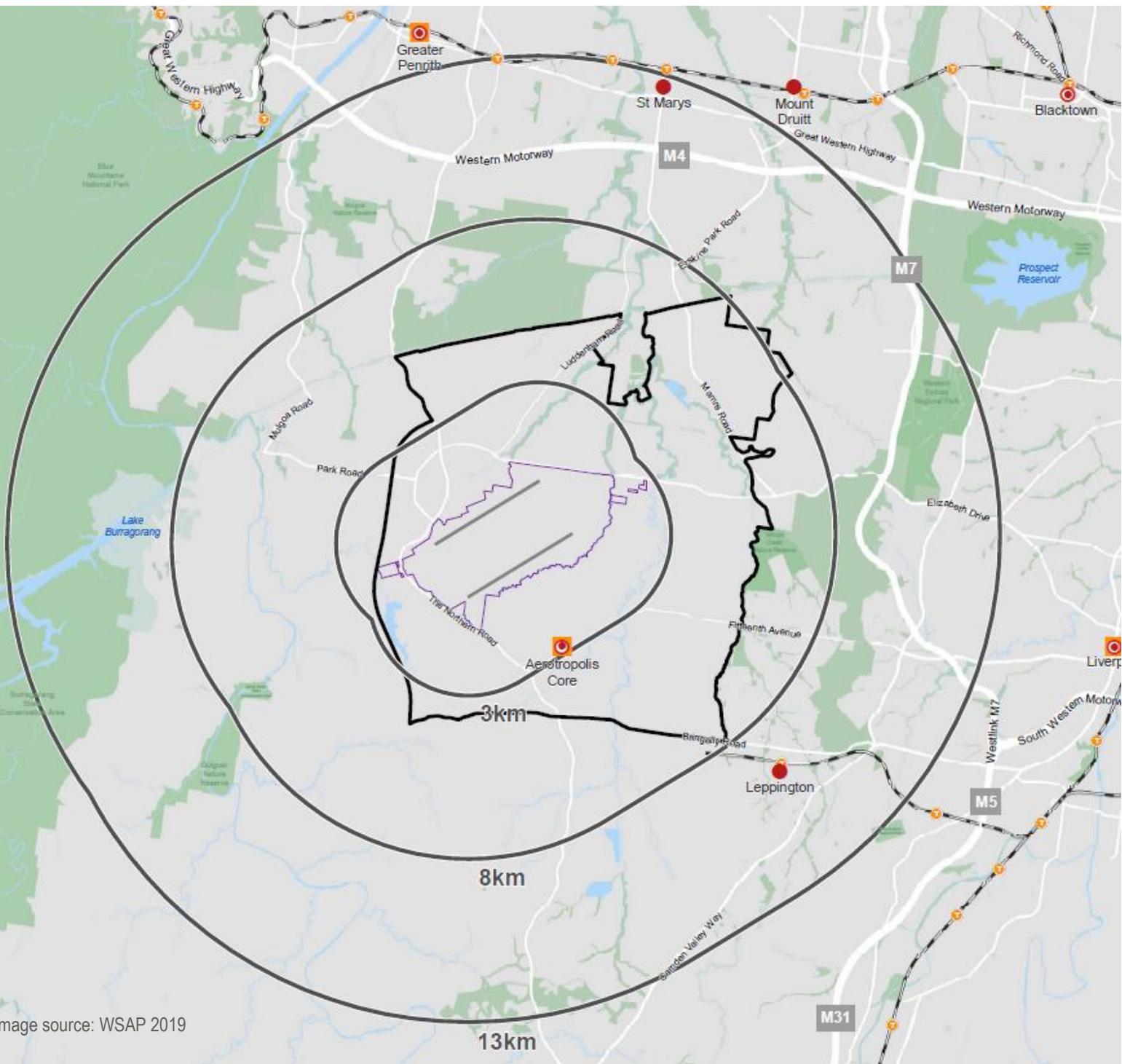


Western Sydney Aerotropolis

Draft Wildlife Management Assessment Report

Western Sydney Planning Partnership

May 2020



Executive Summary

The Western Sydney Planning Partnership engaged Avisure in December 2019 to help identify wildlife attraction issues associated with land use planning for the Western Sydney Aerotropolis and Western Parkland City, and develop mechanisms to mitigate wildlife strike risks for aircraft operating at Western Sydney Airport once the airport is operational. The aim is to safeguard the airport whilst not compromising the vision of the Western Sydney Aerotropolis and Western Parkland City.

Avisure prepared this Wildlife Management Assessment report in close consultation with the Planning Partnership and its stakeholders following an intensive review of documents that form the Western Sydney Aerotropolis planning framework, along with relevant aviation regulations, standards and guidance.

Safeguarding the Western Sydney Airport against wildlife strikes is seemingly at odds with the vision of the Western Sydney Aerotropolis that includes natural area revitalisation, water retention, enhancing biodiversity, establishing an extensive blue-green grid, and increasing tree canopy coverage to 40%. Despite the contradictory nature of this challenge, we have taken a balanced approach, with the National Airports Safeguarding Framework at its core, which affords the area amenity but minimises the wildlife threats to aviation.

This report describes the legal framework and summarises a variety of support and guidance documentation. Key to this are the Ministerial Directions 3.5 and 7.8 described under the NSW *Environment Planning and Assessment Act 1979*, and the National Airports Safeguarding Framework that forms the basis of the Aerotropolis Aviation Wildlife Safeguarding Framework. Case studies of off-airport land use risk assessments provide the Western Sydney Planning Partnership and stakeholders with examples for safeguarding an airport against wildlife hazards and the various approaches available to manage specific land use issues.

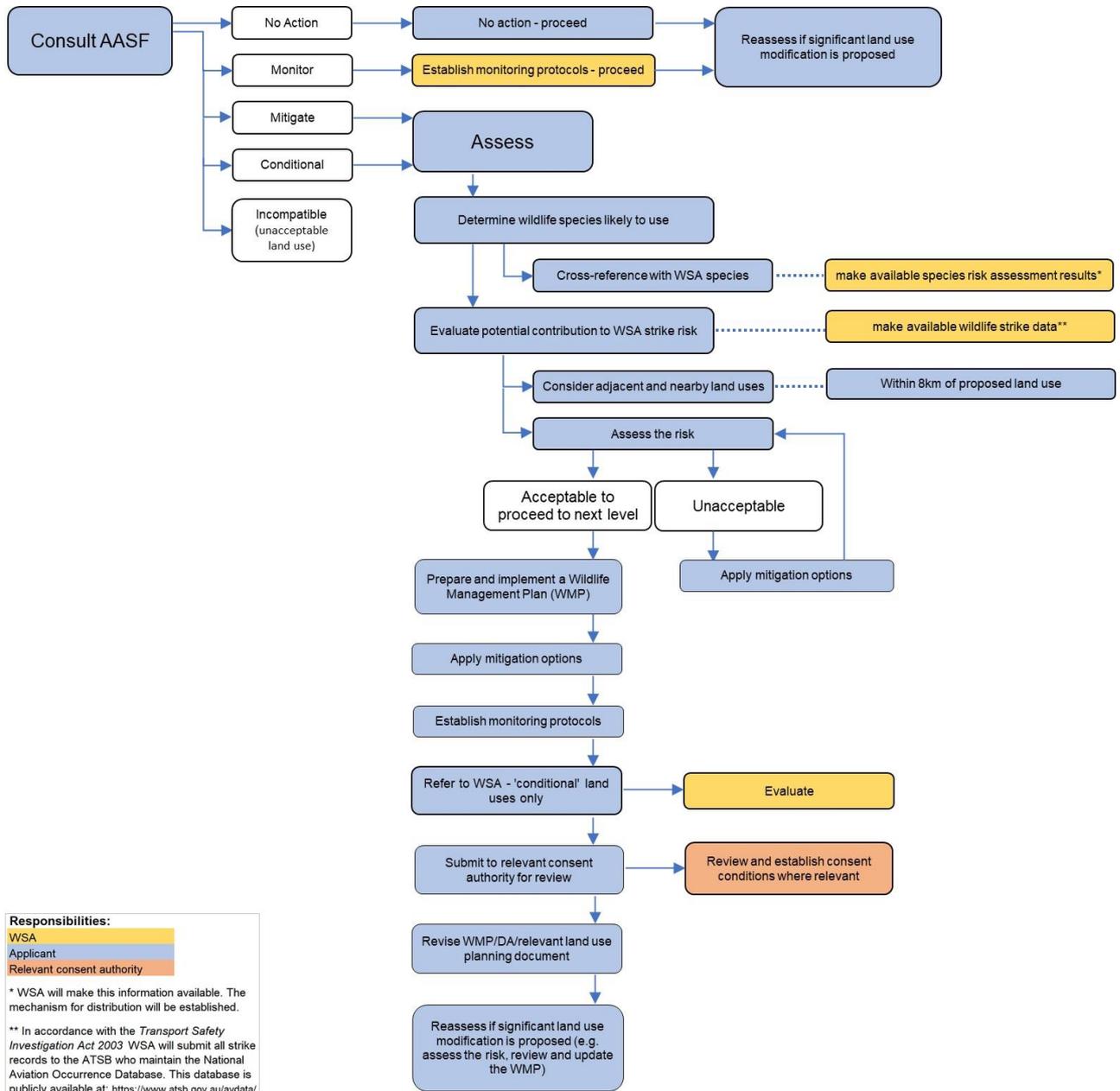
Key government commitments to delivering the Parkland vision have not been compromised, particularly with regard to landscaping. This includes the: Environment and Recreation Zone, Mixed Use Zones in the Aerotropolis Core and Northern Gateway, Luddenham Village and areas subject to Biodiversity Certification. For these areas, wildlife hazard mitigation will be applied to relevant uses and (if appropriate) monitoring will be used to identify any emerging risks, and active control measures (e.g. dispersal, breeding control (e.g. egg and nest removal or egg oiling)) applied if necessary.

