

Appendix I

Bird and bat strike



Western Sydney Airport Environmental Impact Statement

Preliminary Bird and Bat Strike Risk Assessment

September 2015



Executive summary

GHD engaged Avisure to conduct an assessment of the bird and bat strike risk at the proposed Western Sydney Airport (the airport) as part of its Environmental Impact Statement. The Preliminary Bird and Bat Strike Risk Assessment report (this document) provides a preliminary risk assessment of birds and bats present on and in the vicinity of the airport site and has been used to inform the Hazards and Risk and the Biodiversity Assessment components of the Environmental Impact Statement.

The assessment was based on a desktop review of relevant literature and a three-day site visit conducted in March 2015. The site visit included investigations within the airport site and study area. The study area included the area within a 25 km radius of airport site centre point. The justification for this distance is based on international standards (International Civil Aviation Organization and World Birdstrike Association) and national guidelines (National Airports Safeguarding Framework) that recommend identifying, and where necessary managing, potential wildlife attractants within 13 km of runways.

The assessment found that there would be a bird and bat strike risk at the proposed airport due to species presence and abundance, habitat available on the airport site and within the study area, projected aircraft movements and staged construction. The presence of farm dams presents the greatest risk for bird strike at the proposed airport. Despite the complexity involved in managing an abundant and highly distributed habitat type outside of the airport site, it is important to consider this risk relative to other possible features which could present significant bird and bat strike risk for an airport. For example, the proposed site does not have a large estuary in close proximity, is not within a major bird migratory route, does not have flying-fox roosts or ibis colonies in close proximity, and is likely to have reduced available habitat as the airport surrounds urbanise.

Each potential contributor to bird and bat strike risk at the proposed Western Sydney Airport can be managed to an acceptable risk level so the preliminary assessment of overall bird and bat strike risk for the airport is low. Risk management would require the airport operator to implement a suite of mitigation measures and develop an integrated management program designed for ongoing implementation. The mitigation measures detailed in this report are specific to Stage 1 of the proposed airport site development. Similar strategies will apply to the longer-term development with the additional risk of bird and bat strike risk due to the operation of one runway during the construction of a second. Further review of appropriate mitigation strategies will be required during the detailed design, construction and operation stages of longer term development. In addition, the airport operator would need to comply with the International Civil Aviation Organization, the Civil Aviation Safety Authority, and the National Airports Safeguarding Framework regulations, standards and guidelines.

The mitigation strategies listed in this report are based on our preliminary assessment and need to be refined as more information about the detailed design and construction of the proposed airport becomes available. Key considerations include: that the design does not create bird and bat attractive features; that bird and bat populations are monitored to assess strike risk; and, that a plan to implement mitigation actions where hazards are identified is developed.

To confirm the level of bird and bat strike risk and to refine the mitigation strategies, further works in the airport site and study area are required. These include additional bird and bat surveys and the review of detailed design and construction documents. The required study area works include additional surveys and the review of development plans for the area surrounding the airport.

Abbreviations

AC	Advisory Circular
ATSB	Australian Transport Safety Bureau
CASA	Civil Aviation Safety Authority
DIT	Department of Infrastructure and Transport
EIS	Environmental Impact Statement
ICAO	International Civil Aviation Organization
MOS	Manual of Standards
NASF	National Airports Safeguarding Framework
NSW	New South Wales
WHMP	Wildlife Hazard Management Plan

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1. Introduction

1.1 Overview

GHD engaged Avisure to conduct a preliminary assessment of the bird and bat strike risk at the proposed Western Sydney Airport (the airport) as part of its Environmental Impact Statement (EIS). The Preliminary Bird and Bat Strike Risk Assessment Report (this document) provides a preliminary risk assessment of birds and bats present on and in the vicinity of the airport site and has been used to inform the Hazards and Risk and the Biodiversity Assessment components of the EIS.

The assessment included a review of:

- existing habitat on the airport site and surrounding area
- birds and bats that are known to be or are likely to be present
- species that present a potential risk to aircraft operations.

The report includes:

- assessment methods
- an overview of relevant regulations, standards and guidelines
- a preliminary risk assessment for the airport based on habitat, species and indicative airport operations
- a review of the Draft Airport Plan to determine the design and construction considerations that present a bird and bat strike risk
- staged mitigation strategies to reduce the bird and bat strike risk based on international and national regulations, standards and guidelines
- recommendations for ongoing work and assessments to confirm the preliminary findings and to plan for operational bird and bat hazard management at the airport.

1.2 Project description

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

More recently, the *Joint Study on Aviation Capacity in the Sydney Region* (Department of Infrastructure and Transport, 2012) and *A Study of Wilton and RAAF Base Richmond for civil aviation operations* (Department of Infrastructure and Transport, 2013) led to the Australian Government announcement on 15 April 2014 that Badgerys Creek will be the site of a new airport for Western Sydney. The airport is proposed to be developed on approximately 1,700 hectares of land acquired by the Commonwealth in the 1980s and 1990s. Construction could commence as early as 2016, with airport operations commencing in the mid-2020s.

The proposed airport would provide both domestic and international services, with development staged in response to demand. The initial development of the proposed airport would include a single, 3,700 metre runway coupled with landside and airside facilities such as passenger terminals, cargo and maintenance areas, car parks and navigational instrumentation capable of facilitating the safe and efficient movement of up to 10 million passengers per year. While the proposed Stage 1 development does not currently include a rail service, planning for the proposed airport preserves flexibility for several possible rail alignments including a potential express service. A final alignment will be determined in consultation with the New South Wales Government, with any enabling work required during Stage 1 subject to a separate approval and environmental assessment process.

In the longer term, approximately 40 years after operations commence and in accordance with relevant planning processes, the airport development could include parallel runways and additional passenger and transport facilities for around 82 million passenger movements per year. To maximise the potential of the site, the airport is proposed to operate on a 24 hour basis. Consistent with the practice at all federally leased airports, non-aeronautical commercial uses could be permitted on the airport site.

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

The Australian Government Department of Infrastructure and Regional Development is undertaking detailed planning and investigations for the proposed airport, including the development of an Airport Plan. The draft Airport Plan is the primary source of reference for, and companion document to, the EIS. The draft Airport Plan identifies a staged development of the proposed airport. It provides details of the initial development being authorised, referred to as Stage 1, as well as a long-term vision of the airport's development. This enables preliminary consideration of the implications of longer term airport operations. Any stages of airport development beyond Stage 1 would be managed in accordance with the existing process in the Airports Act. This includes a requirement that for major developments (as defined in the Airports Act), a major development plan be approved by the Australian Government Minister for Infrastructure and Regional Development following a referral under the EPBC Act.

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

1.3 The bird and bat strike issue

Birds and bats are attracted to airport environs in response to the availability of food, water, shelter and the safety of a relatively predator-free environment. The presence of birds or bats on an airport can lead to conflict in the form of strikes.

The consequence of bird and bat strikes with aircraft can be very serious. Since 1912, 120 aircraft have been destroyed due to bird strike incidents with 60 of these incidents leading to the death of 297 people (Thorpe 2014). Bird strikes cost the commercial civil aviation industry an estimated US\$1.2 billion per annum and involve more than just the repair of damaged engines and airframes (Allan 2002). Even apparently minor strikes which result in no damage can reduce engine performance, cause concern among aircrew and add to airline operating costs.

The main factors determining the consequences of a strike are the number and size of animals struck, the phase of flight when struck, and the part of the aircraft hit. Generally, the larger the animal the greater the damage. Large animals have the ability to destroy engines and windshields and cause significant damage to airframe components and leading edge surfaces. Strikes involving more than one animal (multiple strikes) can be serious, even with relatively small animals, potentially disabling engines and/or resulting in major accidents.

The probability of strikes is specific to each airport. The availability of habitat on the airport and in the surrounding areas determines the number of animals that potentially may collide with aircraft. Each species and/or age class also has its own propensity for being struck (i.e. some species are better than others for avoiding aircraft). In addition, the number of aircraft movements, approach and departure paths and flight times can influence the likelihood of bird and bat strikes. Based on the characteristics of the airport, surrounding areas and aircraft movements, it is possible to broadly define an airport location as having a high, moderate or low overall bird and bat strike risk. Generally, if an airport is located within a biologically productive region, has suitable habitat on the airport and in its proximity, and has a high number of daily aircraft movements, it is likely to have a higher strike risk than an airport located in a biologically poor region with little habitat diversity and few aircraft movements. Man-made habitats however, can sometimes offer more potential for hazardous bird populations to develop than natural ones. A prime example is putrescible waste facilities which in many parts of Australia support very large populations of large flocking species such as Australian White Ibis, Australian Pelican and Silver Gull.

The seriousness of bird and bat strikes is recognised through a network of international and national regulations, standards and guidelines. These documents form the basis for the approach to the bird and bat strike risk assessment conducted and for the mitigation and management measures proposed.

1.4 Western Sydney Airport site

The airport site is located in a temperate climate and predominantly consists of cleared pastures with scattered woodlands. The landholdings on the site support farm dams, agriculture fields, residential housing, market garden infrastructure and other infrastructure such as power lines and roads. Immediately adjacent the airport site, is a mosaic of land uses that contain similar habitat, and within 25 km of the airport site there are urban residential areas, small towns, parklands, conservation areas, large waterbodies and waste disposal facilities. Consideration of the airport site relative to the land uses within the study area is important as birds and bats are likely to use the whole landscape interchangeably, transiting to and from the various habitats and potentially impacting on operational airspace in the form of bird and bat strikes. The attractiveness of sites on and around the airport site for species such as Australian White Ibis and Grey-

headed Flying-fox is particularly important given their high strike consequence (i.e. rates of damage) due to their flocking nature and relatively large sizes.

1.5 Limitations

This preliminary risk assessment is based on information available at the time of the assessment, a three day site assessment, and our knowledge of bird and bat strike issues at other airports. Assessment results will need to be further refined as the design, construction and operation of the airport progresses. The site assessment has particular limitations:

- There was restricted access to some potentially hazardous bird sites due to tenant limitations.
- The scope to complete only one set of surveys. Limited data reduced the power of the risk assessment to determine any seasonal impacts or other anomalies at the time of the surveys.
- The assessment and recommended mitigation and management measures are focused on birds and bats. However, other animals were recorded in the airport site surveys. The airport operator will also be obligated to manage terrestrial animals, including reptiles and mammals other than bats.

The mitigation and management measures presented in this report are flexible, allowing for refinement as the project progresses. Recommendations for further work are provided to address the limitations of this preliminary study (refer Section 6).

2. Methods

The assessment included a desktop review and field assessment of the airport site and the study area (within a 25 km radius of the centre of the airport site) (Figure 1).

2.1. Desktop review

Prior to the site assessment, Avisure reviewed literature and data to develop a preliminary understanding of the current strike risk for a new airport presented by bird and bat populations.

2.1.1 Assessment of Existing Environment

The following documents provided information on the existing environment and historical data on bird and bat populations:

- Draft Environmental Impact Statement, Second Sydney Airport (PPK1997a)
- Technical Paper 10 – Hazards and Risks (PPK 1997b)
- Supplement to the Draft Environmental Impact Statement, Second Sydney Airport (PPK 1999)
- Draft Environmental Impact Statement, Second Sydney Airport Proposal, Auditor's Report (SMEC 1998)
- Supplement to the Draft Environmental Impact Statement, Second Sydney Airport Proposal, Auditor's Report (SMEC 1999)
- Australian Aviation Wildlife Strike Statistics 2004 to 2013 (Australian Transport Safety Bureau 2014)
- *Western Sydney Airport EIS Biodiversity Assessment* (GHD 2015a).

