and should be coordinated with the offset package.

Table 16–17 – Species credits potentially available at offset sites

Common name	Scientific name	Species credits required	Individuals / area required in offset site	Individuals / area available in offset site(s)
Black Bittern	<i>Ixobrychus flavicollis</i>	719	101	Up to around 314 hectares of potential habitat in Forest Red Gum – Rough-barked Apple grassy woodland (HN526) and Coastal freshwater wetland (HN630) at proposed off set sites.
Cumberland Plain Land Snail	<i>Meridolum corneovirens</i>	1568	221	Up to around 414 hectares of potential habitat in Grey Box – Forest Red Gum grassy woodland on shale (HN529) and Grey Box – Forest Red Gum grassy woodland on plains (HN528). The species has been recorded at the Forrester and Caddens biobank sites.
<i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i> in endangered population	<i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i> – endangered population	3720	524	Up to around 476 hectares of potential habitat in Grey Box – Forest Red Gum grassy woodland on shale (HN529), Grey Box – Forest Red Gum grassy woodland on plains (HN528) and Grey Box – Forest Red Gum shrubby woodland (HN524).
<i>Pultenaea parviflora</i>	<i>Pultenaea parviflora</i>	60	8	100 individuals recorded at the Dunheved biobank site.
Southern Myotis	<i>Myotis macropus</i>	656	92	Up to around 313 hectares of potential habitat in Forest Red Gum – Rough-barked Apple grassy woodland (HN526) at proposed off set sites. The species has been recorded at the Mamre biobank site.

16.8.5.2. Identification of additional offsets

Based on the preliminary offset assessment guide calculations and BioBanking calculations, the proposed offset sites could not meet all of the proposed airport's EPBC Act offsetting requirements as direct offsets. Additional offset sites containing Cumberland Plain Woodland would be identified throughout the environmental assessment process for the proposed airport and would be included in the final offset package. Any additional offset sites would be identified to ensure that they are an appropriate 'like for like' match for the airport's impacts and meet the other requirements of the EPBC Act Offsets Policy and consider the OEH principles for biodiversity offsets.

A similar approach would be taken in the event that any credits which have been identified for purchase from BioBanking sites identified in this draft EIS are sold to third parties, or otherwise become unavailable, before they can be secured as offsets for the proposed airport.


16.8.5.3. Finalisation of the offset package

The offset package would be finalised in accordance with any conditions required by the Minister for the Environment. The Minister for the Environment would advise the final quantum of biodiversity offsets required for the proposed airport. This may include the requirement for additional site specific information such as proposed management, current risk of development and the security of titling proposed for individual offset sites. These additional data would be considered the DoE and the final calculations and details regarding data and assumptions underlying the results would be compiled and collectively comprise the EPBC Act offset package for the proposed airport.

16.9. Conclusion

Construction of the Stage 1 development would result in the removal of approximately 1,065 hectares of vegetation. The majority of this vegetation consists of exotic grassland and cleared land or cropland dominated by exotic species and noxious and environmental weeds. Approximately 280.8 hectares of native vegetation would be removed. The removal of vegetation at the airport site would result in the loss of fauna foraging, breeding, roosting, sheltering and dispersal habitat. Construction of the Stage 1 development would also result in indirect impacts on terrestrial and aquatic flora and fauna including impacts associated with increased fragmentation, altered hydrology, erosion and sedimentation, dust, light, noise and vibration. Indirect impacts may also include fauna displacement, injury and/or mortality.


Operation of the proposed airport would involve an increased risk of fauna strike from contact with aircraft and ground transportation vehicles. Indirect impacts may include those associated with light, noise and vibration, the increased incidence of fire and the introduction of exotic species.



The Stage 1 development would affect threatened species, populations and ecological communities listed under both the EPBC Act and the TSC Act. Assessments of significance have been prepared in accordance with the *Significant Impact Guidelines 1.1 – Matters of National Environmental Significance* (DoE 2013a) for impacts on threatened biota and other MNES, and the *Significant Impact Guidelines 1.2 – Actions on, or Impacting upon, Commonwealth Land and Actions by Commonwealth Agencies* (DoE 2013b) for impacts on the natural environment. The outcome of these assessments is that the Stage 1 development is likely to have a significant impact on Cumberland Plain Woodland, the Grey-headed Flying-fox, and other plants and animals (including a number of species and populations listed as threatened under the TSC Act) in an area of Commonwealth land.

Mitigation and management measures would be implemented to reduce the potential impacts on biodiversity. These measures would include staged vegetation removal during construction, pre-clearing surveys and measures for the salvage of resident fauna and habitat resources, translocation programmes for threatened flora and fauna species and populations, and designing the airport to minimise its attractiveness to fauna and thus minimising bird and bat strike and terrestrial fauna strike. In addition, an environmental conservation zone would be established along the southern perimeter of the airport site where approximately 122 hectares of land would be protected.

Biodiversity offsets are required to compensate for significant residual impacts arising from the proposed airport. An offset package has been prepared to compensate for the removal of approximately 90.8 hectares of Cumberland Plain Woodland, the removal of about 120.6 hectares of foraging habitat for the Grey-headed Flying-fox, and on features of the natural environment including plant populations, fauna populations and several species and communities listed under NSW legislation. The offset package is intended to conserve habitat for the affected threatened biota in suitable offset sites in the surrounding region in perpetuity.



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