The Aerotropolis Aviation Wildlife Safeguarding Framework (detailed below) was adapted from the National Airports Safeguarding Framework for use in the Western Sydney Aerotropolis planning framework and guidance material. This includes subdividing the National Airports Safeguarding Framework's wildlife buffers to reduce the number of wildlife infringing critical aircraft airspace by restricting land use activities on the north-west side of the airport. Restrictions in these areas does not necessarily mean rejecting development applications but will require land users to apply more stringent mitigation. The rationale to subdivide the wildlife buffers aims to reduce the movement of birds across the airfield (i.e. north west to south east and vice versa).

Aerotropolis Aviation Wildlife Safeguarding Framework (AAWSF)

Land Use	Standard Instrument Definition	Wildlife Attraction Risk	Western Sydney Aerotropolis: Actions for Existing Developments					Western Sydney Aerotropolis: Actions for Proposed Developments / Changes to Existing Developments				
			3 km radius (Area A)	3 km radius (Area A)	8 km radius (Area B)	8 km radius (Area B)	13 km radius (Area C)	3 km radius (Area A)	3 km radius (Area A)	8 km radius (Area B)	8 km radius (Area B)	13 km radius (Area C)
			Sub-area A1	Sub-area A2	Sub-area B1	Sub-area B2	(Area C)	Sub-area A1	Sub-area A2	Sub-area B1	Sub-area B2	(Area C)
Agriculture												
Abattoir	Livestock processing industry	Very High	Mitigate	Mitigate	Mitigate	Mitigate	Mitigate	Incompatible	Incompatible	Mitigate	Mitigate	Mitigate
Turf farm	Intensive plant agriculture	Very High	Mitigate	Mitigate	Mitigate	Monitor	Monitor	Incompatible	Incompatible	Mitigate	Monitor	Monitor
Piggery	Intensive livestock agriculture	High	Mitigate	Mitigate	Mitigate	Monitor	Monitor	Conditional	Mitigate	Mitigate	Monitor	Monitor
Orchard	Intensive plant agriculture	High	Mitigate	Mitigate	Mitigate	Monitor	Monitor	Conditional	Mitigate	Mitigate	Monitor	Monitor
Fish processing /packing plant	Livestock processing industry	High	Mitigate	Mitigate	Mitigate	Monitor	Monitor	Conditional	Mitigate	Mitigate	Monitor	Monitor
Aquaculture	Aquaculture	High	Mitigate	Mitigate	Mitigate	Monitor	Monitor	Conditional	Mitigate	Mitigate	Monitor	Monitor
Farm dam	Water storage facility	High	Mitigate	Mitigate	Mitigate	Monitor	Monitor	Conditional	Mitigate	Mitigate	Monitor	Monitor
Crops (e.g. wheat, grains, rice, legumes)	Agriculture	High	Mitigate	Mitigate	Mitigate	Monitor	Monitor	Conditional	Mitigate	Mitigate	Monitor	Monitor
Grain storage	Storage premises (or ancillary)	High	Mitigate	Mitigate	Mitigate	Monitor	Monitor	Conditional	Mitigate	Mitigate	Monitor	Monitor
Cattle /dairy farm	Intensive livestock agriculture	Moderate	Mitigate	Monitor	Monitor	Monitor	Monitor	Mitigate	Mitigate	Mitigate	Monitor	Monitor
Poultry farm	Intensive livestock agriculture	Moderate	Mitigate	Monitor	Monitor	Monitor	Monitor	Mitigate	Mitigate	Mitigate	Monitor	Monitor
Plant nursery	Plant nursery	Moderate	Mitigate	Monitor	Monitor	Monitor	Monitor	Mitigate	Mitigate	Mitigate	Monitor	Monitor
Viticulture	Viticulture	Moderate	Mitigate	Monitor	Monitor	Monitor	Monitor	Mitigate	Mitigate	Mitigate	Monitor	Monitor
Market farms and gardens	Garden centre	Moderate	Mitigate	Monitor	Monitor	Monitor	Monitor	Mitigate	Mitigate	Mitigate	Monitor	Monitor
Forestry	Forestry	Low	Monitor	Monitor	Monitor	No Action	No Action	Mitigate	Monitor	Mitigate	No Action	No Action
Horticulture	Horticulture	Low	Monitor	Monitor	Monitor	No Action	No Action	Mitigate	Monitor	Mitigate	No Action	No Action
Conservation and Natural Areas												
Wildlife sanctuary - wetland	Environmental protection works	High	Mitigate	Mitigate	Mitigate	Monitor	Monitor	Conditional	Mitigate	Mitigate	Monitor	Monitor
Conservation area - wetland	Environmental protection works	High	Mitigate	Mitigate	Mitigate	Monitor	Monitor	Conditional	Mitigate	Mitigate	Monitor	Monitor
Wildlife breeding/roosting	Environmental protection works	High	Mitigate	Mitigate	Mitigate	Monitor	Monitor	Conditional	Mitigate	Mitigate	Monitor	Monitor
Flying-fox camp	N/A – dependent on camp location	High	Mitigate	Mitigate	Mitigate	Monitor	Monitor	Conditional	Mitigate	Mitigate	Monitor	Monitor
Wetland	Wetland	High	Mitigate	Mitigate	Mitigate	Monitor	Monitor	Conditional	Mitigate	Mitigate	Monitor	Monitor
Wildlife sanctuary - dryland	Environmental protection works	Moderate	Mitigate	Monitor	Monitor	Monitor	Monitor	Mitigate	Mitigate	Mitigate	Monitor	Monitor
Conservation area - dryland	Environmental protection works	Moderate	Mitigate	Monitor	Monitor	Monitor	Monitor	Mitigate	Mitigate	Mitigate	Monitor	Monitor
Waterway (e.g. creeks, rivers)	Waterway	Moderate	Mitigate	Monitor	Monitor	Monitor	Monitor	Mitigate	Mitigate	Mitigate	Monitor	Monitor
Natural areas	Environmental facility or environmental protection works	Low	Monitor	Monitor	Monitor	No Action	No Action	Mitigate	Monitor	Mitigate	No Action	No Action
Recreation												
Showground	Recreation facility (outdoor) or (major)	High	Mitigate	Mitigate	Mitigate	Monitor	Monitor	Conditional	Mitigate	Mitigate	Monitor	Monitor
Fish cleaning facilities	N/A	High	Mitigate	Mitigate	Mitigate	Monitor	Monitor	Conditional	Mitigate	Mitigate	Monitor	Monitor
Public feeding of wildlife	N/A	High	Mitigate	Mitigate	Mitigate	Monitor	Monitor	Conditional	Mitigate	Mitigate	Monitor	Monitor
Urban open space (e.g. cycleways, green areas, pedestrian walkways)	Recreational area	Moderate	Mitigate	Monitor	Monitor	Monitor	Monitor	Mitigate	Mitigate	Mitigate	Monitor	Monitor
Racetrack / horse riding school	Recreation facility (outdoor)	Moderate	Mitigate	Monitor	Monitor	Monitor	Monitor	Mitigate	Mitigate	Mitigate	Monitor	Monitor
Golf course	Recreation facility (outdoor)	Moderate	Mitigate	Monitor	Mitigate	Monitor	Monitor	Mitigate	Monitor	Mitigate	Monitor	Monitor
Sports facility (tennis, bowls, etc)	Recreation facility (outdoor)	Moderate	Mitigate	Monitor	Mitigate	Monitor	Monitor	Mitigate	Monitor	Mitigate	Monitor	Monitor
Sports fields	Recreation area	Moderate	Mitigate	Monitor	Mitigate	Monitor	Monitor	Mitigate	Monitor	Mitigate	Monitor	Monitor
Park / Playground	Recreation area	Moderate	Mitigate	Monitor	Mitigate	Monitor	Monitor	Mitigate	Monitor	Mitigate	Monitor	Monitor
Picnic / camping ground	Camping ground	Moderate	Mitigate	Monitor	Mitigate	Monitor	Monitor	Mitigate	Monitor	Mitigate	Monitor	Monitor

A wildlife hazard assessment process was established (see flowchart). Whilst most of the responsibility rests with the land user, Western Sydney Airport and the relevant consent authority play important roles.