2.1.2 Bird and bat attracting habitat

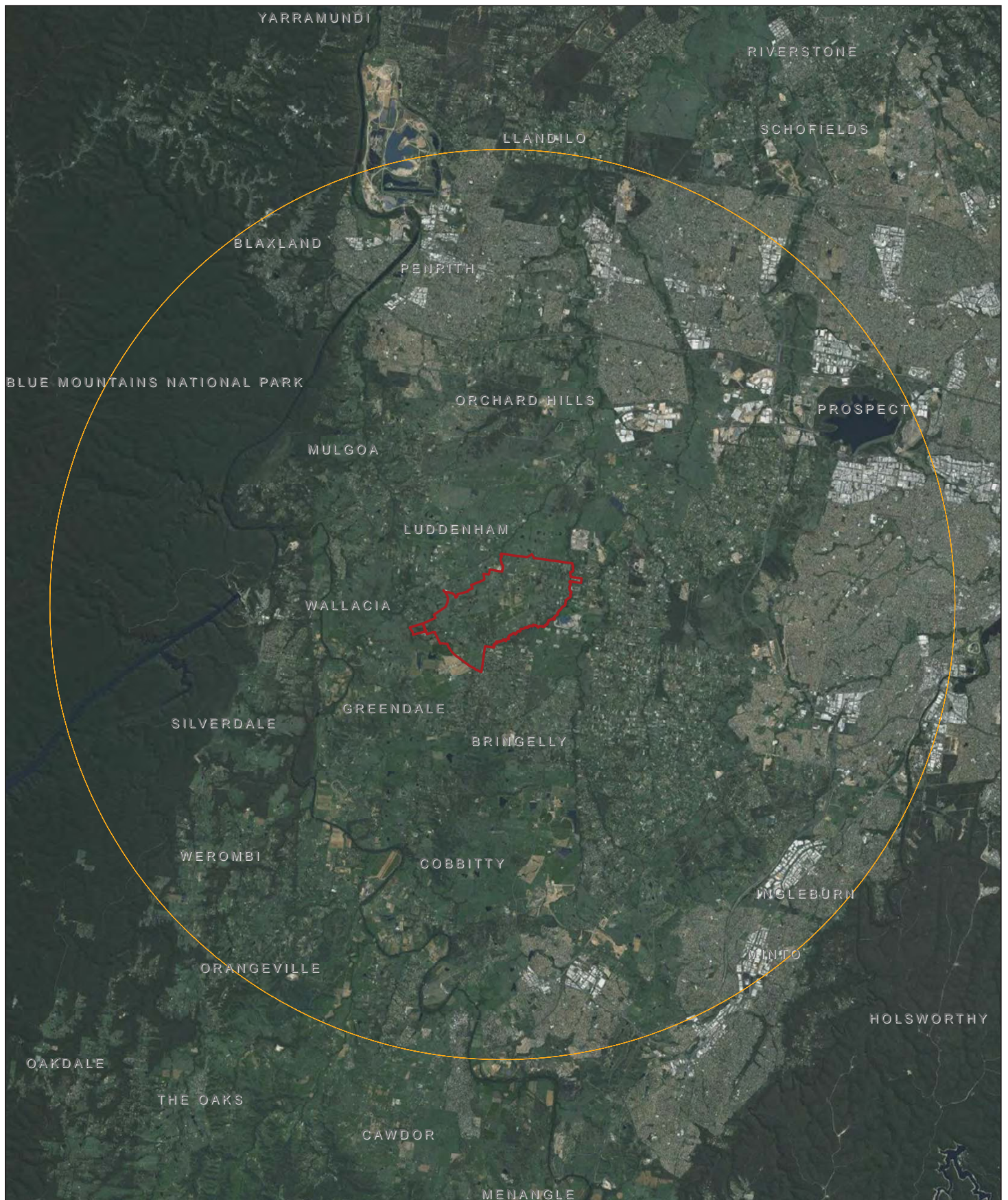
The following resources were used to identify key areas for the field assessment, including Australian White Ibis colonies and Grey-headed Flying-fox roosts (refer Section 2.2.2):

- Sydney Basin Australian White Ibis Regional Management Plan (Ecosure 2009)
- Australian Government Department of the Environment Interactive Flying-fox Web Viewer (Department of Environment 2015).

2.1.3 Western Sydney Airport plans

The following documents provided an overview of the proposed airport design, construction and operation stages. The overall design of the airport and its staged construction was incorporated into the risk assessment and resultant management recommendations. Included in the review of airport plans is the number and profile of aircraft movements:

- Western Sydney Airport Preliminary Airspace Management Analysis (Airservices 2015)



LEGEND

Airport property

Study area

Paper Size A3

0 7501,500 3,000 4,500 6,000

Metres

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



Western Sydney Unit, Department of Infrastructure and Regional Development
WSA Bird and Bat Strike Risk Assessment

Job Number 21-24265
Revision A
Date 18 Jun 2015

Airport and surrounding area

Figure 1

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Data source: Data source: Aerial Imagery - ESRI 2015, General & Topo Data - Geoscience Australia, NSW LPI DTDB & DCDB 2012, Avisure Pty Ltd 2015 Created by: jrichardson
Level 15, 133 Castlereagh Street Sydney NSW 2000 T 61 2 9239 7100 F 61 2 9239 7199 E sydney@ghd.com.au W www.ghd.com.au

- Western Sydney Airport Design Basis Report (May 2015) (GHD 2015b)
- Western Sydney Airport: Airport Land Use Master Plan – Concept Design Report (April 2015) (L&B 2015)
- Draft Airport Plan Western Sydney Airport (Department of Infrastructure and Regional Development 2015).

2.1.4 Regulations, standards and guidelines

- The following documents provided context for the assessment of bird and bat strike risk and the identification of appropriate mitigation and management recommendations:
- Civil Aviation Safety Authority Advisory Circular AC 139-26(0) (Civil Aviation Safety Authority 2011)
- Civil Aviation Safety Authority Manual of Standards Part 139 – Aerodromes (Civil Aviation Safety Authority 2014)
- *Civil Aviation Safety Regulations 1998* (Cth) (Regulations)
- National Airports Safeguarding Framework – Guideline C: Managing the Risk of Wildlife Strikes in the Vicinity of Airports (Department of Infrastructure and Transport 2012)
- Recommended Practices No. 1 – Standards for Aerodrome Bird/Wildlife Control (International Birdstrike Committee 2006)
- Doc 9137 Airport Services Manual. Part 3: Wildlife Control and Reduction (International Civil Aviation Organization 2012)
- Annex 14 to the Convention on International Civil Aviation: Aerodromes, Volume 1 Aerodrome Design and Operation (International Civil Aviation Organization 2013).

2.2. Site visit

A site visit was conducted from 23 to 25 of March 2015 by Avisure's Principal Wildlife Biologist, Phil Shaw and Senior Wildlife Biologist, Jeff Follett. The site visit included an inspection and verification of habitats on the airport site, and an inspection of key bird and bat habitats in the study area identified during the desktop review.

2.2.1 Western Sydney Airport site assessment

The airport site was inspected on 24 of March 2015. Bird and bat surveys were conducted by vehicle along a set route of publicly accessible roads across three periods; morning, midday and afternoon (Figure 2). Birds and bats observed were recorded with species, number, behaviour, location and habitat noted against each observation. Observations were aided by the use of 42 x 10 Leica binoculars.

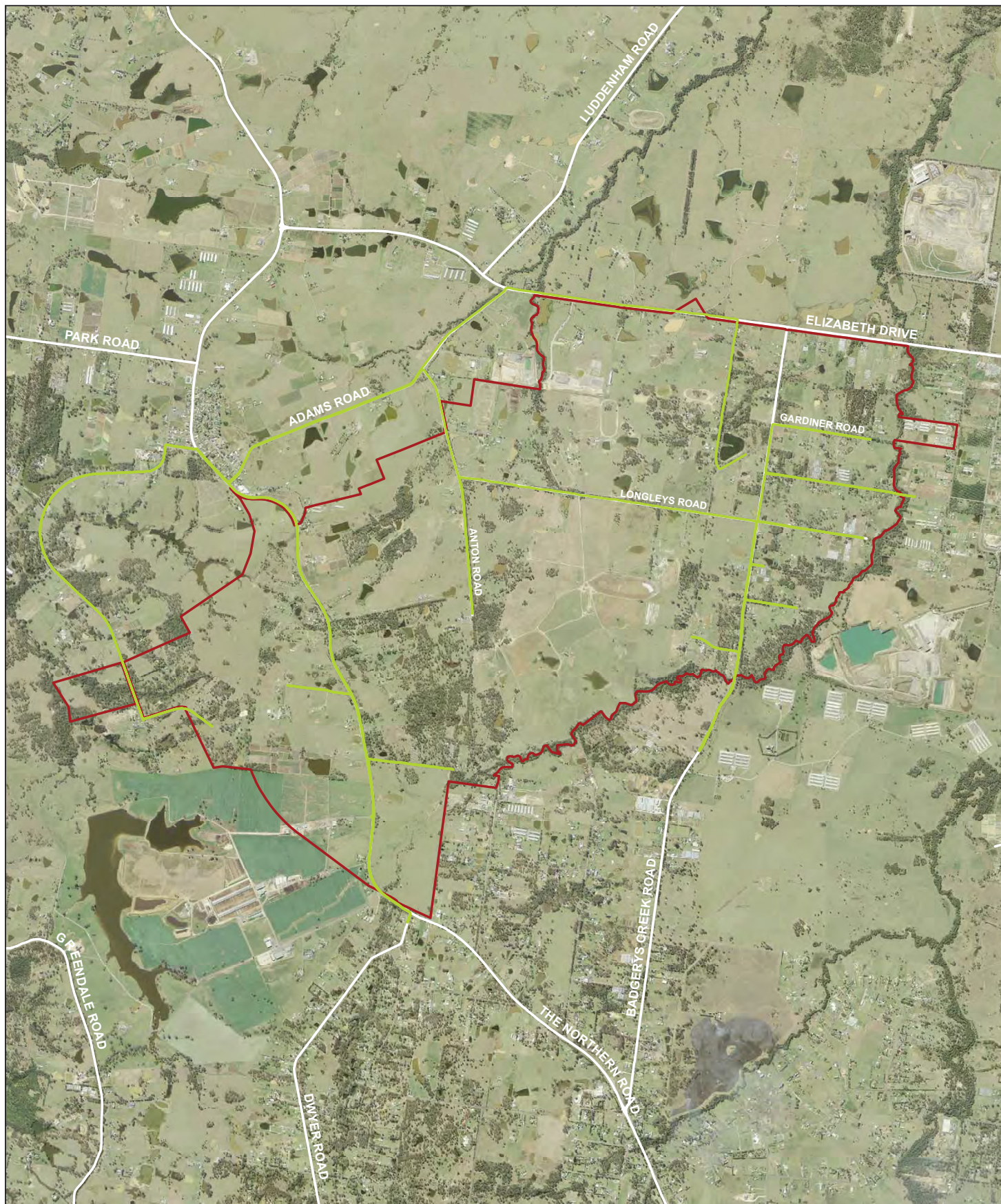
The purpose of the surveys was to record species presence, species numbers and attractive habitats within the airport site and to gather information on the movement of bird and bat populations to, from and over the site. The presence of attractive habitats on the site is particularly important due to the airport's staged construction. It is likely that the existing habitat that is not modified in Stage 1 would continue to attract similar species and numbers whilst the northern runway is operational.

2.2.2 Western Sydney Airport study area assessment

Thirty-one likely bird attracting habitats that were accessible for surveys including landfills, waste transfer stations, nature refuges, golf courses, known Australian White Ibis colonies (Ecosure 2009), and flying-fox camps (Department of the Environment, 2015) within the study area were inspected on the 24 and 25 of March 2015. At each site bird and/or bat species, number of individuals and behaviour were recorded.

The study area included the area within a 25 km radius from the airport site centre point. This distance was adopted based on international standards from International Civil Aviation Organization (ICAO) and the World Birdstrike Association and national guidelines in accordance with the National Airports Safeguarding Framework (NASF) that recommend identifying, and where necessary managing, potential wildlife attractants within 13 km of runways. A 25 km buffer was adopted for this preliminary study to include sites that may be hazardous and to be deliberately conservative.

Some sites within the study area were not assessed due to access restrictions as mentioned in the limitations (Section 1.5). This includes Duncan Creek to the southwest of the airport site as well as some rural properties, waste management facilities and quarries surrounding the site. Section 6 details requirements for further work to address study area assessment limitations. Some study area sites were amalgamated as one location for the determination of potential to increase bird and bat strike risk (e.g. farm dams, cattle farms and poultry farms) to acknowledge their prevalence on the site and in the study area but also to address the time available to visit each site to assess risk (refer to Section 4.2).



LEGEND

Airport property

Survey route

Paper Size A3

0 145 290 580 870 1,160

Metres

Map Projection: Transverse Mercator

Horizontal Datum: GDA 1994

Grid: GDA 1994 MGA Zone 56



Western Sydney Unit, Department of Infrastructure and Regional Development
WSA Bird and Bat Strike Risk Assessment

Job Number 21-24265
Revision A
Date 18 Jun 2015

Airport site survey route

Figure 2

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Level 15, 133 Castlereagh Street Sydney NSW 2000 T 61 2 9239 7100 F 61 2 9239 7199 E sydney@ghd.com.au W www.ghd.com.au
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Data source: Data source: Aerial Imagery - Dept of Lands 2013, General & Topo Data - Geoscience Australia, NSW LPI DTDB & DCDB 2012, Avisure Pty Ltd 2015 Created by: jrichardson

2.2.3 Data analysis and risk assessment

Management of bird and bat hazards at airports requires an understanding of bird and bat populations, their behaviour, and the risk management process. The process outlined in Australian and New Zealand Standard 31000:2009 Risk Management has been followed for this assessment:

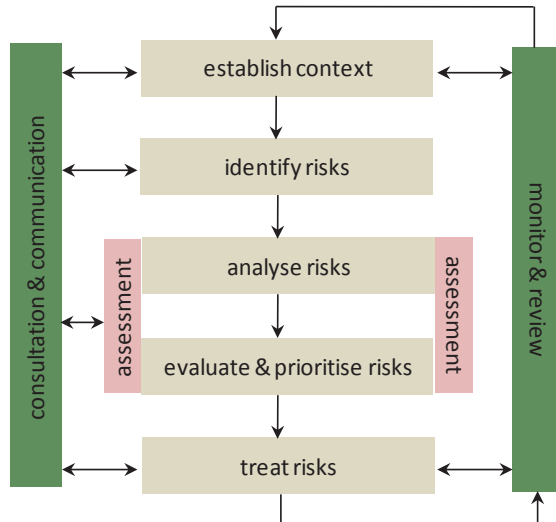


Figure 3. The risk management process (Source: AS/NZS 31000:2009 Risk Management).

Efforts to rank species according to risk level generally involve one of the following:

1. Using national databases to indicate risk level across a country (Dolbeer et al., 2000). This lacks the resolution required to determine risk at a particular airport, although may be useful as a guide.
2. Subjective assessment based on knowledge of bird species present, interpretation of the strike history, and professional judgement for an operational airport. This is the primary methodology used by advisors to airports worldwide.
3. A more formalised, yet still subjective assessment of risk based on scoring a species for categories such as population size, bird mass, flock size, time of day, location on airport site, time spent in air, etc. (Carter, 2001; Morgenroth, 2003). This assessment is open to the vagaries of professional interpretation and cannot be easily used to compare one airport with another, or objectively compare one year to the next.
4. A determination of probability of strike based on bird strike history at the operational airport over the previous five years to determine a yearly average for each species and using percentage of strikes causing damage for each species in a national bird strike database to determine consequence levels (Allan et al., 2006). This is probably the most frequently used method but does not consider the effect of differences in numbers of aircraft movements both between airports and across the same airport for different time periods. It also cannot categorise species which have not been struck in the previous five year period, yet may still remain a significant risk. It is also dependent on effective bird strike reporting which is consistent over time.
5. Avisure has developed a model for determining risk categories using professional bird survey data (Shaw, 2004). The survey data is used to derive probability factors (population size,

position on airport, time spent in air and the species ability to avoid) and consequence factors (bird mass and flock size) for all species recorded. The combination of these probability and consequence factors give a numerical risk index, the Survey Risk Index. This provides a real-time method of risk assessment as it is able to react to observed changes in airside bird assemblages and movement patterns.

Each of these approaches is based on the existence of historical data in the form of strike records or long-term, standardised surveys (options 1, 2, 4, 5) or lacks the necessary rigour to apply to a specific location (options 2, 3). For these reasons, Avisure has evaluated the risk of bird and bat strike at the airport site based on the risk presented by individual species, airport site and study area habitats, projected aircraft movements, airport design and construction plans and operational considerations and has compiled these into an overall qualitative assessment of risk for the airport (Section 4).

Species assessment

The surveys conducted in March 2015 form the basis for the assessment of species risk. The total number of records across the survey set was divided by three to determine the average number recorded for each species per survey. This is done to account for the variability in numbers recorded in morning, midday and afternoon surveys. Behaviour was recorded for each observation to determine the possible impact on aircraft movements and to identify possible mitigation strategies.

Airport site habitat assessment

Habitat present on the airport site has the potential to attract birds and bats. It is understood that a portion of the current habitat will be removed during Stage 1 of construction. However, a portion of existing habitat will remain on the airport site until the construction of the longer term development and even after construction of the final stages, some habitat will remain within the airport site such as the environmental conservation zones along Badgerys and Oaky Creeks. An interpolation of survey data was used to determine the possible attraction of the remaining habitat (Figure 5). During the surveys, comments were recorded as to the attractiveness of various structures, dams, grasslands, agricultural areas, riparian areas and remnant woodlands. These areas were noted because they will become the airport operator's responsibility to reduce the attractiveness to birds and bats in habitats located on its property (refer to Section 3).

Study area habitat assessment

The presence of attractive habitat surrounding the airport site will increase the probability of bird and bat strikes due to increased populations and the possibility of aircraft colliding with birds and bats transiting to and from sites. The study area assessment focused on sites identified in Guideline C of the NASF, *Managing the Risk of Wildlife Strikes in the Vicinity of Airports* (Department of Infrastructure and Transport, 2012). The NASF is embedded within the broader regulatory framework identified in Section 3, and it is the most suitable tool to determine the appropriateness of mitigation and monitoring measures for study area sites.

Projected aircraft movement

The total number of aircraft movements can influence the probability of strikes, with the number of strikes directly correlated with the number of aircraft movements assuming that all other variables remain constant (type of aircraft, weather and mitigation measures, etc.). Strike probability is also influenced by the positioning of the runways and subsequent flight paths for arrivals and departures. For example, a flight path positioned over attractive habitats (e.g. farm dams) increases the likelihood of a strike. For these reasons, the report includes an assessment of the risk presented by the projected aircraft movements and indicative flight paths for the airport. To assist the analysis, additional information comprising a table of airport key design parameters and synthetic aircraft movement schedules for 2030, 2050 and 2063 was reviewed.

Staged construction assessment

Airport design can be used to limit the creation of attractive habitat when applied to landscaping, lighting, buildings, fencing, drains, detention and retention basins, and various other airport infrastructure. Construction itself can have a significant impact on the behaviour of bird and bat populations (e.g. earthworks, exposed soils, exposed seeds, temporary water retention areas, availability of roosting and loafing opportunity on stockpiles of soil and other construction materials), and is of particular concern for this project due to the plan to operate the first runway during the construction of the second runway. The assessment of the design and construction of the airport assumes that the airport will implement the mitigation and management measures outlined in Section 5 and will comply with the regulations, standards and guidelines outlined in Section 3.

Overall airport assessment

The overall bird and bat strike risk for the airport is a compilation of the five aforementioned assessments. Where data or information was not available, Avisure made professional judgements on the risk presented, informed by our eighteen years of aviation experience. The overall risk is based on the airport's responsibilities under international and national regulations, standards and guidelines; however, Avisure has used the data from all of the assessments to ensure recommendations suit the airport site, whilst complying with legislative and regulatory requirements. Our assessment of the overall risk considers: species behaviour and size; habitat attraction to particular species; aircraft movements and time of day; and, staged construction of the site.

3. Regulations, standards and guidelines

There are a number of regulations, standards and guidelines for the assessment and management of activities that contribute to an airport's bird and bat strike risk.

3.1 International regulations and standards

ICAO is a specialised United Nations agency that coordinates and regulates international civil aviation. As a signatory of the Convention on International Civil Aviation, Australia is required to maintain aviation rules that align with the requirements of the Convention. This includes standards for wildlife hazard management at civilian airports in accordance with Annex 14, Volume 1 (Aerodrome Design and Operation), which establishes requirements for the management of collisions between wildlife and aircraft, and requires authorities to take actions to reduce the prevalence of wildlife attracting sites in the vicinity of airports.

ICAO's Doc 9137 (Airport Services Manual Part 3, Wildlife Control and Reduction) (2012) elaborates on the wildlife management responsibilities of airports, providing guidance on the development and implementation of effective airport wildlife management programs, whilst recognising that geographic location, climate, attractiveness of the site to wildlife and air traffic density are site specific and that programs should be developed accordingly. Doc 9137 also includes recommendations on hazard review and habitat management, and identifies a recommended boundary for monitoring off-airport wildlife hazards and land uses.

ICAO's regulations and standards inform Civil Aviation Safety Authority (CASA) regulations and recommendations for wildlife management at airports, and are therefore relevant to the airport bird and bat strike risk assessment.

3.2 National regulations, standards and guidelines

CASA defines and regulates wildlife hazard management at Australia's civilian airports, in accordance with the *Civil Aviation Safety Regulations* 1998 and the CASA Manual of Standards (MOS) Part 139. The regulations establish the requirements for monitoring and recording information on wildlife hazards and identify the airport's responsibilities in the event that a wildlife hazard is identified.

To assist with the interpretation and implementation of MOS Part 139, CASA released *Advisory Circular (AC) 139-26(0)*. The AC provides airport operators with further guidance on how to meet their monitoring obligations and how to address wildlife management issues.

Under these national regulations, the airport is obliged to monitor on- and off-airport sites, and to mitigate wildlife hazards within the airport site through the development and implementation of a Wildlife Hazard Management Plan. The national regulations and related AC assisted the development of the risk management strategies in Section 5.

In May 2012, the Department of Infrastructure and Transport (DIT)¹ released the NASF which aims to develop informed land use planning regimes to safeguard airports and their adjacent communities based on the international and national regulatory framework.

Guideline C of the NASF (Managing the Risk of Wildlife Strikes in the Vicinity of Airports) aims to provide wildlife management guidelines to land users and planning decision makers. Based on the ICAO guideline of reviewing land use within 13 km of an airport, the NASF allocates risk categories to particular land use types from very low to high, and recommends actions for both existing and proposed developments (i.e. incompatible, mitigate, monitor, no action), within zones at 3, 8 and 13 km radial distances. The NASF encourages a coordinated approach between airport operators and land use planning authorities to mitigate risks.

The guideline is particularly useful when considering the establishment of new airports because planning agencies can consider land usage that is incompatible, or requires mitigation or monitoring before commencing work.

NASF Guideline C (included in Appendix A) is relevant to the airport's responsibilities to monitor and mitigate wildlife hazards within the study area. It provides guidance on how the airport operator should work with local councils or other land use planning authorities to establish mechanisms to prevent the creation of land uses that would increase the risk of bird or bat strike risk. Guideline C was incorporated into the study area habitat assessments (Section 4) and the mitigation measures recommended in Section 5.

¹ Now called the Department of Infrastructure and Regional Development

4. Bird and bat strike risk assessment

The overall airport risk assessment included consideration of the species, the airport study site habitat, study area, projected aircraft movement, and staged construction assessments.

4.1 Species assessment

The Australian Transport Safety Bureau (ATSB) identify kites, bats/flying-foxes, lapwings/plovers and Galahs as the four most frequently struck species for Australian airports between 2004 and 2013 (ATSB 2014) with aircraft operating at New South Wales (NSW) airports mostly striking bat/flying-foxes, Galahs, lapwing/plover and magpies. For high capacity air transport², the ATSB identify bat/flying-fox, Galah, kite, duck, hawk and magpie as the species most involved in damaging strikes. Galahs were involved in the most multiple strikes with 38% of Galah strikes involving more than one bird. A multiple strike has a greater likelihood of damage and has the potential to disable more than one engine which can result in catastrophic incidents.

Of the aforementioned species, Avisure recorded Masked Lapwing, Galah, Australian Magpie, and various duck species in the airport site surveys. Of particular note was the number of Galahs recorded, with an average of 9.33 per survey and four duck species (Pacific Black Duck, Grey Teal, Australian Wood Duck, and Hardhead), with greater than 10 per survey (Figure 4). In addition, the presence of Straw-necked Ibis in high numbers presents a risk as they are a flocking species of significant mass (1.3 kg) and are relatively difficult to manage on an operating airport.

In addition to the species listed above, several species recorded on the airport site are likely to remain in the area post-construction. Despite their lower ATSB ranking, these species present at least a moderate strike risk due to the availability of food, water and shelter on and adjacent to the airport site (see Sections 4.2 and 4.3). These include, but are not limited to; Common Starling, Feral Pigeon, Cattle Egret and Australian White Ibis. Their risk potential is based on their strike history at other airports, their size, and the likelihood that they will be involved in multiple strikes due to flocking behaviour.

Figure 4 illustrates the average number of individuals observed during the survey period. The figure excludes species that had an average of less than five individuals per survey. These species were excluded because a lower bird number generally equates to a lower strike probability. Additional surveys are required to determine if the observed averages are a true indication of abundance.

The behaviours recorded during the airport site surveys indicate that the site itself is attractive to birds, rather than the site simply acting as a transit pathway between various sites in the adjacent study area. Approximately 88% of the recorded birds were foraging, loafing or perching within the airport, compared to

² Includes Regular Public Transport and charter operations on aircraft certified as having a maximum capacity exceeding 38 seats or a maximum payload exceeding 4,200 kg.

only 11% transiting or soaring over the site. This observation is of particular importance for the staged construction discussed in Section 4.4.

No flying-foxes were recorded by Avisure on the airport site. The afternoon survey included the dusk period to provide an opportunity to observe foraging flying-foxes; however, eucalypts were not flowering at the time of the assessment. Additional surveys in other seasons are required to identify flying-fox use of the site as GHD (2015a) recorded a small number of Grey-headed Flying-fox foraging in the riparian corridor (Badgerys Creek). No flying-fox roost sites were observed within the airport site. GHD (2015a) also recorded 12 species of microbats; however, these have been excluded in the bird and bat strike risk assessment as they are unlikely to present a significant strike risk due to their relatively small size and population.

Although potentially moderate and high risk species were recorded in surveys at the airport site, their numbers were not unusually large and there were limited transits through the air. While it is considered necessary to conduct additional surveys to confirm this it is the preliminary conclusion that the bird and bat hazard could be effectively managed to an acceptable risk level through the implementation of a Wildlife Hazard Management Plan.