The report provides Acceptable Solutions for inclusion in the draft Western Sydney Aerotropolis Development Control Plan – Phase 2. The proposed Acceptable Solutions aligns with the relevant Performance Outcome described in the Development Control Plan - Phase 1 (PO11 Development does not cause wildlife to create a safety hazard in the operational airspace of the airport).

Finally, this report provides mitigation options and recommendations to help land users manage wildlife hazards, including the following recommendations:

- Develop a risk assessment method applicable for all land use type/activity assessments. The method should consider species, mass, land use/activity type, location relative to WSA, location relative to nearby land uses that attract, or have the potential to attract, wildlife, Western Sydney Airport species strike risks.
- Apply the wildlife hazard assessment as required. If the land use is assessed as 'moderate' or higher in the wildlife hazard assessment, prepare and implement a Wildlife Management Plan.
- Where a Wildlife Management Plan is required in association with a land use, where required, establish regular and standardised monitoring regimes. Monitoring should determine the level of wildlife attraction, identify temporal variation of wildlife activity (i.e. how wildlife use the site at different times of the day, year or climatic phase), identify emerging risks, and validate plant species choice and landscaping structure, or other mitigation applied.
- Actively manage wildlife in accordance with any approved wildlife management plan. Where, despite mitigation, unacceptable wildlife activity is observed, implement procedures in approved wildlife management plans to apply active control such as wildlife dispersal, roost disturbance, breeding disruption (e.g. egg and nest removal or egg oiling), and lethal control.
- Consider the planting and landscape principles described in Appendix B when preparing landscaping plans and schedules to reduce the wildlife attraction, particularly for potentially significant risks such as flying-foxes. Avisure acknowledges that some of these principles contradict the landscaping objectives and principles developed for the Western Parkland City, particularly in areas that support the key government commitments.
- Facilitate a workshop with relevant stakeholders to develop a suitable species palette and guidelines for use within 13km of the airport that balances safeguarding the airport against wildlife strikes and achieving the landscaping vision of the Western Sydney Aerotropolis and Western Parkland City.
- Proactively mitigate wildlife risks at the land use planning and design stages. Proposed land use should be evaluated for their potential to attract wildlife and if the numbers of types of wildlife are likely to impact the airport's strike risk.

- Mitigate wildlife risks where monitoring identifies emerging issues.
- Assemble a coordination body comprised of Western Sydney land use planning stakeholders to coordinate the implementation of the Aerotropolis planning framework.

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Abbreviations

AAWSF	Aerotropolis Aviation Wildlife Safeguarding Framework
AC	Advisory Circular
AGL	Above Ground Level
AIP	Aeronautical Information Package
AS	Acceptable Solutions
ATC	Air Traffic Control
ATSB	Australian Transport Safety Bureau
CASA	Civil Aviation Safety Authority
CEMP	Construction Environment Management Plan
DCP	Development Control Plan
IBSC	International Bird Strike Committee
ICAO	International Civil Aviation Organization
MOS	Manual of Standard
NASF	National Airports Safeguarding Framework
NOTAM	Notice to Airman
PO	Performance Outcomes
SEPP	State Environment Planning Policy
SRI	Species Risk Index
WBA	World Birdstrike Association
WHMP	Wildlife Hazard Management Plan
WMA	Wildlife Management Assessment
WMP	Wildlife Management Plan
WSA	Western Sydney Airport
WSAP	Western Sydney Aerotropolis Plan

Glossary

AAWSF action	Refers to the wildlife hazard recommended action based on land use type and location relative to the airport.
AAWSF action: No Action	The land use type presents a low risk and can proceed without the need to manage wildlife hazards.
AAWSF action: Monitor	The land use type presents a low to moderate risk and should be regularly monitored to determine if wildlife using the site are contributing the airport's strike risk.
AAWSF action: Mitigate	The land use type presents a moderate to high risk and an assessment should be applied to determine the level and acceptability of this risk. Wildlife hazard management measures, and monitoring, are a likely requirement for the land use to proceed.
AAWSF action: Conditional	The land use type presents a high to very high risk and should be referred to Western Sydney Airport. An assessment should be applied to determine the level and acceptability of this risk. Wildlife hazard management measures, and monitoring, are a likely requirement for the land use to proceed.
AAWSF action: Incompatible	The land use type/activity presents a very high risk and mitigation is unlikely to sufficiently address the risk. The land use/activity should not proceed.
Abattoir	SI Definition ¹ : Livestock processing industry means a building or place used for the commercial production of products derived from the slaughter of animals (including poultry) or the processing of skins or wool of animals and includes abattoirs, knackeries, tanneries, woolscours and rendering plants.
Active Management	The use of short-term management techniques such as distress calls, pyrotechnics, trapping and culling to disperse or remove birds.
Aerospace Industry	Science and engineering that researches, designs, manufactures, operates and maintains aircraft or spacecraft.

¹ Definitions provided in Schedule 5 of the *Standard Instrument – Principal Local Environmental Plan*. These definitions have been applied in a way that best fits the land use type.

Airport Safeguarding	Land use planning processes to manage the impact of development around airports to improve safety outcomes and community amenity.
Aquaculture	SI Definition: Aquaculture (defined in accordance with the <i>Fisheries Management Act 1994</i>). It includes oyster aquaculture, pond-based aquaculture and tank-based aquaculture.
Boat Ramps	SI Definition: Boat launching ramp means a structure designed primarily for the launching of trailer borne recreational vessels and includes associated car parking facilities.
Car park	SI Definition: Car park means a building or place primarily used for the purpose of parking motor vehicles, including any manoeuvring space and access thereto, whether operated for gain or not.
Cattle /dairy farm	SI Definition: Intensive livestock agriculture means the keeping or breeding, for commercial purposes, of cattle, poultry, pigs, goats, horses or other livestock that are fed wholly or substantially on externally-sourced feed, and includes any of the following: (a) dairies (restricted), (b) feedlots, (c) piggeries, (d) poultry farms.
Cinemas	SI Definition: Entertainment facility means a theatre, cinema, music hall, concert hall, dance hall and the like, but does not include a pub or registered club.
Consequence	The outcome of an event expressed qualitatively or quantitatively, being a loss, injury, disadvantage or gain. There may be a range of possible outcomes associated with an event.
Conservation Area - dryland	SI Definition: Environmental protection works : means works associated with the rehabilitation of land towards its natural state or any work to protect land from environmental degradation, and includes bush regeneration works, wetland protection works, erosion protection works, dune restoration works and the like, but does not include coastal protection works.
Conservation Area - wetland	SI Definition: Environmental protection works – See <i>Conservation Area - dryland</i> .
Construction	The activity of constructing infrastructure (e.g. building).

Critical Area	Areas within or in close proximity to the flight strip, approach and landing paths, and movement areas of an airport.
Crops (e.g. wheat, grains, rice, legumes)	SI Definition: Agriculture means any of the following: (a) aquaculture; (b) extensive agriculture; (c) intensive livestock agriculture; (d) intensive plant agriculture.
Dams	SI Definition: Water storage facility means a dam, weir or reservoir for the collection and storage of water, and includes associated monitoring or gauging equipment.
Development Control Plan	Provides detailed planning and design guidelines.
Earthworks	Excavation or filling.
Farm dam	SI Definition: Water storage facility - See Dams.
Fast food / drive-in / outdoor restaurant	SI Definition: Food and drink premises means premises that are used for the preparation and retail sale of food or drink (or both) for immediate consumption on or off the premises, and includes any of the following: (a) a restaurant or cafe, (b) take away food and drink premises, (c) a pub, (d) a small bar.
Fish cleaning facilities	Dedicated areas where fish, commercially or recreationally captured, are cleaned. These areas may be ancillary to other land use types (e.g. recreation facility (outdoor) or agricultural produce industry).
Fish processing / packing plant	SI Definition: Livestock processing industry – See Abattoir.
Flying-fox camp	A permanent, or semi-permanent area, usually a group of trees, where flying-foxes congregate to roost and breed.
Food processing	SI Definition: Agricultural produce industry means a building or place used for the handling, treating, processing or packing, for commercial purposes, of produce from agriculture (including dairy products, seeds, fruit, vegetables or other plant material), and includes wineries, flour mills, cotton seed oil plants, cotton gins, feed mills, cheese and butter factories, and juicing or canning plants, but does not include a livestock processing industry; or Livestock processing industry – See Abattoir.
Foraging	When animals search for and obtain food.