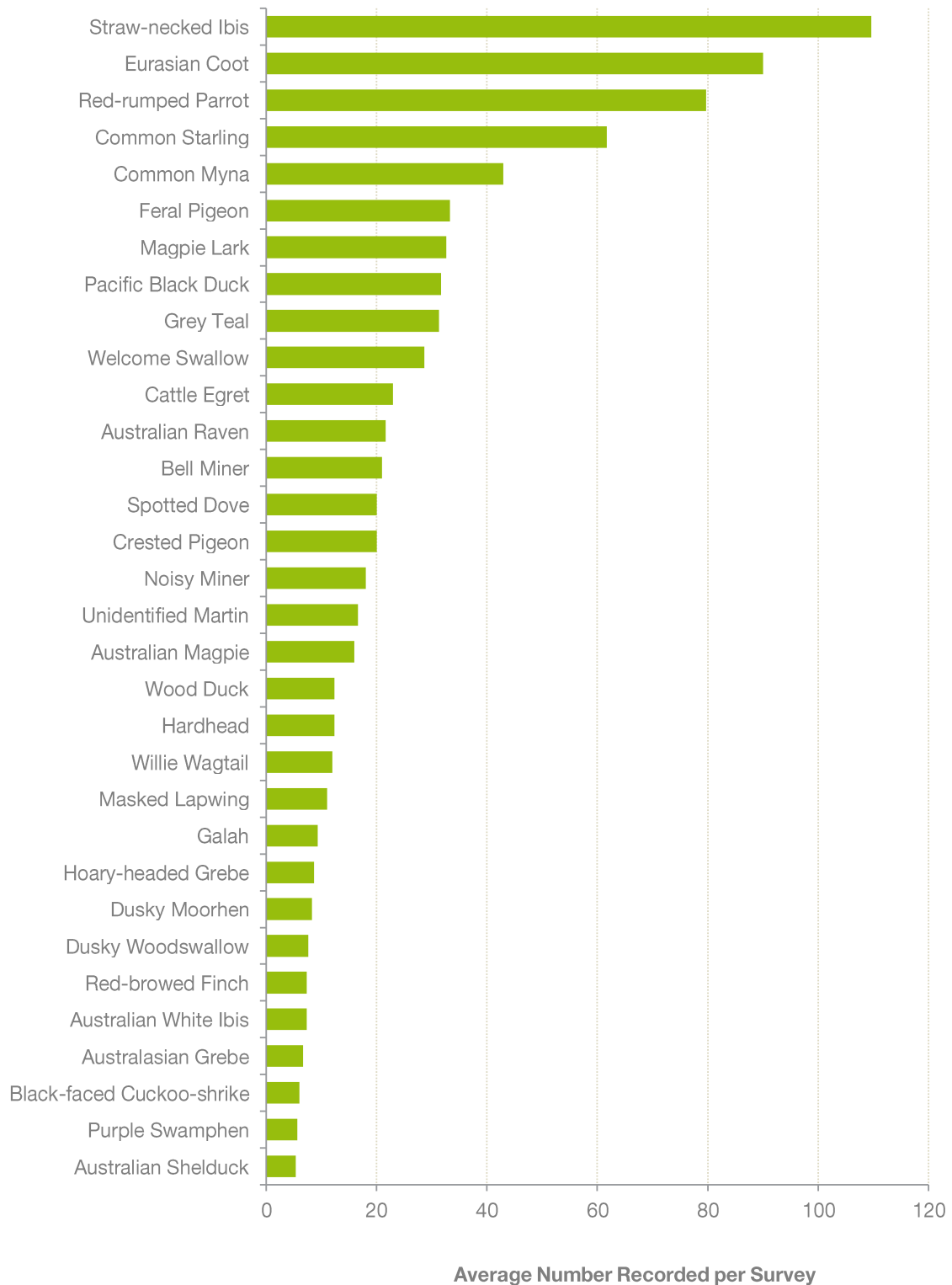


Figure 4. Species and average numbers observed per survey, site for the Western Sydney Airport, March 2015. Note: includes only species with an average number of individuals per survey greater than 5. An additional twenty-eight species were recorded, but had an average less than 5 per survey.

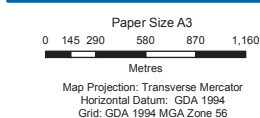
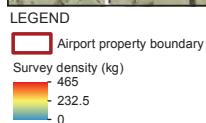
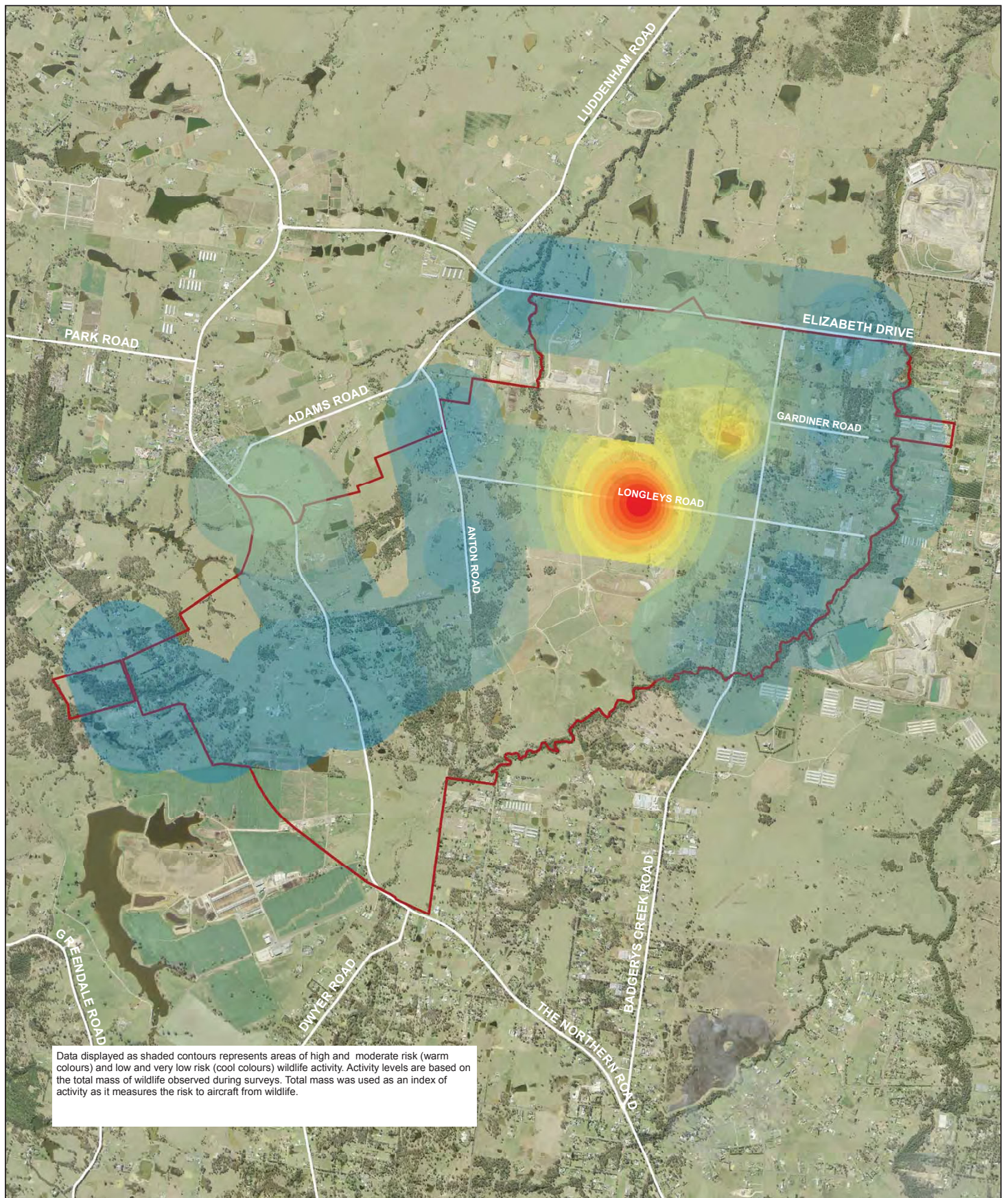
4.2 Habitat assessment

4.2.1 Airport site

The airport site consists of habitats attractive to grassland, wetland, riparian (including the environmental conservation zones along Badgerys and Oaky Creeks) and remnant woodland bird species, with a relatively equal proportion of habitat use observed (grasslands (24%), trees (23%) and ponded water (23%)). The observations recorded for built environment (12%) included residential and agricultural structures, power lines, light poles and other infrastructure. These areas were predominantly used for perching. Despite the absence of flying-foxes, the site does include areas of suitable foraging habitat for Grey-headed Flying-foxes. Eucalypts were not flowering at the time of the site assessment; however, GHD recorded Grey-headed Flying-fox in its surveys (GHD 2015a).

The greatest concentration of birds was observed along Longleys Road (agricultural field and farm dam) and at the retention pond on Taylors Road. Birds were predominantly recorded around farm dams, and the grasslands, trees and infrastructure immediately surrounding them (Figure 5). The implications of staged development of the site and its impact on the availability of habitat at the airport site is discussed in Section 4.4.

Overall, the airport site contains attractive habitat for grassland and wetland species; however, with proper design of airport facilities and landscapes and the implementation of habitat management at the construction and operation phases of the airport, the attractiveness of habitat can likely be managed to achieve an acceptable risk level.



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Airport site wildlife activity

Figure 5

4.2.2 Study area

New airport developments must consider the impacts of potentially conflicting airspace between birds and aircraft due to movements of birds to and from off-airport sites. The attractiveness of a particular habitat is not the sole consideration. A highly attractive habitat that does not have a complementary habitat on the other side of the aerodrome, may have little or no impact on strike risk because birds and bats will not be inclined to transit through critical airspace. Whereas a habitat with relatively low attraction may pose a significant risk due to its close proximity and position, causing birds and bats to transit through critical airspace (Figure 6). Figure 6 shows an example of a major hazard increase as a result of a new development on the opposite side of a runway.

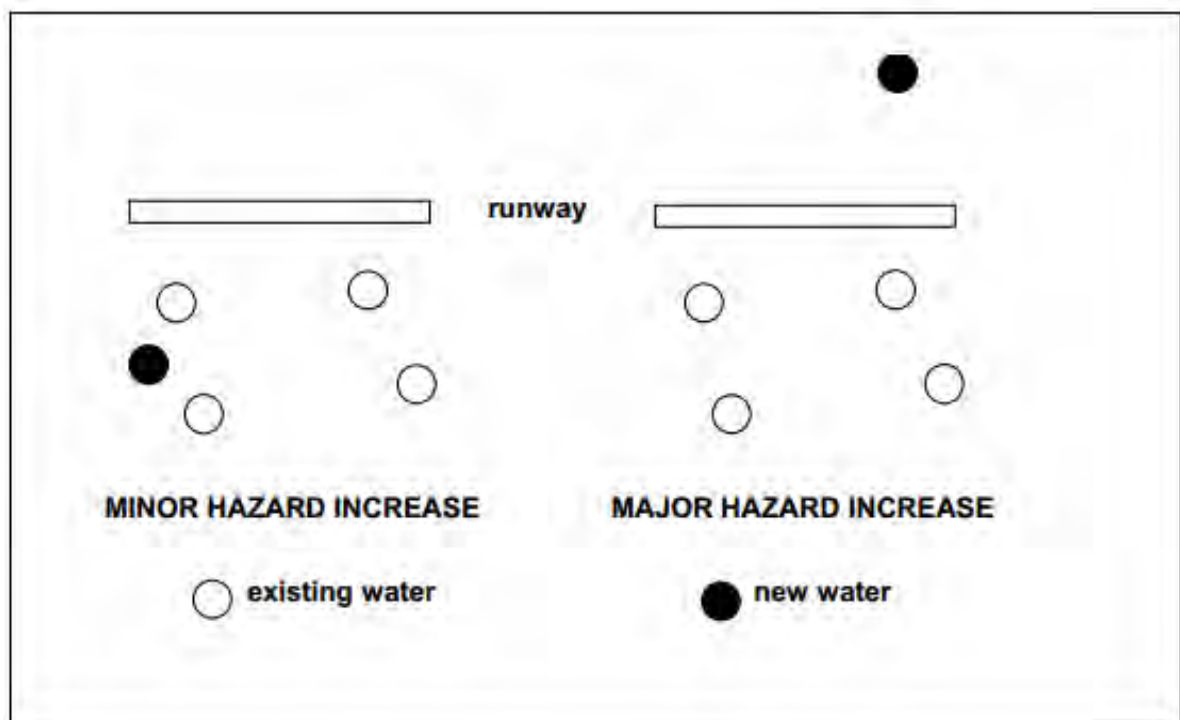
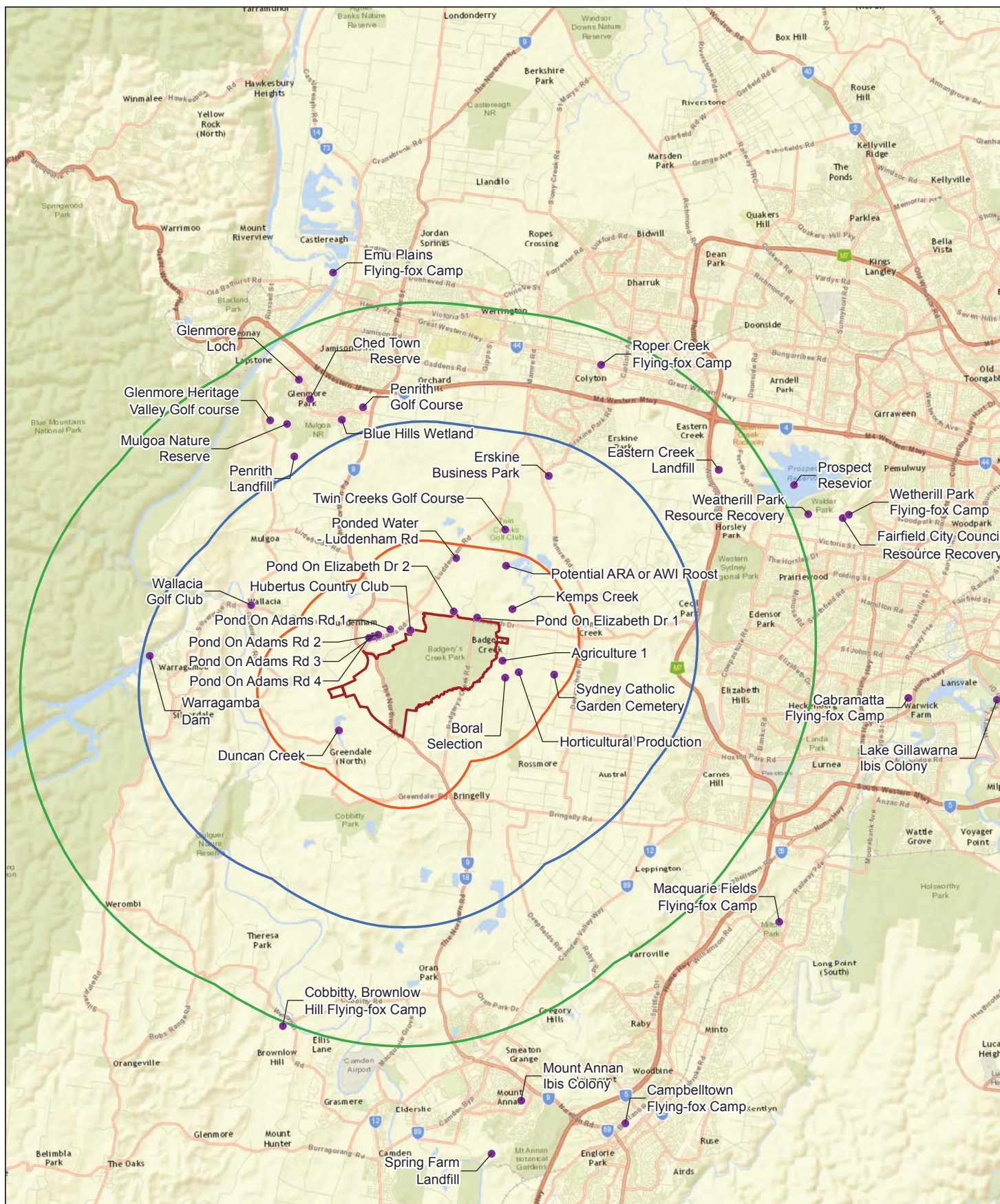


Figure 6. Impact of hazard location in relation to a runway, United Kingdom, Civil Aviation Publication 680.

Figure 6 is relevant to the proposed airport site as there are locations that are potentially attractive to birds and bats throughout the study area (Figure 7). The study area assessment focused on the location of these sites, their attractiveness to birds and bats (determined through site visits where possible), their distance from the airport site, and current management actions to determine their contribution to the bird and bat strike risk at the airport. Table 1 summarises the potential for study area sites to contribute to the bird and bat strike risk at the airport. The table includes the NASF land use description and wildlife attraction risk for the purposes of baseline risk determinations, and Avisure's determination of, and justification for, specific risk to the airport site.

Due to their quantity and distribution, farm dams, cattle farms and poultry farms have been listed as amalgamated locations. Their patchwork distribution throughout the study area, and the general attraction of water to birds, creates a potentially serious risk if birds infringe operational airspace whilst transiting from one location to another. The distribution of farm dams within 3 km of the airport (Figure 8) site is comparable to the scenario provided in Figure 6 with hazards on either side of the runway.

Overall, the presence of off-airport farm dams presents the greatest risk for bird strike at the airport site. The other locations identified within the study area are not currently considered to constitute high risk due to the reasons outlined above. Despite the complexity involved in managing an abundant and highly distributed habitat type outside of the airport site, it is important to consider this risk relative to other possible features which could present significant bird and bat strike risk for an airport. For instance, unlike some airports, the proposed site does not have a large estuary in close proximity, is not within a major migratory route, does not have flying-fox roosts or ibis colonies in close proximity and is likely to have reduced natural habitat available as urbanisation surrounds the airport site. The risk presented by study area sites can be managed through effective relationships with surrounding land owners and planning authorities and by having a standardised monitoring system in place to identify the locations that present an increased bird and bat strike risk. Consistent identification and monitoring of key risk locations as per the NASF guideline will assist in determining changes in risk presented by surrounding land uses and in building relationships to manage sites likely to increase bird or bat strike risk.



LEGEND

- Airport property
- 3km
- 8 km
- 13 km
- Assessment

Paper Size A3
0 7001,400 2,800 4,200 5,600
Metres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56



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Date 18 Jun 2015

Study area assessment locations

Figure 7

Table 1. Study area assessment locations, National Airport Safeguarding Framework Guidelines and potential risk to Western Sydney Airport, March 2015.

Name	Location from the airport site	NASF Land Use Description	NASF Wildlife Attraction Risk	Potential Risk Posed to Western Sydney Airport	Justification of Potential Risk Rating
Farm Dams	Various	Not described	Not applicable	High	Australian Pelican, Black Swan, various species of ducks, cormorants, grebes, coots and others were observed on the numerous ponds within the airport site and study area. The movement of these birds between various water bodies could result in birds infringing aircraft flight paths.
Eastern Creek Landfill	14.87 km NE	Putrescible waste facility - landfill	High	Moderate (High)	Despite the significant number of large flocking birds present, the facility is scheduled for closure in 2017. If the current development application to delay closure is approved, the risk will elevate to high.
Penrith Waste Services	10.39 km NW	Non-putrescible waste facility - landfill	Moderate	Low to Moderate	Due to the relative proximity of the airport site to this location, concern is that mixed waste (including food waste) could enter the landfill and attract birds. Further assessment required to determine bird use of the location and likelihood to transit operational airspace.
Spring Farm Landfill (formerly Jacks Gully Landfill)	20.66 km S	Putrescible waste facility - landfill	High	Low to Moderate	Although significant numbers of large birds present, they appear to roost locally (Mount Annan) and do not appear to travel north toward the airport site. As a regional food source it contributes to the regional bird population growth, potentially contributing to the new airport's strike risk. Further assessment required to determine if birds transiting to and from this location transit operational airspace.

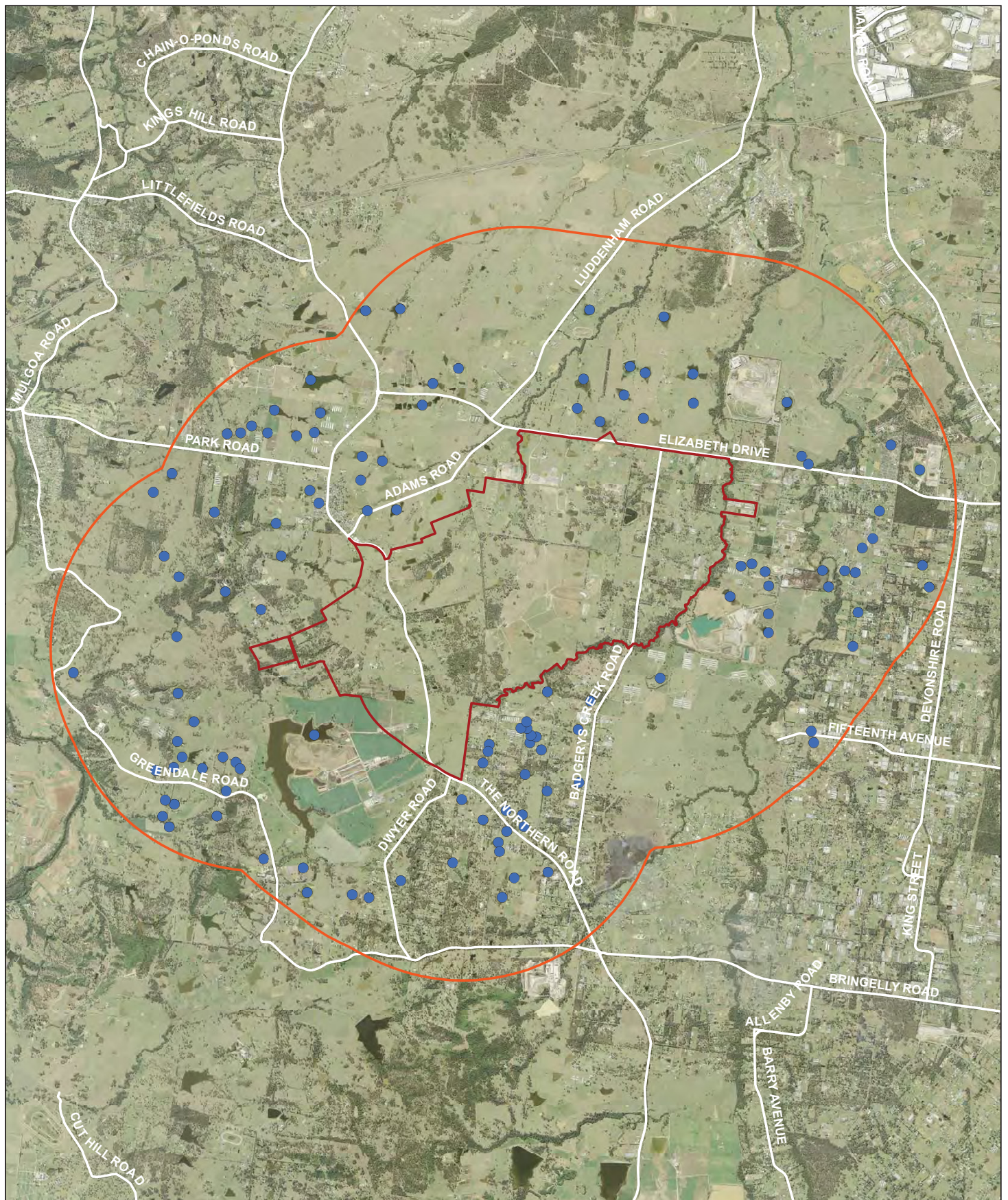
Name	Location from the airport site	NASF Land Use Description	NASF Wildlife Attraction Risk	Potential Risk Posed to Western Sydney Airport	Justification of Potential Risk Rating
Blue Hills Wetland	10.93 km NW	Wildlife sanctuary / conservation area - wetland	High	Low to Moderate	Has the potential to be a roost or nesting location for wetland species. Further assessment required to determine if birds transiting to and from this location transit operational airspace.
Glenmore Loch	13.12 km NW	Wildlife sanctuary / conservation area - wetland	High	Low to Moderate	Has potential to provide roosting and nesting opportunities for wetland species. Further assessment required to determine if birds transiting to and from this location transit operational airspace.
Kemps Creek Landfill	4.4 km NE	Non-putrescible waste facility - landfill	Moderate	Low to Moderate	Mixed waste (including food waste) could enter the landfill and attract birds, contributing to the airport's strike risk. Further assessment required to determine bird use of the location and likelihood of operational airspace transits.
Ched Towns Reserve	12.22 km NW	Sports facility (tennis, bowls, etc.)	Moderate	Low to Moderate	Has the potential to support flocks of corellas and Galahs. Further assessment required to determine if birds transiting to and from this location transit operational airspace.
Cattle farms	Various	Cattle /dairy farm	Moderate	Low to Moderate	Cattle Egrets and Straw-necked Ibis forage on the grasslands. The movement of these birds between various farms could see birds infringing aircraft flight paths. Further assessment required to determine movement patterns amongst the sites.
Poultry farms	Various	Poultry farm	Moderate	Low to Moderate	European Starlings, Feral Pigeons and other birds could be attracted to chicken food, their presence in flocks may present a hazard to aircraft if they transit

Name	Location from the airport site	NASF Land Use Description	NASF Wildlife Attraction Risk	Potential Risk Posed to Western Sydney Airport	Justification of Potential Risk Rating
Warragamba Dam	11.63 km W	Not described	Not applicable	Low to Moderate	operational airspace. Further assessment required to determine movement patterns amongst the sites. Could potentially support Australian Pelican and other large water birds. Further assessment required to determine use of the location and to assess movement patterns to and from the site.
Fairfield City Council Resource Recovery	18.67 km NE	Non-putrescible waste facility - landfill	Moderate	Low	Waste is inaccessible to birds.
Wetherill Park Resource Recovery	17.37 km NE	Non-putrescible waste facility - transfer station	Moderate	Low	Waste is inaccessible to birds.
Mulgoa Nature Reserve	11.72 km NW	Wildlife sanctuary / conservation area - dryland	Moderate	Low	May provide forage for flying-fox, but its location relative to the airport site and flying-fox camps reduces the hazard level.
Glenmore Heritage Valley Golf Course	12.22 km NW	Golf course	Moderate	Low	Unlikely to support large flocking species, however corellas, cockatoos and Galahs may use the site from time to time.
Twin Creeks Golf Course	6.65 km NE	Golf course	Moderate	Low	Although pelicans, lapwings and cormorants were present, it is unlikely to support large numbers. Corellas, cockatoos and Galahs may use the site from time to time. Further assessment required to determine if birds transiting to and from this location transit operational airspace.

Name	Location from the airport site	NASF Land Use Description	NASF Wildlife Attraction Risk	Potential Risk Posed to Western Sydney Airport	Justification of Potential Risk Rating
Wallacia Golf Course	7.77 km W	Golf course	Moderate	Low	Unlikely to support large flocking species; however, corellas, cockatoos and Galahs may use the site from time to time. Further assessment required to determine if birds transiting to and from this location transit operational airspace.
Cabramatta Flying-fox Camp	20.42 km E	Not described	Not applicable	Low	Distant camp. Further assessment required to determine the attractiveness of airport site habitat in other months.
Campbelltown Flying-fox Camp	21.97 km SE	Not described	Not applicable	Low	Distant camp. Further assessment required to determine the attractiveness of airport site habitat in other months.
Cobbitty Flying-fox Camp	16.25 km SW	Not described	Not applicable	Low	Distant camp. Further assessment required to determine the attractiveness of airport site habitat in other months.
Emu Plains Flying-fox Camp	16.97 km NW	Not described	Not applicable	Low	Distant camp. Further assessment required to determine the attractiveness of airport site habitat in other months.
Lake Gillawarna / Mirambeena Regional Park Ibis Colony	24.15 km E	Not described	Not applicable	Low	Bankstown City Council have a management plan in place for limiting population growth of Australian White Ibis. Its location relative to the airport site, and the lack of known food sources on or beyond the airport site, reduces its hazard potential.