Forestry	SI Definition: Forestry (defined in accordance with the <i>Forestry Act 2012</i> or Part 5B of the <i>Local Land Services Act 2013</i>).
Golf course	SI Definition: Recreation facility (outdoor) means a building or place (other than a recreation area) used predominantly for outdoor recreation, whether or not operated for the purposes of gain, including a golf course, golf driving range, mini-golf centre, tennis court, paint-ball centre, lawn bowling green, outdoor swimming pool, equestrian centre, skate board ramp, go-kart track, rifle range, water-ski centre or any other building or place of a like character used for outdoor recreation (including any ancillary buildings), but does not include an entertainment facility or a recreation facility (major).
Grain storage	SI Definition: Storage premises (or ancillary) means a building or place used for the storage of goods, materials, plant or machinery for commercial purposes and where the storage is not ancillary to any industry, business premises or retail premises on the same parcel of land, and includes self-storage units, but does not include a heavy industrial storage establishment or a warehouse or distribution centre.
Hazard	A source of potential harm or a situation with potential to cause loss.
Horticulture	SI Definition: Horticulture means the cultivation of fruits, vegetables, mushrooms, nuts, cut flowers and foliage and nursery products for commercial purposes, but does not include a plant nursery, turf farming or viticulture.
Hotel / motel	SI Definition: Hotel or motel accommodation means a building or place (whether or not licensed premises under the <i>Liquor Act 2007</i>) that provides temporary or short-term accommodation on a commercial basis and that: (a) comprises rooms or self-contained suites, and (b) may provide meals to guests or the general public and facilities for the parking of guests' vehicles, but does not include backpackers' accommodation, a boarding house, bed and breakfast accommodation or farm stay accommodation.
Landscaping – natural area revegetation	SI Definition: Environmental protection works – See <i>Conservation Area - dryland</i> .
Landscaping – parks and gardens	SI Definition Recreation area means a place used for outdoor recreation that is normally open to the public, and includes: (a) a

	children’s playground, or (b) an area used for community sporting activities, or (c) a public park, reserve or garden or the like.
Landscaping – roads and motorways	SI Definition: Road means a public road or a private road within the meaning of the <i>Roads Act 1993</i> and includes a classified road.
Landscaping – streets and transport corridors	SI Definition: Road – See <i>Landscaping – roads and motorways</i> .
Loafing	When animals rest.
Marina	SI Definition: Marina means a permanent boat storage facility (whether located wholly on land, wholly on a waterway or partly on land and partly on a waterway), and includes any of the following associated facilities: (a) any facility for the construction, repair, maintenance, storage, sale or hire of boats, (b) any facility for providing fuelling, sewage pump-out or other services for boats, (c) any facility for launching or landing boats, such as slipways or hoists, (d) any car parking or commercial, tourist or recreational or club facility that is ancillary to the boat storage facility, (e) any berthing or mooring facilities.
Market farms and gardens	SI Definition: Garden centre means a building or place the principal purpose of which is the retail sale of plants and landscaping and gardening supplies and equipment. It may, if ancillary to the principal purpose for which the building or place is used, include a restaurant or cafe and the sale of any the following: (a) outdoor furniture and furnishings, barbecues, shading and awnings, pools, spas and associated supplies, and items associated with the construction and maintenance of outdoor areas, (b) pets and pet supplies, (c) fresh produce.
Markets	SI Definition: Market means an open-air area, or an existing building, that is used for the purpose of selling, exposing or offering goods, merchandise or materials for sale by independent stall holders, and includes temporary structures and existing permanent structures used for that purpose on an intermittent or occasional basis.
National Airports Safeguarding Framework	A national land use planning framework that aims to: a) improve community amenity by minimising aircraft noise-sensitive developments near airports; and

	<p>b) improve safety outcomes by ensuring aviation safety requirements are recognised in land use planning decisions through guidelines being adopted by jurisdictions on various safety-related issues.</p> <p>Guideline C <i>Managing the Risk of Wildlife Strikes in the Vicinity of Airports</i>, provides guidelines to land users and planners regarding the management of wildlife hazards.</p>
Natural areas	SI Definition: Environmental facility or environmental protection works .
Non-putrescible waste facility - landfill	SI Definition: Waste disposal facility means a building or place used for the disposal of waste by landfill, incineration or other means, including such works or activities as recycling, resource recovery and other resource management activities, energy generation from gases, leachate management, odour control and the winning of extractive material to generate a void for disposal of waste or to cover waste after its disposal.
Non-putrescible waste facility - transfer station	SI Definition: Waste or resource transfer station means a building or place used for the collection and transfer of waste material or resources, including the receipt, sorting, compacting, temporary storage and distribution of waste or resources and the loading or unloading of waste or resources onto or from road or rail transport.
Office building	SI Definition: Office premises means a building or place used for the purpose of administrative, clerical, technical, professional or similar activities that do not include dealing with members of the public at the building or place on a direct and regular basis, except where such dealing is a minor activity (by appointment) that is ancillary to the main purpose for which the building or place is used.
Orchard	SI Definition: Intensive plant agriculture Means any of the following: (a) the cultivation of irrigated crops for commercial purposes (other than irrigated pasture or fodder crops), (b) horticulture, (c) turf farming, (d) viticulture.
Organic waste facility	SI Definition: Waste or resource management facility means any of the following: (a) a resource recovery facility; (b) a waste disposal facility; (c) a waste or resource transfer station; (d) a building or place that is a combination of any of the things referred to in paragraphs (a)-(c).

	<p><u>Enclosed</u> facilities means there is no open waste (accessible by wildlife) due to the installation of infrastructure to enclose operations.</p> <p><u>Open</u> facilities means the waste is accessible by wildlife.</p>
Park / Playground	SI Definition: Recreation area See - <i>Landscaping – parks and gardens</i> .
Petrol station	SI Definition: Service station means a building or place used for the sale by retail of fuels and lubricants for motor vehicles, whether or not the building or place is also used for any one or more of the following: (a) the ancillary sale by retail of spare parts and accessories for motor vehicles, (b) the cleaning of motor vehicles, (c) installation of accessories, (d) inspecting, repairing and servicing of motor vehicles (other than body building, panel beating, spray painting, or chassis restoration), (e) the ancillary retail selling or hiring of general merchandise or services or both.
Picnic / camping ground	SI Definition: Camping ground means an area of land that has access to communal amenities and on which campervans or tents, annexes or other similar portable and lightweight temporary shelters are, or are to be, installed, erected or placed for short term use, but does not include a caravan park.
Piggery	SI Definition: Intensive livestock agriculture - See <i>Cattle/dairy Farm</i> .
Plant nursery	SI Definition: Plant nursery means a building or place the principal purpose of which is the retail sale of plants that are grown or propagated on site or on an adjacent site. It may include the on-site sale of any such plants by wholesale and, if ancillary to the principal purpose for which the building or place is used, the sale of landscape and gardening supplies and equipment and the storage of these items.
Potable water treatment facility	SI Definition: Resource recovery facility means a building or place used for the recovery of resources from waste, including works or activities such as separating and sorting, processing or treating the waste, composting, temporary storage, transfer or sale of recovered resources, energy generation from gases and water treatment, but not including re-manufacture or disposal of the material by landfill or incineration.

Poultry farm	SI Definition: Intensive livestock agriculture - See <i>Cattle/dairy Farm</i> .
Probability	The likelihood of a specific event or outcome, measured by the ratio of specific events or outcomes to the total number of possible events or outcomes.
Public feeding of wildlife	The act of giving food to wild animals.
Public transport facility	Any area or facility that supports public transport infrastructure.
Putrescible waste facility - landfill	SI Definition: Waste disposal facility – See <i>Non-putrescible waste facility - landfill</i> . <u>Enclosed</u> facilities means there is no open waste (accessible by wildlife) due to the installation of infrastructure to enclose operations <u>Open</u> facilities means the waste is accessible by wildlife.
Putrescible waste facility - transfer station	SI Definition: Waste or resource transfer station – See <i>Non-putrescible waste facility - transfer station</i> . <u>Enclosed</u> facilities means there is no open waste (accessible by wildlife) due to the installation of infrastructure to enclose operations. <u>Open</u> facilities means the waste is accessible by wildlife.
Racetrack / horse riding school	SI Definition: Recreation facility (outdoors) – See <i>Golf Course</i> .
Raptor	Birds of prey such as eagles and falcons.
Recreational fishing areas	Areas on water or along waterways where members of the public fish.
Risk	The chance of something happening that will have an impact upon objectives. It is measured in terms of consequences and probability.
Roosting	When birds repeatedly return to a particular place in numbers to loaf or spend the night.
School/university	SI Definition: Educational establishment means a building or place used for education (including teaching), being: (a) a school, or (b) a tertiary institution, including a university or a TAFE establishment, that provides formal education and is constituted by or under an Act.