Name	Location from the airport site	NASF Land Use Description	NASF Wildlife Attraction Risk	Potential Risk Posed to Western Sydney Airport	Justification of Potential Risk Rating
Macquarie Fields Flying-fox Camp	18.39 km SE	Not described	Not applicable	Low	Distant camp. Further assessment required to determine the attractiveness of airport site habitat in other months.
Mount Annan Ibis Colony	18.68 km S	Not described	Not applicable	Low	Although significant numbers of large birds present, they appear to feed locally (Spring Farm Landfill) and do not appear to travel north toward the airport site. Further assessment required to determine bird use of the location and likelihood of operational airspace transits.
Roper Creek Flying-fox Camp	14.66 km NE	Not described	Not applicable	Low	Distant camp. Further assessment required to determine the attractiveness of airport site habitat in other months.
Wetherill Park Flying-fox Camp	18.97 km NE	Not described	Not applicable	Low	Distant camp. Further assessment required to determine the attractiveness of airport site habitat in other months.
Sydney Catholic Garden Cemetery	5.45 km E	Not described	Not applicable	Low	Landscape may attract grassland foraging species such as lapwings, ibis and magpies. Further assessment required to determine if transits to and from the site intersect operational airspace.
Boral Selection Facility	3.4 km E	Not described	Not applicable	Low	Ponds may attract water birds. Further assessment required to determine bird use of the location and likelihood of operational airspace transits.

Name	Location from the airport site	NASF Land Use Description	NASF Wildlife Attraction Risk	Potential Risk Posed to Western Sydney Airport	Justification of Potential Risk Rating
Duncan Creek	5.3 km SE	Wildlife sanctuary / conservation area - wetland	Moderate	Not determined	Further assessment required to determine bird use of the location and likelihood of operational airspace transits.
Prospect Reservoir	17.32 km NE	Not described	Not applicable	Not determined	Further assessment required to determine bird use of the location and likelihood of operational airspace transits.



LEGEND
 Airport property
 3km
 Farm dam

Paper Size A3
 0 260 520 1,040 1,560 2,080
 Metres
 Map Projection: Transverse Mercator
 Horizontal Datum: GDA 1994
 Grid: GDA 1994 MGA Zone 56



Western Sydney Unit, Department of Infrastructure and Regional Development
 WSA Bird and Bat Strike Risk Assessment

Farm dams within 3 km of airport site boundary

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Figure 8

4.3 Projected aircraft movement

The projected annual aircraft movements for the airport would be responsive to demand; however, for the purposes of the EIS, is assumed to grow as follows: 56,000 (2030), 79,300 (2035), 164,200 (2050) and 339,900 (2063). For 2004 to 2013, the average strike rate for the major Australian airports was 5.4 strikes per 10,000 movements (ATSB 2014). Australian major airports have a range of 3.13 strikes per 10,000 movements to 10.96 per 10,000 (Figure 9). Each major airport has a unique bird and bat strike risk profile; however, assuming that the proposed airport will have an average similar to that across all of the major airports, approximately 30 (2025), 43 (2035), 89 (2050) and 184 (2063) strikes within the airport confines could be expected. The international benchmark for adverse effect on flight (i.e. delay or damage) is 1 per 100,000 movements (Begier and Dolbeer 2011). Assuming that the airport aligns with the international benchmark, this represents a damaging strike approximately every two years from the opening date and will increase to approximately three per year by the year 2063.

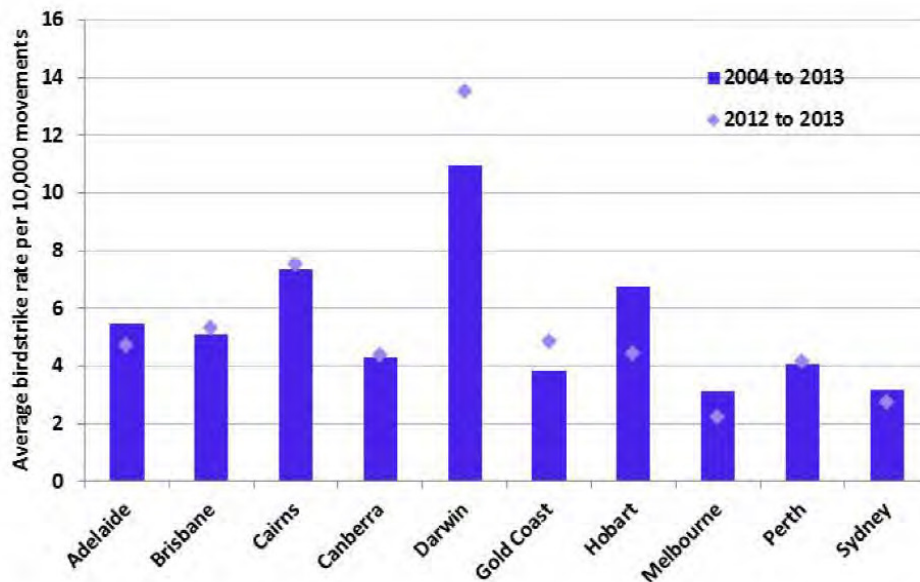


Figure 9. Average rate of birdstrike for major aerodromes (inside aerodrome confines) per 10,000 movements, 2004 – 2013 (source: Australian Transport Safety Bureau 2014).

The time of day profile for projected aircraft movements is similar to other airports in Australia, peaking in the morning and afternoon periods. Based on other airports' bird and bat strike history, it is likely that the airport would record its greatest number of strikes in the morning with a second peak in the afternoon, corresponding with the peak aircraft movements and high bird activity periods. In general, airports that have significant flying-fox populations in close proximity to the airport, or that have large areas of suitable foraging habitat, experience an additional strike peak during dusk and post-dusk periods as flying-foxes depart their roosts and begin their nightly foraging.

The planned approach and departure paths for Stage 1 and the longer term development would take aircraft over or close to potentially significant sites such as the Eastern Creek Landfill, Prospect Reservoir and Warragamba Dam. Based on indicative flight paths for Stage 1, aircraft will be at approximately 2,250 feet

(Prospect Reservoir and Warragamba Dam) on arrival and at approximately 630 feet (Eastern Creek Landfill) on departure whilst close to these sites. In addition, the approach and departure paths are over a number of farm dams which may present a significant bird and bat strike risk. The altitude at which aircraft intersect these locations partially determines the risk level as 93% of bird strikes occur below 3,500 feet (Dolbeer 2006). Bird and bat strike risk should therefore be considered when finalising the flight paths as the height of intersection with significant sites will partially determine their contribution to bird and bat strike risk at the proposed airport (see Section 5).

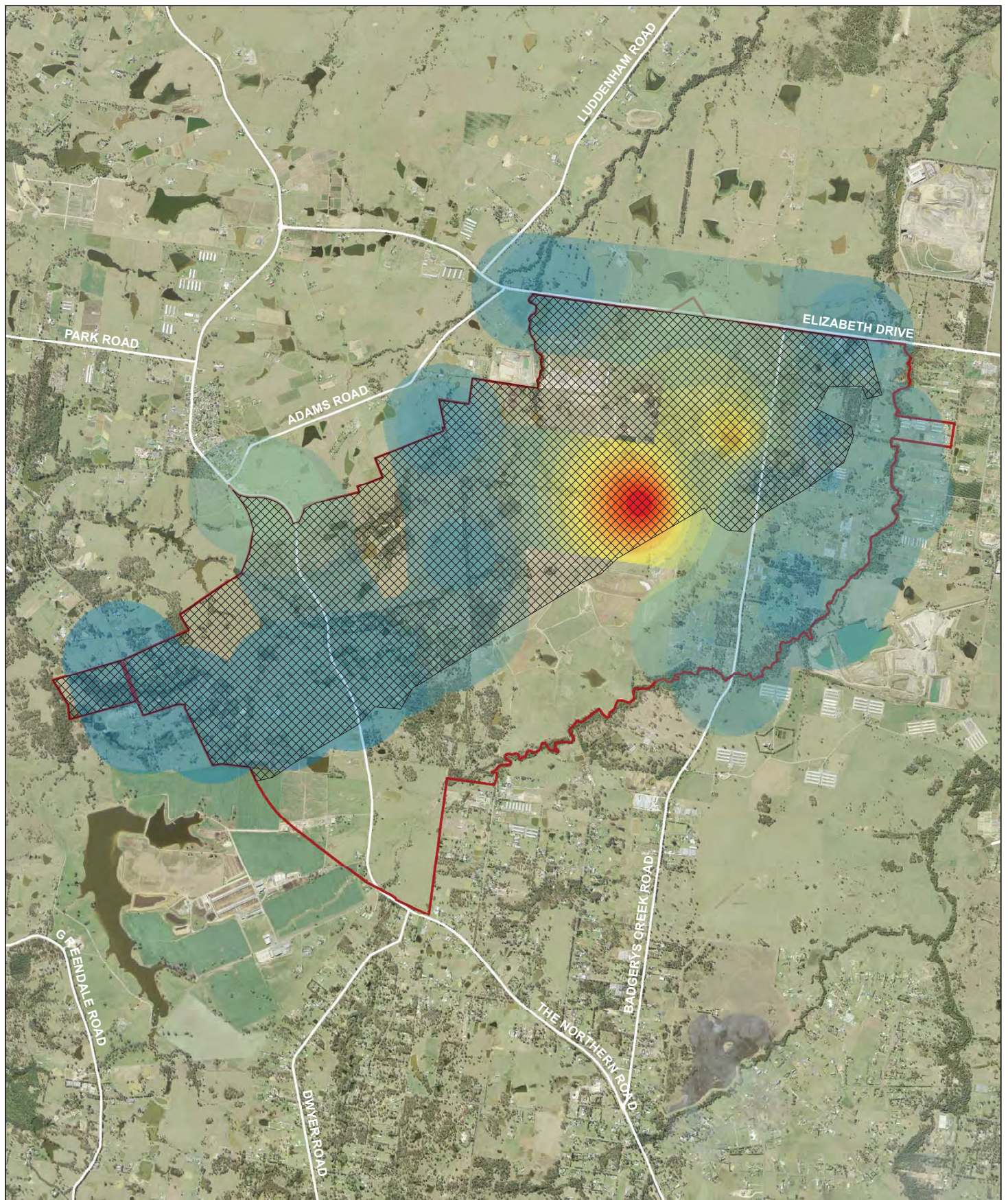
Assuming effective consideration of flight path impact on bird and bat strike risk and the implementation of a robust wildlife management program, projected aircraft movements are unlikely to present a greater bird and bat strike risk when compared to other airports and the impact of significant risks such as consistent, large-scale bird or bat movements can be managed to an acceptable risk level through notification systems and operational modifications such as flight arrival and departure times.

4.4 Staged construction assessment

The airport would be developed across a number of stages. Stage 1 is to be completed with one operational runway (northern). The longer term development anticipates construction of a second runway in the southern half of the site to be completed around 2050. The staged approach to construction presents additional risk of bird and bat strikes at the airport in two ways. Firstly, Stage 1 leaves suitable habitat at the airport site in close proximity to the northern runway operations. Secondly, construction of the second runway could temporarily increase bird and bat strike risk as it will disturb pre-existing populations within the airport site.

Stage 1 construction would reduce the overall habitat available at the airport site (Figure 10); however, suitable habitat would remain in the eastern and southern portions of the site. Approximately 32% of the birds recorded during surveys were utilising habitats that would not be disturbed for the Stage 1 construction. Stage 1 also includes the creation of detention ponds, catering areas, commercial developments and the terminal complex. Each of these has the potential to attract birds from the eastern and southern portions of the airport site, as well as from adjacent properties on all sides of the airport. The full determination of bird and bat attraction implications is limited because the draft airport plan does not include detailed designs and mitigation plans for drainage systems, grasslands, landscaping and other known bird and bat attractants. The draft airport design includes the management of stormwater runoff to ensure no ponding on runways, taxiways and aprons (Department of Infrastructure and Regional Development 2015). It allows for ponding within 75 m of runways and 15 m of taxiways for less than 12 hours. The detention basins will operate as dry basins when they are not providing detention and treatment of stormwater.

The longer term development of the airport site has the potential to disturb birds and bats present in the eastern and southern portions of the airport site during construction. Construction would displace birds and microbats present in the area and has the potential to change bird and bat (including flying-fox) movement patterns due to changed foraging, roosting and nesting behaviours. With an active northern runway, this could increase the probability of bird and bat strikes temporarily until bird and bat patterns adapt to changed



LEGEND

Airport property boundary
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 Survey density (kg)

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 0

Paper Size A3
 0 145 290 580 870 1,160
 Metres
 Map Projection: Transverse Mercator
 Horizontal Datum: GDA 1994
 Grid: GDA 1994 MGA Zone 56



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Habitat implications of Stage 1 construction

Figure 10

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 Data source: Data source: Aerial Imagery - Dept of Lands 2013, General & Topo Data - Geoscience Australia, NSW LPI DTDB & DCDB 2012, Avisure Pty Ltd 2015 Created by: jrichardson

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conditions. Birds and bats present in the area are likely to seek similar habitats in surrounding areas, potentially altering their movement patterns around the airport site. As with Stage 1, the second phase has the potential to attract birds and bats from surrounding areas due to the design of drainage systems, detention basins, grassland areas, landscaped areas and other infrastructure. Birds and bats present in the area will seek the nearest suitable habitat on the airport site or within the study area, and will probably use these sites interchangeably. Careful consideration should be given the location of the detention basins planned for the northern and southern sides of the runways, as birds may transit critical aircraft movement areas to access them. Despite their design, detention basins have the potential to increase risk at times when they are detaining stormwater for treatment, even if the risk is only temporary (United States Department of Transportation 2007, Transport Canada 2010).