Sewage / wastewater treatment facility	SI Definition: Sewage treatment plant means a building or place used for the treatment and disposal of sewage, whether or not the facility supplies recycled water for use as an alternative water supply.
Shopping centre	SI Definition: Retail premises means a building or place used for the purpose of selling items by retail, or hiring or displaying items for the purpose of selling them or hiring them out, whether the items are goods or materials (or whether also sold by wholesale), and includes any of the following: (a) bulky goods premises, (b) cellar door premises, (c) food and drink premises, (d) garden centres, (e) hardware and building supplies, (f) kiosks, (g) landscaping material supplies, (h) markets, (i) plant nurseries, (j) roadside stalls, (k) rural supplies, (l) shops, (m) timber yards, (n) vehicle sales or hire premises, but does not include highway service centres, service stations, industrial retail outlets or restricted premises.
Showground	SI Definition: Recreation facility (outdoors) - See Golf Course.
Sports facility (tennis, bowls, etc)	SI Definition: Recreation area - See Landscaping – parks and gardens.
Sports fields	SI Definition: Recreation facility (outdoors) - See Golf Course.
Stormwater drains	SI Definition: Water storage facility – See Dams.
Stormwater management facilities	SI Definition: Water storage facility – See Dams.
Transit	When birds fly from one place to another.
Turf farm	SI Definition: Intensive plant agriculture – See Orchard.
Urban open space (e.g. cycleways, green areas, pedestrian walkways)	SI Definition: Recreation area - See Landscaping – parks and gardens.
Viticulture	SI Definition: Viticulture means the cultivation of grapes for use in the commercial production of fresh or dried fruit or wine.
Water retention basins	SI Definition: Water storage facility – See Dams.
Warehouse (food storage)	SI Definition: Warehouse or distribution centre means a building or place used mainly or exclusively for storing or handling items

	(whether goods or materials) pending their sale, but from which no retail sales are made.
Warehouse (non-food storage)	SI Definition: Warehouse or distribution centre – See <i>Warehouse (food storage)</i> or Storage premises – See <i>Grain storage</i> .
Waste collection points (commercial)	Designated areas for commercial and industrial rubbish bins/skips.
Water sport facilities	SI Definition: Recreation facility (outdoors) - See <i>Golf Course</i> .
Waterway (e.g. creeks, rivers)	SI Definition: Waterway means the whole or any part of a watercourse, wetland, waterbody (artificial) or waterbody (natural).
Wetland	SI Definition: Wetland means (a) natural wetland, including marshes, mangroves, backwaters, billabongs, swamps, sedgeland, wet meadows or wet heathlands that form a shallow waterbody (up to 2 metres in depth) when inundated cyclically, intermittently or permanently with fresh, brackish or salt water, and where the inundation determines the type and productivity of the soils and the plant and animal communities, or (b) artificial wetland, including marshes, swamps, wet meadows, sedgeland or wet heathlands that form a shallow waterbody (up to 2 metres in depth) when inundated cyclically, intermittently or permanently with water, and are constructed and vegetated with wetland plant communities.
Wildlife breeding/roosting	A location where wildlife have established a breeding or roosting site. The site can be naturally occurring (e.g. forest) or in the built environment (e.g. building).
Wildlife sanctuary - dryland	SI Definition: Environmental protection works – See <i>Conservation Area - dryland</i> .
Wildlife sanctuary - wetland	SI Definition: Environmental protection works – See <i>Conservation Area - dryland</i> .
Wildlife Strike	A reported wildlife strike is deemed to have occurred whenever: <ul style="list-style-type: none"> • a pilot reports a strike to the ATSB • aircraft maintenance personnel find evidence of a bird or animal strike on an aircraft • personnel on the ground report seeing an aircraft strike one or more birds or animals

	<ul style="list-style-type: none"> • bird or animal remains are found on the airside pavement area, or within the runway strip, unless another reason for the bird or animals death can be established. <p>A suspected wildlife strike is deemed to have occurred whenever a bird or animal strike has been suspected by aircrew or ground personnel but upon inspection:</p> <ul style="list-style-type: none"> • no wildlife carcass or remains are found, and • there is no physical evidence on the aircraft of the strike having occurred. <p>A confirmed wildlife strike is deemed to have occurred whenever:</p> <ul style="list-style-type: none"> • aircrew report that they <i>definitely</i> saw, heard or smelt a bird strike • bird or animal remains are found on the airside pavement area or within the runway strip, unless another reason for the bird or animal’s death can be found • aircraft maintenance personnel find evidence of a bird or animal strike on an aircraft. <p>A wildlife near miss is deemed to have occurred whenever a pilot takes evasive action to avoid birds or animals.</p> <p>An on-aerodrome wildlife strike is deemed to be any strike that occurs within the boundary fence of the aerodrome, or where this is uncertain, where it occurred below 500 ft on departure and 200 ft on arrival.</p> <p>A wildlife strike in the vicinity of an aerodrome is deemed to have occurred whenever a bird strike occurs outside the area defined as ‘on aerodrome’ but within an area of 15 kilometres radius from the aerodrome reference point (ARP) or up to 1,000 feet above the elevation of the aerodrome.</p> <p>A wildlife strike remote from the aerodrome is deemed to have occurred whenever a bird strike occurs more than 15 kilometres from an aerodrome or more than 1,000 feet above the elevation of the aerodrome.</p>
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Wildlife Survey	Standardised ² high-level surveys that capture data regarding wildlife species, their behaviours and their distribution. Usually completed by wildlife biologists.
Zoo	SI Definition: Animal boarding or training establishment means a building or place used for the breeding, boarding, training, keeping or caring of animals for commercial purposes (other than for the agistment of horses), and includes any associated riding school or ancillary veterinary hospital.

² Standardised means the survey method is prescriptive and replicable.

1. Background

1.1. The Wildlife Strike Issue

The consequence of wildlife strikes with aircraft can be very serious. Wildlife strikes have caused 532 human fatalities and 614 aircraft losses since the beginning of aviation (Shaw et al, 2019³). Wildlife strikes cost the commercial civil aviation industry an estimated US\$1.2 billion per annum (Allan, 2002) and involve more than just the repair of damaged engines and airframes. Even apparently minor strikes which result in no obvious damage can reduce engine performance, cause concern among aircrew and add to airline operating costs.

Strike risk depends on the probability of colliding with wildlife and the consequence to the aircraft if collision occurs. The probability of a wildlife strike occurring increases as the number of wildlife and aircraft operating in the same airspace increases. Strike probability also increases with airspeed. In practice, this means that the likelihood of colliding with a bird inflight increases when operating at high speed below 5000 feet above ground level (AGL), which is where the majority of birds operate. Wildlife density, and therefore strike probability, increases with decreasing height above the ground. Operating at low altitudes over, or near, known wildlife hazards will significantly increase strike probability.

The main factors determining the consequences of a strike are the number and size of animals struck, the combined closing speed at which the strike occurred, 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 edges. Strikes involving more than one animal (i.e. a multiple strike) can be serious, even with relatively small wildlife, potentially disabling engines and/or resulting in major accidents. While total mass struck and impact site on the aircraft are important strike consequence considerations, final impact speed is the most significant determinant as impact force varies exponentially with the square of closing speed⁴.

³ A database that lists more details about significant and fatal wildlife strike events is available at <https://avisure.com/about-us/fatalities-and-destroyed-aircraft-due-to-wildlife-strikes-1912-to-present/>

⁴ The energy of the impact is proportional to the mass of the bird multiplied by the square of the speed of impact (impact energy = 1/2 x mass x velocity²).

The Australian Transport Safety Bureau (ATSB) received 16,626 confirmed strike reports between 2008 and 2017. This does not account for the numerous suspected strikes or near miss events reported by airports and pilots. Approximately 1 in 10 strikes with turbofan aircraft results in an engine ingestion, and the strike rate with high capacity air transport operations increased from 7.1 strikes per 10000 aircraft movements calculated in 2008 to 8.7 in 2017 (ATSB, 2019). In the absence of any significant change to the way wildlife strike management is approached in Australia, it is likely this increasing trend will continue.

1.2. Wildlife Strikes and Land Use Around Airports

In civil aviation around 93% of strikes occur at below 3500 feet AGL (Dolbeer 2011), with 96% of flying-fox strikes recorded at or below 1000 feet AGL (Parsons et al 2008). Consequently, management focusses largely on terminal airspace and management responsibility has typically resided with aerodrome operators. However, aircrew and air traffic controllers should be engaged in strike risk and mitigation processes, and that high-risk operations consider predicted or observed wildlife movement patterns. It is also critical that external stakeholders, including wildlife authorities, local planning authorities and land users, are engaged to monitor and mitigate wildlife hazards, and that both on- and off-aerodrome hazards are critically assessed. It is particularly pertinent for land use planning to consider wildlife strikes where a new airport and the surrounding areas are being developed.