A staged approach to construction with the operation of one runway during the construction of a second runway presents a temporarily greater risk than alternative development approaches. However, the temporarily increased bird and bat strike risk due to staged construction can be managed to an acceptable level through the implementation of proper planning and routinely updating the Wildlife Hazard Management Plan to reflect key changes at the airport site.

4.5 Overall airport risk assessment

In accordance with the limitations (Section 1.5) and the methods (Section 2), the overall assessment is based on an analysis of the species surveyed, habitat at the airport site and study area, projected aircraft movements, and the proposed staging of construction. In addition, it assumes the airport operator would comply with ICAO, CASA and NASF and implement the mitigation measures outlined in Section 5.

Based on this analysis and these assumptions, the preliminary assessment of the overall bird and bat strike risk for the proposed airport is low during both stages of development.

Recommendations for further work are provided in Section 6 to address the limitations of this preliminary study and to ensure that bird and bat strike risk is appropriately managed.

5. Strike risk mitigation strategies

Mitigation strategies recommended for each stage of the proposed airport development aim to maintain the bird and bat strike risk at an acceptable level, and have been derived according to the regulations, standards and guidelines outlined in Section 3, along with the assessments detailed in Section 4.

The airport lessee company has the opportunity to design the airport in a way that limits its attractiveness to birds and bats. The current design and construction specifications lack sufficient detail to provide specific recommendations to reduce the strike risk. However, the following general strategies, when implemented at the specified stage, would contribute to mitigating the strike risk.

The mitigation strategies listed in this report are based on our preliminary assessment and will be refined as more information about the design and construction of the airport becomes available. Key considerations will be to ensure that the design does not create wildlife attractive features, that bird and bat populations are monitored to assess strike risk, and that a plan to implement mitigation actions where hazards are identified is developed.

The strategies listed below are specific to Stage 1 of the proposed airport site development. Similar strategies will apply to the longer-term development with the additional risk of bird and bat strike risk due to the operation of one runway during the construction of a second. Further review of appropriate mitigation strategies will be required during the detailed design, construction and operation stages of longer term development.

5.1 Detailed design

1. Engage a wildlife strike specialist to develop a Wildlife Hazard Management Plan (WHMP) that documents at least the following:
 - a. hazard assessment, including monitoring action and analysis
 - b. pilot notification
 - c. liaison and working relationships with land use planning authorities
 - d. on-airport bird and animal attractors which provide food, water or shelter, including stockpile management and induction programs for workers to ensure food wastes are disposed of appropriately
 - e. suitable harassment methods
 - f. an ongoing strategy for bird and animal hazard reduction through subsequent project development stages
 - g. wildlife strike reporting.
2. Implement a standardised and robust bird and bat monitoring system within the airport site and study areas as per the WHMP.
3. Design options and exclusion devices to exclude roosting, nesting and perching opportunities for birds on lighting and fencing, and in aircraft hangars, drains, culverts, and other airport

infrastructure where birds are known to roost, perch and establish nests should be incorporated in accordance with NASF guidelines.

4. Drainage systems, retention ponds and swales should be designed and located to minimise the availability of standing water. Detention basins should be designed to be 'dry' otherwise provision for nets should be included.
5. All-weather access roads for wildlife management should be provided, particularly close to the runway and with easy access to runways and taxiways.
6. Proposed grassland areas should be managed in a way to reduce the attractiveness to birds and the maintenance protocol should be documented. A separate investigation into the preferred grass seed selection may be required to ensure seed mixes are not attractive to granivorous birds, yet are suitable to the climate and soils.
7. Ensure waste receptacles are designed to reduce the accessibility of putrescible waste to scavenging species such as ibis and crows.
8. The detailed design is to be reviewed by a wildlife strike specialist prior to finalisation.

5.2 Construction

1. Monitor birds and bats within the airport site and study areas as per the WHMP.
2. Initiate active management six months prior to the commencement of runway operations. This can assist in determining how birds will use the airport site in the long-term.

5.3 Operation

1. Develop a wildlife management committee that includes the airport operations team, airport environment team, airlines, air traffic control, local and state planning authorities, off-airport landowners, regulators, wildlife strike specialists and conservation groups.
2. Ensure the wildlife management committee meets routinely to assess changing bird and bat activity and how this will impact the airport's strike risk during the operational stage.
3. Engage a wildlife strike specialist to review and revise the WHMP after six months of operation and then according to the review schedule outlined in the WHMP. Where monitoring identifies wildlife hazards, within the airport site or surrounding areas, apply the mitigation actions detailed in the WHMP to reduce the strike risk.
4. Reassess the bird and bat strike risk monthly to determine up to date risks that can inform management actions, resource allocation, as well as monitor program progress.

6. Strike risk assessment next steps

The next step of the bird and bat strike risk assessment is to complete further works in the airport site and broader study area to confirm the level of bird and bat strike risk and to refine the mitigation strategies. The work outlined below is in addition to, and precedes, the mitigation strategies listed in Section 5.

6.1 The airport site work recommendations

1. Conduct monthly bird and bat surveys for one year before the airport design for Stage 1 is completed. Additional surveys will provide a more robust understanding of bird and bat abundance and distribution at the airport site, accounting for seasonal changes. The data can be used to help develop appropriate mitigation measures.
2. Conduct a detailed analysis of the species recorded in surveys to determine the specific habitat requirements, likely areas of attraction, and appropriate management actions for the most abundant species. The monthly surveys would provide an indication of which species or species assemblages would be the focus of this detailed analysis. The result of the analysis would be a predictive tool that could be used to determine the probability of strikes per species.
3. Review design and construction documents as developed to identify any potential bird and bat attractants. This can allow for modifications to be implemented at the design and construction, negating the potential for retrospective management actions if the design is finalised or once construction has begun.

6.2 The airport study area recommendations

1. Conduct monthly bird and bat surveys for one year before the airport design for Stage 1 is completed. Additional surveys will provide a more robust understanding of bird and bat abundance and distribution in the airport study area, accounting for seasonal changes. The data can be used to help develop appropriate mitigation measures, and may even contribute to long-term cost savings. The inclusion of radar data to track bird and bat movements would further inform the assessment. This is an emerging technology that is likely to be used regularly in the future to make operational decisions to reduce overall bird and bat strike risk.

Surveys should include:

- a. All identified sites within 3 km of the airport, including farm dams, cattle farms and poultry farms. Access to private property will be required.
- b. All identified sites within 8 km of the airport along approach and departure paths. Access to private property will be required.
2. Review all development plans for the area around the airport site. The review should identify land uses within 13 km of the airport site that are likely to increase the bird and bat strike risk at the airport and prioritise monitoring to determine changes in bird and bat strike risk at these locations.

7. Summary and conclusion

The preliminary bird and bat strike risk assessment included a desktop review of literature and data related to the airport environment; the regulations, standards and guidelines related to wildlife management at airports; the airport plans and forecast aircraft movements; and bird and bat attracting habitat. In addition, the assessment included a three-day airport site and study area visit to conduct surveys of bird and bat activity at the airport site and to investigate potential bird and bat attracting sites in the study area. The information gathered in the desktop review and the site visit was compiled to make a preliminary assessment of the overall bird and bat strike risk at the future airport.

It was concluded that each identified contributor to bird and bat strike risk at Western Sydney airport can be managed to an acceptable risk level and as a result, this preliminary assessment has concluded that overall bird and bat strike risk for the airport is low. The overall airport risk assessment included consideration of the species, the airport study site habitat, study area, projected aircraft movements, and staged construction assessments.

Risk management will require the airport operator to implement a suite of mitigation measures across subsequent project development stages and develop an integrated management program designed for ongoing implementation. In addition, the airport lessee will need to comply with the ICAO, the CASA and the NASF regulations, standards and guidelines during operation.

To confirm the preliminary findings of the bird and bat strike risk assessment, it is necessary to complete further works at the airport site and broader study area during subsequent stages of design development. The recommended airport site work includes additional bird and bat surveys and the review of more detailed design and construction documents. The recommended study area works include additional surveys, and the review of development plans for the area surrounding the airport. These works are required to confirm the level of bird and bat strike risk and to refine the mitigation strategies.

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Appendix A: National Airports Safeguarding Framework Guideline C

NATIONAL AIRPORTS SAFEGUARDING FRAMEWORK

MANAGING THE RISK OF WILDLIFE STRIKES IN THE VICINITY OF AIRPORTS

REVISION DATE	VERSION NUMBER	CHANGES MADE	APPROVED BY
Feb 2012	3.1.1	Document Creation	NASAG
Apr 2012	3.1.2	Drafting changes post consultation process	SCOTI
15/7/12	3.1.3	Version control table added. Page numbers added.	S. Stone, GM Aviation Environment, DOIT.

Purpose of Guideline

1. This document provides guidelines to State/Territory and local government decision makers to manage the risk of collisions between wildlife and aircraft at or near airports where that risk may be increased by the presence of wildlife-attracting land uses.

Why it is important

2. The *Principles for a National Airports Safeguarding Framework* acknowledge the importance of airports to national, state/territory and local economics, transport networks and social capital.
3. Wildlife strikes and / or avoidance can cause major damage to aircraft and / or reduction of safety. The consequences of wildlife strike can be influenced by the number and size of wildlife involved, phase of flight and the aircraft part hit by the wildlife.
4. Land use planning decisions and the way in which existing land use is managed in the vicinity of airports can significantly influence the risk of wildlife hazards. Many existing airports are surrounded by areas which are attractive to wildlife, especially birds. As examples, land uses such as agriculture, wildlife sanctuaries, wetlands and land fill sites can attract a high number of birds which increase the risk of interference with aviation activity.
5. The number of wildlife strikes and the attendant risk of fatalities, injuries, aircraft damage and operational delays can be reduced by managing land use around airports to minimise the potential for wildlife to be in conflict with aircraft operations.

How it should be used

6. Some States/Territories already have planning guidelines or policies in place and this document provides guidance for review. For those without policies in place, these Guidelines (in addition to the associated Safeguarding Framework) will provide input to new policies.

Roles and Responsibilities

7. State/Territory and Local Governments are primarily responsible for land use planning in the vicinity of all airports.
8. Australia's 19 major airports are under Australian Government planning control and are administered under the Airports Act 1996. Planning on other airports is undertaken by State/Territory and Local Governments or private operators.
9. As a contracting state to the Convention on International Civil Aviation (the Convention) Australia has international obligations regarding the regulation and management of aviation safety. The International Civil Aviation Organisation (ICAO), which was established by the Convention, has established Standards and Recommended Practices covering all aspects of civil aviation safety.
10. Australian civil aviation safety legislation includes provisions to meet Australia's international obligations. Part 139 of the Civil Aviation Safety Regulations 1998 (the Regulations) imposes an obligation on airports to reduce the risks of wildlife strikes. These regulations are administered by the Civil Aviation Safety Authority (CASA). All Certified Airports are required to document procedures for wildlife hazard management in their Aerodrome Manual. Certified Airports with a confirmed wildlife hazard are also required to develop and implement wildlife hazard management plans. CASA regulates and conducts surveillance of all regulated airports to ensure that that airport operators are adequately managing the risk of on-airport wildlife strikes.
11. Under the Regulations, CASA can address the risk of waste foodstuffs being dumped near airports that may pose a risk to aviation safety by attracting wildlife. When CASA identifies a property that is being used to dump waste food stuffs, it has powers to make it an offence to dump waste foodstuffs there. CASA can also require the property owner to remove waste foodstuffs from the property and can, if necessary, make arrangements to remove the waste material.

Key considerations for managing risk of wild life strikes in the vicinity of airports

12. Most wildlife strikes occur on and in the vicinity of airports, where aircraft fly at lower elevations. The risk of a strike on airport relates to the level and form of wildlife activity both within the boundary of an airport and in surrounding areas. Wildlife attracted to land uses around airports can migrate onto the airport or across flight paths, increasing the risk of strikes. Airports actively reduce wildlife populations and manage the risk of strikes on airport land. Such on-airport activities are underpinned by current aviation safety regulations.
13. Australia's international aviation safety obligations as a contracting state to the Convention on Civil Aviation include responsibilities to take action to manage the risk from wildlife hazards. Specifically, the following standards and recommendations relating to wildlife hazards apply. Clauses 9.4.3 and 9.4.4 and 9.4.5 of Annex 14 of ICAO state:

- Action shall be taken to decrease the risk to aircraft operations by adopting measures to minimize the likelihood of collisions between wildlife and aircraft;
- The appropriate authority shall take action to eliminate or to prevent the establishment of garbage disposal dumps or any source which attracts wildlife to the aerodrome, or its vicinity, unless an appropriate wildlife assessment indicates that they are unlikely to create conditions conducive to a wildlife hazard problem. Where the elimination of existing sites is not possible, the appropriate authority shall ensure that any risk to aircraft posed by these sites is assessed and reduced to as low as reasonably practicable; and
- States should give due consideration to aviation safety concerns related to land developments in the vicinity of the aerodrome that may attract wildlife.

GUIDELINES FOR MANAGING THE RISK OF WILD LIFE STRIKES IN THE VICINITY OF AIRPORTS

14. Aviation safety regulations do not address the risk of wildlife strikes occurring outside the boundary of airports in the same way as they address on-airport risk. The risk of a strike off airport relates mostly to wildlife activity in areas surrounding the airport. There is a need to strengthen arrangements to address the risk of wildlife hazards that occur off airport and ensure Australia is in step with its local and international obligations.
15. The International Civil Aviation Organisation (ICAO) has developed specific advice on land uses with the potential to become high risk wildlife attractants. These include:
 - food garbage disposal;
 - sewage treatment and disposal;
 - artificial and natural lakes;
 - abattoirs and freezing works;
 - fish processing plants;
 - bird sanctuaries; and
 - outdoor theatres.
16. The table at **Attachment 1** aligns with international benchmarks set by ICAO and other international aviation regulators. It provides guidance on the land uses that present a risk of attracting wildlife and triggers (based on distance from an airport) for adopting active measures to mitigate that risk. Attachment 1 is a tool to assess plans for new or revised land uses within 3km, 8km and 13km of an airport.
17. The guidelines recognise that at many existing airports it may be difficult or impossible to change the existing usage of the land which serves as a wildlife attractant. In such cases, airport operators should work with land use planning authorities to mitigate the risk of wildlife strike.
18. The guidelines can also be used when considering the establishment of new airports. When a greenfields site is being considered for a new airport, selection agencies can consider the degree of incompatible land usage, including wildlife attracting land usage, in the vicinity of potential sites.

Managing on-airport wildlife strike risk

19. All certified airports (airports certified under Part 139 of the Civil Aviation Safety Regulations 1998 – CASR Part 139) are required to document procedures for wildlife hazard management in their aerodrome manual. Certified airports with a confirmed wildlife hazard are also required to have a wildlife hazard management plan (WHMP). The role foreshadowed for aerodrome operators in these guidelines should form part of future WHMPs and be incorporated in revisions of existing WHMPs.

Managing off-airport wildlife strike risk -general

20. There are many existing locations where there would be advantages in mitigating existing risk. It is also essential that new land uses and changes to land zoning within 13 km of the airport property are regularly monitored and action plans created to mitigate any unacceptable increase in the risk of bird strike. For example, the ICAO document 'Airport Services Manual- Bird Control and Reduction' suggests that dumps should not be sited within 13km of airport property.

Managing off-airport wildlife strike risk – the role of airport operators and council/land use planning authorities

21. Airport operators should work with local councils (or the relevant land-use planning authority) to establish mechanisms that will identify land uses and prevent the creation of land uses that would cause hazardous wildlife attraction or activity at or across the airport and/or its approaches and departures. This can be accomplished through the following:
- airport operators and land use planning authorities should use the guidance at Attachment 1 as the criteria for deciding on appropriate action in relation to a particular existing or proposed development within a 13 km radius of an aerodrome. Airport operators should conduct ongoing and regular consultation with planning authorities on land uses of concern;
 - airport operators should conduct ongoing consultation with bodies such as national /state wildlife and parks management and wetlands management agencies on land uses of concern;
 - land use planning authorities should ensure that airport operators are given adequate opportunity to formally comment on planning applications for new or revised land uses that fall within the guidance provided in **Attachment 1**. Airport operators will be expected to respond with comments on how the proposed changes to land use might increase the risk of wildlife strike and on any regulatory actions that could increase the risk of wildlife strike, such as permits related to land uses of concern;
 - airport operators should conduct regular outreach/education activities to sensitise relevant stakeholders and the surrounding community to bird strike hazards and land uses that may increase these hazards;
 - airport operators should be in a position to provide assistance or advice to relevant stakeholders on bird and wildlife mitigation measures, drawing on knowledge obtained in managing this issue on the airport site; and
 - airport operators should include relevant external stakeholders (including, but not limited to, planning authorities, relevant landowners, national /state wildlife and parks

management and wetlands management agencies) on the Airport's Bird and Animal Hazard Management Committee or equivalent group.

22. Airport operators should negotiate with land use planning authorities and land owners if required on agreed action plans for monitoring and, where necessary, reducing wildlife attraction to areas in the vicinity of airports, in accordance with **Attachment 1**. These plans could include:

- regular monitoring surveys;
- wildlife hazard assessments by qualified ornithologists or biologists;
- wildlife awareness and management training for relevant staff;
- establishment of bird population triggers;
- implementation of activities to reduce hazardous bird populations; and
- adoption of wildlife deterrent technologies to reduce hazardous bird populations.

23. Airport operators should maintain files to track all contacts with land use planning authorities regarding land uses near the airport that could attract birds. The log should be used to conduct the reviews below and maintain contact with relevant parties. Under the WHMP, airport operators should consult this log annually to:

- review the status of individual bird attractants sites and any changes required;
 - identify existing/potential flyways (regular bird flight paths) between separate bird attractant sites;
 - identify measures and on-airport wildlife management procedures that would address risk; and
 - document the participants in the review, items discussed and changes identified.
- Airport operators should document the procedures provided here in their WHMP as well as in any relevant documentation required under CASR Part 139, such as the airport's Safety Management System.

Managing risk when new land uses are to be established which increase risk of wildlife strike

24. Where local authorities seek to establish land uses which may increase the risk of wildlife strike near existing airports, steps should be taken to mitigate risk in consultation with the airport operator and qualified bird and wildlife management experts. Risk mitigation measures that should be considered in such cases include:

- a requirement for a Wildlife Management Program;
- the establishment of wildlife management performance standards;
- allowance for changes to design and/or operating procedures at places/plants where land use has been identified as increasing the risk of wildlife strike to aircraft;
- establishment of appropriate habitat management at incompatible land uses;
- creation of performance bonds to ensure clean-up and compensation should obligations not be met;
- authority for airport operators to inspect and monitor properties close to airports where wildlife hazards have been identified; and
- consistent and effective reporting of wildlife events in line with Australian Transport Safety Bureau (ATSB) guidelines.

25. Attached to these guidelines are the following:

- **Attachment 1:** Wildlife attraction risk and actions by land use: This identifies the risk posed by a range of land uses and the actions required, if any.
- **Attachment 2:** Brisbane Airport Buffers: Using Brisbane airport as an example, this is a depiction of the proposed buffers. The shape of the buffers would vary depending on the runway layouts.

Background information on managing the risk of wildlife strike

26. The vast majority of wildlife strikes take place at or close to airports. Almost all involve birds and flying mammals (such as bats and flying foxes). Land animal (mainly terrestrial mammals) strikes are relatively rare and the risk of these has been reduced by the implementation of stringent fencing requirements to keep out unauthorised persons.
27. There would be safety benefits if airport operators and land use planning authorities follow a common, coordinated approach to managing existing wildlife hazards at, and within the vicinity of, airports. Managing wildlife attractants is a key strategy in discouraging wildlife on and around airports.
28. In essence, the guidelines propose distance separation benchmarks between airports and land use practices that attract wildlife species which may be hazardous to aviation. Proposed separation distances based on the radial distances of 3km, 8km and 13 km respectively are proposed. This is consistent with advice from ICAO.
29. The guidelines provide examples of land uses that are acceptable and those that require mitigation measures. In the case of land uses that need to be mitigated, advice regarding appropriate risk mitigation measures is provided.
30. The guidelines recognise that it can be impractical to consider changing existing land use or zoning around established airports which are often located in built up areas and where options for alternative land use can be limited. However, the guidelines allow for improved planning for land uses which may attract wildlife around new airports and new land uses proposed around existing airports.
31. Airport operators already have legislative obligations under aviation safety legislation to manage the risk of on-airport wildlife hazards. They do actively manage and deter wildlife, often reducing wildlife numbers. Given that aviation safety legislation regarding management of wildlife applies only on airport land, there is an opportunity to improve land use management in the vicinity of airports to further minimise the risk of wildlife hazards to aviation.

ATTACHMENT A:

Land Use	Wildlife Attraction Risk	Actions for Existing Developments			Actions for Proposed Developments/ Changes to Existing Developments		
		3 km radius (Area A)	8 km radius (Area B)	13 km radius (Area C)	3 km radius (Area A)	8 km radius (Area B)	13 km radius (Area C)
Agriculture							
Turf farm	High	Mitigate	Mitigate	Monitor	Incompatible	Mitigate	Monitor
Piggery	High	Mitigate	Mitigate	Monitor	Incompatible	Mitigate	Monitor
Fruit tree farm	High	Mitigate	Mitigate	Monitor	Incompatible	Mitigate	Monitor
Fish processing /packing plant	High	Mitigate	Mitigate	Monitor	Incompatible	Mitigate	Monitor
Cattle /dairy farm	Moderate	Mitigate	Monitor	Monitor	Mitigate	Mitigate	Monitor
Poultry farm	Moderate	Mitigate	Monitor	Monitor	Mitigate	Mitigate	Monitor
Forestry	Low	Monitor	Monitor	No Action	Monitor	Monitor	No Action
Plant nursery	Low	Monitor	Monitor	No Action	Monitor	Monitor	No Action
Conservation							
Wildlife sanctuary / conservation area - wetland	High	Mitigate	Mitigate	Monitor	Incompatible	Mitigate	Monitor
Wildlife sanctuary / conservation area - dryland	Moderate	Mitigate	Monitor	Monitor	Mitigate	Mitigate	Monitor
Recreation							
Showground	High	Mitigate	Mitigate	Monitor	Incompatible	Mitigate	Monitor
Racetrack / horse riding school	Moderate	Mitigate	Monitor	Monitor	Mitigate	Mitigate	Monitor
Golf course	Moderate	Mitigate	Monitor	Monitor	Mitigate	Mitigate	Monitor
Sports facility (tennis, bowls, etc)	Moderate	Mitigate	Monitor	Monitor	Mitigate	Mitigate	Monitor
Park / Playground	Moderate	Mitigate	Monitor	Monitor	Mitigate	Mitigate	Monitor
Picnic / camping ground	Moderate	Mitigate	Monitor	Monitor	Mitigate	Mitigate	Monitor
Commercial							
Food processing plant	High	Mitigate	Mitigate	Monitor	Incompatible	Mitigate	Monitor
Warehouse (food storage)	Low	Monitor	Monitor	No Action	Monitor	Monitor	No Action
Fast food / drive-in / outdoor restaurant	Low	Monitor	Monitor	No Action	Monitor	Monitor	No Action
Shopping centre	Low	Monitor	Monitor	No Action	Monitor	Monitor	No Action
Office building	Very Low	Monitor	No Action	No Action	Monitor	No Action	No Action
Hotel / motel	Very Low	Monitor	No Action	No Action	Monitor	No Action	No Action
Car park	Very Low	Monitor	No Action	No Action	Monitor	No Action	No Action
Cinemas	Very Low	Monitor	No Action	No Action	Monitor	No Action	No Action
Warehouse (non-food storage)	Very Low	Monitor	No Action	No Action	Monitor	No Action	No Action
Petrol station	Very Low	Monitor	No Action	No Action	Monitor	No Action	No Action
Utilities							
Food / organic waste facility	High	Mitigate	Mitigate	Monitor	Incompatible	Mitigate	Monitor
Putrescible waste facility - landfill	High	Mitigate	Mitigate	Monitor	Incompatible	Mitigate	Monitor
Putrescible waste facility - transfer station	High	Mitigate	Mitigate	Monitor	Incompatible	Mitigate	Monitor
Non-putrescible waste facility - landfill	Moderate	Mitigate	Monitor	Monitor	Mitigate	Mitigate	Monitor
Non-putrescible waste facility - transfer station	Moderate	Mitigate	Monitor	Monitor	Mitigate	Mitigate	Monitor
Sewage / wastewater treatment facility	Moderate	Mitigate	Monitor	Monitor	Mitigate	Mitigate	Monitor
Potable water treatment facility	Low	Monitor	Monitor	No Action	Monitor	Monitor	No Action

GLOSSARY

Airport operators	These include operators, managers and owners at both regional and major airports.
ATSB	Australian Transport Safety Bureau
CASA	Civil Aviation Safety Authority
Flying mammals	Animals with vertebrae, having the body more or less covered with hair, nourishing the young with milk from the mammary glands, and, with the exception of the egg-laying monotremes, giving birth to live young which are able to fly. For example, bats and flying foxes.
High capacity air transport operations	A high capacity air transport operation involves an aircraft that is certified as having a maximum seating capacity exceeding 38 seats or a maximum payload exceeding 4,200 kg.
ICAO	International Civil Aviation Organization
Land Managers	These include local governments, local planning authorities, state governments, national park/wetland management agencies, private landowners and owners of properties.
SARP	Standards and Recommended Practices
Terrestrial mammals	Animals with vertebrae, having the body more or less covered with hair, nourishing the young with milk from the mammary glands, and, with the exception of the egg-laying monotremes, giving birth to live young which dwell on land. For example, kangaroos and foxes.
WHMP	Wildlife Hazard Management Plan

Revision History

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00	14/08/2015	Preliminary Western Sydney Airport Bird and Bat Strike Risk Assessment	Jeff Follett Snr Wildlife Biologist	Phil Shaw Managing Director	Jeff Follett Snr Wildlife Biologist
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contact@avisure.com | www.avisure.com

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HEAD OFFICE-GOLD COAST

PO Box 404
West Burleigh QLD 4219
Australia
P +61 7 5508 2046
F +61 7 5508 2544

ADELAIDE OFFICE

PO Box 145
Pouria SA 5095
Australia
P +61 1300 112 021
M +61 (0)407 295 766

SYDNEY OFFICE

PO Box 880
Surry Hills NSW 2010
Australia
P +61 1300 112 021