1.3. Project Description

The Western Sydney Planning Partnership is a collaboration of several councils located in Western Sydney and key NSW government agencies. Their aim is to deliver integrated land use and infrastructure planning for the Western Sydney Aerotropolis, a 11,200ha area surrounding Western Sydney Airport (WSA). The Western Sydney Aerotropolis Plan (WSAP) and the Development Control Plan (DCP) details the foundation of land use and infrastructure strategies for ten precincts. The nature of land use within these precincts requires an assessment to determine potential wildlife attractions that could contribute to the wildlife strike risk at WSA, once operational. The Western Sydney Planning Partnership engaged Avisure in December 2019 to complete this assessment and meet the following objectives:

- safeguard the 24/7 operations of WSA from wildlife strikes;
- ensure the vision for the Western Parkland City and Western Sydney Aerotropolis is achieved;

- identify varying requirements, including landscaping, within the 3km, 8km and 13km wildlife buffers;
- manage the risks of wildlife strikes with aircraft and overall attraction of wildlife within 13 kilometres of the WSA; and
- identify innovative performance-based outcomes to mitigate impacts for wildlife attracting uses identified in Guideline C of the National Airports Safeguarding Framework (NASF).

This project aligns with the following Planning Principles established in the WSAP⁵:

- Objective 3 (Productivity) – Safeguard airport operations:
 - PR7: Appropriately design, construct and locate development to safeguard 24/7 airport operations.
 - PR9: Require development to accord with the NASF Guidelines.
- Objective 4 (Sustainability) – A landscape-led approach to urban design and planning:
 - SU11: Retain and protect wetland environments to support plant animal communities and to mitigate wildlife attraction or wildlife strike.
- Objective 8 (Infrastructure and Collaboration) – A collaborative approach to planning and delivery:
 - IC7: Adopt a collaborative approach to precinct planning and master planning with all three levels of government, the community, industry, and landowners.

1.3.1. Scope

The project aims to assist the Western Sydney Planning Partnership identify wildlife attraction issues associated with future land use planning and develop mechanisms to mitigate any potential wildlife strike risks at WSA once the airport is operational. The overall aim is to safeguard the airport whilst not compromising the overall vision of the Western Sydney Aerotropolis (to be Australia's next global gateway) and Western Parkland City (refer Section 1.3.2.3).

⁵ At the time of writing this report the WSAP was in draft. Some elements may have changed during finalisation.

1.3.2. Limitations and assumptions

1.3.2.1. Finding a balanced approach

Safeguarding the 24/7 operations of the airport and the vision of the Western Sydney Aerotropolis are essentially at odds. By its nature, safeguarding attempts to minimise the numbers, flock size and diversity of wildlife operating in and around the WSA airspace, by contrast the Western Sydney Aerotropolis aims to increase tree canopy cover across the area to 40%, enhance riparian zones and wetlands and generally maximise biodiversity across the area. Accordingly, we have had to take a balanced approach that affords the area amenity but minimises the main wildlife threats to aviation.

1.3.2.2. Assumptions in the absence of long-term monitoring data

A detailed wildlife movement study has not been completed. Such a study would involve using remote sensing equipment such as radar to understand how birds and bats move around the landscape and if done over several years, what climatic and seasonal conditions affect behaviour. We have therefore made assumptions based on habitats about, for instance, likely areas of food preference and subsequent directional movements of flying foxes to and from known camps. We also assume that the operational airport and stakeholders will seek to employ the latest technologies such as avian radar for detecting and managing high risk wildlife movements through aircraft flight paths.

1.3.2.3. NSW government commitments to delivering the Western City Parkland vision

The Greater Sydney Commission (2018) states that the overall vision for Western City Parkland is that “*residents in the Western City District will have quicker and easier access to a wider range of jobs, housing types and activities. This vision will improve the District’s lifestyle and environmental assets*”. Achieving this vision will require⁶:

⁶ Taken from the *Western City District Plan 2018* page 6.

- Creating a once-in-a-generation economic boom with the Western Sydney Airport and Badgerys Creek Aerotropolis bringing together infrastructure, businesses and knowledge-intensive jobs.
- Building on the Western Sydney City Deal to transform the Western City District over the next 20 to 40 years by building on natural and community assets and developing a more contained Western City District with a greater choice of jobs, transport and services aligned with growth.
- Delivering the first stage of the North South Rail Link – Sydney Metro Greater West.
- Collaborating and building strong relationships between Liverpool, Greater Penrith and Campbelltown-Macarthur reinforced by the emerging Badgerys Creek Aerotropolis forming a unique metropolitan cluster.
- Providing major transport links for people and freight by unprecedented transport investments.
- Developing a range of housing, providing access to public transport and infrastructure including schools, hospitals and community facilities.
- Linking walking and cycling paths, bushland and a green urban landscape framed by the Greater Blue Mountains World Heritage Area, the Scenic Hills and Western Sydney Parklands.
- Enhancing and protecting South Creek, Georges River and Hawkesbury-Nepean river systems.
- Mitigating the heat island effect and providing cooler places by extending urban tree canopy and retaining water in the landscape.
- Protecting the District's natural landscapes, heritage and tourism assets, unique rural areas and villages.
- Protecting the environmental, social and economic values of the Metropolitan Rural Area.

There are aspects of the Western City Parkland within the Aerotropolis that are key government commitments to delivering the Parkland vision and will not be compromised, particularly within the context of landscaping, Table 1 and Figure 1. However, assessment and mitigation will be applied, where appropriate, based on the nature and extent of site-specific wildlife hazards. The Western Sydney Planning Partnership and its' stakeholders understand that not applying proactive wildlife hazard mitigation in these areas may contribute to the airport's strike risk if wildlife populations establish. If left unmanaged this may result in an unacceptable number and type of birds moving through aircraft airspace, compromising aircraft safety. Accordingly, this report recommends:

- Mitigating impacts associated with relevant land uses, where possible (if it does not compromise the objectives of the government's commitment).
- Considering mitigation options, particularly in natural areas and where biodiversity enhancement is the main objective, that focus on:
 - Built structures and facilities (e.g. visitor centres, waste management facilities, picnic facilities etc.).
 - Human behaviours (e.g. signage to discourage wildlife feeding, the provision of adequate waste management facilities to discourage littering, etc.).
- Monitoring relevant land uses within these areas to identify any emerging risks.
- Managing these risks using active control measures, where required, as identified in an approved wildlife management plan such as dispersal, breeding control (e.g. egg and nest removal or egg oiling), and other methods deemed appropriate.

Table 1. Key government commitments to the delivering the Western City Parkland Vision.

Area	Commitment
Environment and Recreation Zone	The Western Sydney Aerotropolis Structure Plan on page 27 of the Western Sydney Aerotropolis Plan (WSAP) identifies land within the Aerotropolis that is proposed to be zoned Environment and Recreation (either with the initial precincts or at a later date). All land subject to this layer on that map and the proposed outcomes identified within the WSAP must be delivered to achieve the parkland vision. The Environment and Recreation zone captures most of the Wianamatta-South Creek precinct and other areas identified for conservation and

Area	Commitment
	<p>biodiversity. An indicative location for regional parks has been identified. Whilst a portion extends outside of the Environment and Recreation Zone, in the event that government commits to these parks, they will subsequently be zoned Environment and Recreation and would be captured.</p>
<p>Biodiversity Certification, BioBanking and Biodiversity Stewardship Sites</p>	<p>All conditions that have been applied to biodiversity certification approval processes (existing or future), BioBanking and Biodiversity Stewardship Sites must be satisfied. In these areas, conditions must be satisfied and altered landscape and water body outcomes to reduce wildlife attraction cannot be applied.</p>
<p>National Parks and Wildlife Service – national parks and reserves</p>	<p>In these areas landscape and water body outcomes to reduce wildlife attraction cannot be applied.</p>
<p>Heart of Aerotropolis Core</p>	<p>Within the Aerotropolis, all land within the proposed mixed use zone (page 29 of the WSAP) as well as additional land linking key activity/movement corridors must achieve the Parkland vision. This area will capture a regional park shown in an indicative location. A strategic outcome for the Aerotropolis Core precinct is to contribute to urban canopy and maximise connections to the Wianamatta-South Creek corridor and Blue-Grid Green. These areas have been captured in Figure 1.</p>
<p>Northern Gateway – Mixed Use Zone</p>	<p>A strategic outcome for the Northern Gateway precinct is to provide safe, activated, landscaped and shaded streets and urban canopy. Within the Northern Gateway, all land within the proposed mixed use zone (page 29 of the WSAP) must achieve the Parkland vision. These areas have been captured in Figure 1.</p>
<p>Luddenham Village</p>	<p>The delivery of the Parkland Vision for Luddenham Village will be developed further as part of precinct planning.</p>

If the NSW government determines it is necessary to retain some existing farm dams due to their roles in water cycle management and/or high environmental value then these will need to be carefully managed in consultation with WSA.

Whilst the infrastructure associated with Sydney Water's Water Factory is critical within the Aerotropolis to achieve the Parkland Vision it is acknowledged that there are some site specific design solutions (including landscaping) that could be incorporated for any proposed Water Factory. Accordingly, it is appropriate for site specific solutions to be provided for wildlife management in association with those works.

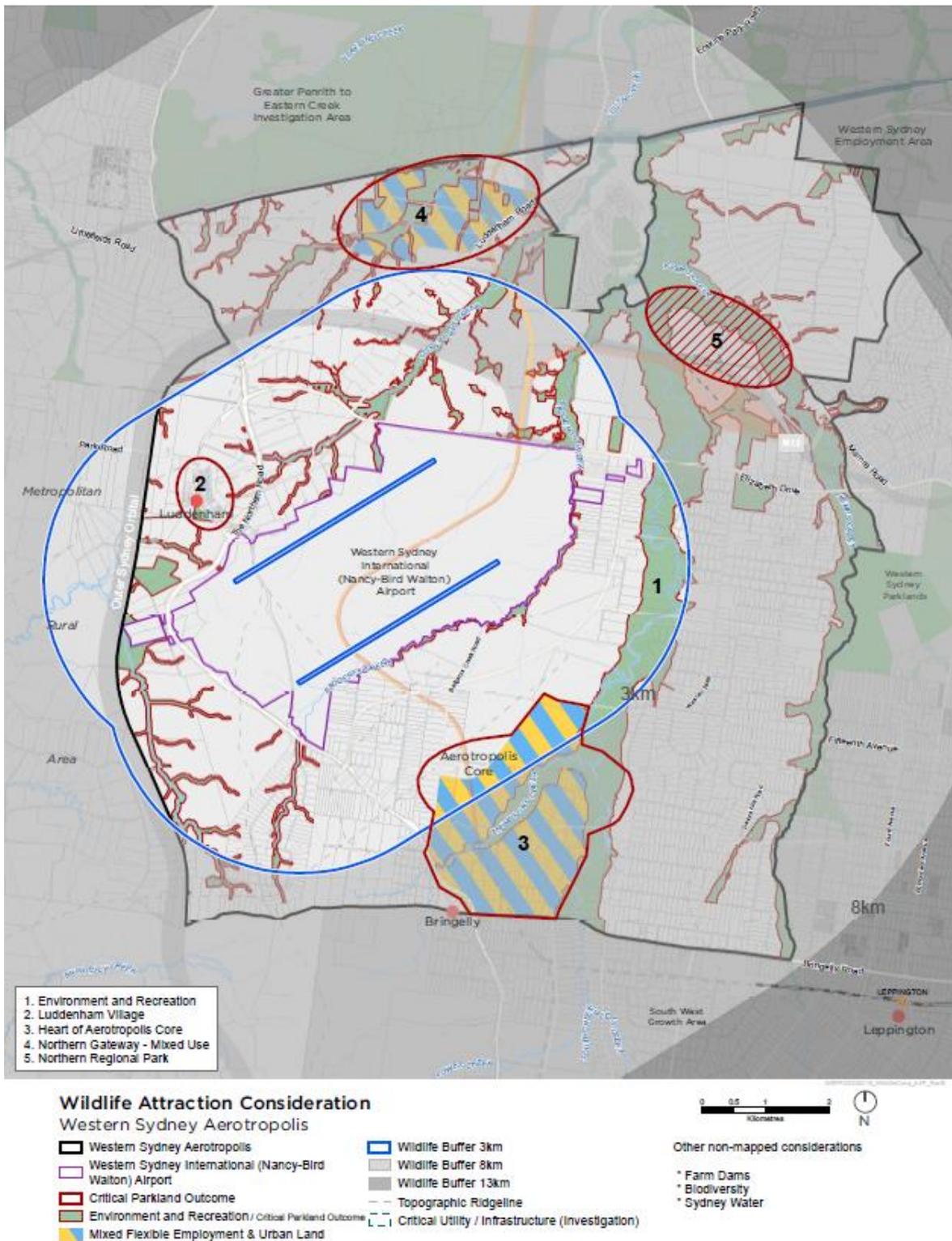


Figure 1. Key government commitments to the delivering the Western City Parkland Vision (map provided by the Western Sydney Planning Partnership).

1.3.3. Key Outcomes

The Wildlife Management Assessment (WMA) report (this report) recommends how to assess for and manage wildlife risks, including landscaping advice, how to adapt the NASF (Guideline C), and how to integrate land use assessment and performance-based outcomes in the planning framework to mitigate potential wildlife hazards. The WMA:

- Describes the legal framework and summarises a variety of support and guidance documentation.
- Adapts the NASF for NSW as part of the Western Sydney Aerotropolis planning framework and guidance material.
- Proposes a wildlife hazard assessment criteria and process for land users to evaluate their potential contribution to the WSA strike risk.
- Suggests acceptable solutions for inclusion in DCPs.
- Provides landscaping guidelines that considers species selection and planting structure.
- Lists mitigation options to help land users manage wildlife hazards.
- Provides case studies where off-airport land use assessments were applied to determine their contribution to the wildlife strike risk.

2. Western Sydney Airport Wildlife Hazards

WSA engaged Avisure in January 2018 to assess the wildlife hazard, identify potential strike risks and to present strike risk mitigation options for consideration during design and construction stages of the airport. Avisure has developed a model for determining risk categories using wildlife survey data. 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/animal mass and flock size) for all species recorded. The combination of these probability and consequence factors give a numerical risk index, the Species Risk Index (SRI). 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. Avisure applied this risk assessment method to the data collected from the WSA site to identify a number of high and moderate risk species, Table 2 (Avisure 2019).

Table 2. WSA wildlife species risk assessment, 2018 (*terrestrial mammals are generally not a consideration for land users to manage outside the boundaries of WSA).

Rank	Common Name	Risk
1	Eastern Grey Kangaroo (<i>Macropus giganteus</i>)*	Very High
2	Spotted Deer (<i>Axis axis</i>)*	High
3	Wood Duck (<i>Chenonetta jubata</i>)	High
4	Black Swan (<i>Cygnus atratus</i>)	Moderate
5	Domestic Dog (<i>Canis lupus familiaris</i>)*	Moderate
6	Straw-necked Ibis (<i>Threskiornis spinicollis</i>)	Moderate
7	Unidentified Duck (Family: <i>Anatidae</i>)	Moderate
8	Pacific Black Duck (<i>Anas superciliosa</i>)	Moderate
9	Feral Goat (<i>Capra aegagrus hircus</i>)*	Moderate
10	Hardhead (<i>Aythya australis</i>)	Moderate
11	Australian Pelican (<i>Pelecanus conspicillatus</i>)	Moderate
12	Australian Raven (<i>Corvus coronoides</i>)	Moderate
13	Eurasian Coot (<i>Fulica atra</i>)	Moderate
14	Cattle Egret (<i>Bubulcus ibis</i>)	Moderate
15	Wedge-tailed Eagle (<i>Aquila audax</i>)	Moderate
16	Masked Lapwing (<i>Vanellus miles</i>)	Moderate
17	Grey Teal (<i>Anas gracilis</i>)	Moderate
18	Little Black Cormorant (<i>Phalacrocorax sulcirostris</i>)	Moderate
19	Little Pied Cormorant (<i>Microcarbo melanoleucos</i>)	Moderate

Rank	Common Name	Risk
20	Purple Swamphen (<i>Porphyrio porphyrio</i>)	Moderate
21	Galah (<i>Eolophus roseicapilla</i>)	Moderate
22	Common Starling (<i>Sturnus vulgaris</i>)	Moderate
23	Swamp Wallaby (<i>Wallabia bicolor</i>)*	Moderate
24	Pied Currawong (<i>Strepera graculina</i>)	Moderate
25	Magpie Lark (<i>Grallina cyanoleuca</i>)	Moderate

In addition, Avisure identified sixty-six sites within 13 km of WSA that attract wildlife and, in their current use, may contribute to the airport's strike risk once operational if left unmanaged (Figure 2). Avisure has developed a model for determining an off-airport location's contribution to wildlife strike risk. It involves probability based on survey data and desktop assessments to derive values for the wildlife attracted (or potentially attracted) to a site and to derive values for the inherent wildlife attractiveness of a location. It also includes strike consequence information based on the wildlife species and the location of the site relative to an airport. In addition, the risk assessment includes the connectivity of wildlife attractive (or potentially attractive) sites to determine the potential for wildlife to transit through critical airspace. Avisure applied this risk assessment method to the data collected from the sixty-six sites identified to determine each site's risk level. Table 3 lists only those sites assessed as moderate to very-high risk (Avisure 2019).

Table 3. Description of off-airport land uses categorised as moderate to high wildlife risk. Determined as part of the Western Sydney Airport Initial Wildlife Hazard Assessment in 2018.

Site and distance from WSA	Site Description	Risk
Longleys Rd Pond 2 (0km)	Farm dam	High
Point 18 Pond (0.05km)	Farm dam	High
Taylor's Rd Retention (0.25km)	Retention basin	High
Hubertus Country Club (0.55km)	Grassland area with ponds	High
Duncan Creek (1.51km)	Chain of farm dams	High
Elizabeth Drive Resource Recovery Facility (Landfill) (1.75km)	Landfill	High
Fire trails ponds 1 – 7 (0km)	Farm dam	Moderate
Longleys Rd Pond 1 (0.002km)	Farm dam	Moderate
Great Northern Rd Pond 2 (0.08km)	Farm dam	Moderate
Pond on Elizabeth Dr 2 (0.33km)	Farm dam	Moderate
Pond on Elizabeth Dr 1 (0.36km)	Farm dam	Moderate
Agricultural 1 (0.37km)	Agricultural property with farm dam	Moderate
IGA Pond (0.41km)	Farm dam	Moderate
Survey 15 pond (0.50km)	Farm dam	Moderate
Survey 16 pond (Jackson Road Pond) (0.50km)	Wetland	Moderate
Pond on Adams Rd 1 (0.68km)	Farm dam	Moderate
Pond on Adams Rd 2 (0.85km)	Farm dam	Moderate
Pond on Adams Rd 4 (0.96km)	Farm dam	Moderate
Pond on Elizabeth Dr 6 (1.13km)	Farm dam	Moderate
Horticultural Production (1.17km)	Landscaping, native vegetation, grasslands, pond	Moderate
Luddenham Rd Pond 2 (1.66km)	Farm dam	Moderate
Elizabeth Drive Ponds (set of 4) (2.01km)	Chain of farm dams	Moderate
Luddenham Rd Pond 1 (2.04km)	Farm dam	Moderate
Pond on Elizabeth Dr 4 (2.13km)	Farm dam	Moderate
Wolstenholme Avenue Pond (2.48km)	Farm dam	Moderate
Sydney Catholic Garden Cemetery (2.61km)	Grasslands with pond	Moderate
Twin Creeks Golf Course (4.11km)	Golf course	Moderate
Blue Hills Wetland (9.47km)	Wetland	Moderate
Ched Town Reserve (10.83km)	Parkland	Moderate
Glenmore Loch (11.81km)	Wetland	Moderate

Site and distance from WSA	Site Description	Risk
Ropes Creek Flying-fox Camp (12.09km)	Riparian vegetation	Moderate
Cobbitty, Brownlow Hill Flying-fox Camp (13.22km)	Riparian vegetation	Moderate
Emu Plains Flying-fox Camp (15.30km)	Riparian vegetation	Moderate
Macquarie Fields Flying-fox Camp (18.32km)	Riparian vegetation	Moderate
Cabramatta Flying-fox Camp (17.55km)	Riparian vegetation	Moderate
Campbelltown Flying-fox Camp (19.23km)	Riparian vegetation	Moderate

The risk associated with large terrestrial mammals (e.g. kangaroo, deer, dog, goat and wallaby) should be minimal once the airport is contained by a secure perimeter fence. The airport will be responsible for maintaining fence integrity by identifying and resolving any breach issues. As such, any wildlife management that occurs in off-airport areas should focus on flying animals (birds and flying-foxes). Terrestrial animals outside the airport site will not conflict with approaching or departing aircraft due to aircraft height.

The redistribution of water birds, who make up 44% of the risk species, will depend on the availability of water sources. At the time of the 2018 risk assessment, the airport site and immediate surrounds hosted a complex network of farm dams and ponds that supported large populations of water birds (e.g. duck, teal, swan, cormorant, pelican). Construction of the airport and changes to land use in the vicinity will remove many of these water sources. However, the construction of additional permanent water sources, along with the revitalisation of natural water courses, may support large populations of these birds. Careful planning regarding the location of these water sources relative to airport, and their design, is required and regular surveys will be required monitor their redistribution.

The species and off-airport risks are dynamic, are not accurate predictors of future risks, and will change in response to landscape changes during airport construction and operation, as well as changing land use activity close to the airport. WSA intend to continue regular monitoring on the airfield site during and after construction, along with regular assessments to determine species risks. How wildlife use the landscape, and how they will respond to changes in that landscape during airport construction and operation, is complex. The only way to develop targeted and effective wildlife management is by understanding how they use this changing landscape, and the only way to understand this is through ongoing and standardised monitoring, including the use of radar, and regular risk assessments.

3. Regulations, Standards and Guidance

There are a number of national and international requirements and guidance documents that indicate land use in the vicinity of an airport can contribute significantly to the wildlife hazard levels and safety of aircraft operations. This section summarises these requirements.

3.1. Australian Civil Aviation Safety Authority

The Manual of Standard (MOS) Part 139 prescribes the aerodrome requirements. Sections relevant to wildlife hazard management focus on: bird hazard information for the Aeronautical Information Package (AIP), drainage and drains in the runway strip, requirements for serviceability inspections, Notice to Airman (NOTAM) requirements for bird hazards, Reporting Officer responsibilities, animal hazard management requirements, and standing water on paved surfaces. Table 4 details requirements specific to wildlife hazards in the vicinity of airports, along with guidance from the Advisory Circular (AC) 139-29(0).

Table 4. MOS Part 139 requirements for wildlife management around airports.

Section	Detail
MOS 11.08 (1)	<p><i>Information that must be included in the Aerodrome Manual</i></p> <p>The wildlife hazard management procedures must be included or referenced in the aerodrome manual to deal with the hazards to aircraft operations caused by the presence of wildlife on or in the vicinity of the aerodrome, including details of the arrangements for the following: <i>Information that must be included in the Aerodrome Manual.</i></p> <p>The wildlife hazard management procedures must be included or referenced in the aerodrome manual to deal with the hazards to aircraft operations caused by the presence of wildlife on or in the vicinity of the aerodrome, including details of the arrangements for the following:</p> <p>(e) for proposed or actual sources of wildlife attraction outside the aerodrome boundary — liaising with the relevant planning authorities or proponents to facilitate wildlife hazard mitigation.</p>
MOS 17.01 (2)	<p>The aerodrome operator, in consultation with the local planning authority, must attempt to monitor sites within 13 km of the aerodrome reference point that attract wildlife.</p>

Section	Detail
MOS 17.04 (2)	<p>The wildlife hazard management plan must at least:</p> <p>(d) specify the liaison arrangements for local planning authorities within a radius of at least 13 km from the aerodrome reference point; and</p>
AC 6.4	<p>Operators of Certified Aerodromes are required to monitor and record the presence of wildlife on or in the vicinity of the aerodrome. Where this monitoring confirms the existence of a wildlife hazard, the aerodrome operator must develop a Wildlife Hazard Management Plan (WHMP).</p>
AC 6.11	<p>For wildlife hazards in the aerodrome vicinity which contribute to the risk but are outside the control of the aerodrome operator (i.e. on land located outside the aerodrome boundary), it is expected that the aerodrome operator will:</p> <ul style="list-style-type: none"> • advise the relevant land owner(s) or controlling authority of both the nature of the wildlife hazard and the resultant impact on the aerodrome; and • work with the relevant land owner(s) or controlling authority to manage the wildlife hazard.
AC 7.3.1	<p>Operators of Certified Aerodromes are required to monitor and record on a regular basis the presence of wildlife on the aerodrome. This requirement also extends to the aerodrome vicinity where wildlife hazards outside the aerodrome boundary are found to impact on the safe operation of the aerodrome.</p>
AC 9.2	<p>Wildlife monitoring must involve wildlife activity in the vicinity of the aerodrome.</p>
AC 9.4.1	<p>The monitoring of wildlife in the vicinity of the aerodrome should cover any obvious concentrations of wildlife and/or sources of wildlife attraction (i.e. habitat, migratory routes, feeding and breeding areas etc.) which contribute to the risk at the aerodrome.</p>
AC 9.4.4	<p>The outcome of the wildlife monitoring must be recorded. These records should be maintained in order to provide a detailed history of wildlife populations and behaviour over time.</p>
AC 9.4.5	<p>Once monitoring has identified a wildlife hazard, it should then be assessed.</p>

3.1.1. National Airports Safeguarding Framework

Guideline C of the NASF, *Managing the Risk of Wildlife Strikes in the Vicinity of Airports*, provides guidelines to land users and planners regarding the management of wildlife hazards. Adhering to the International Civil Aviation Organization (ICAO) guidelines relating to radial distances from airports (3km, 8km and 13km), the NASF allocates risk categories to land uses from very low to high and recommends actions for both existing and proposed developments (i.e. incompatible, mitigate, monitor, no action). The NASF encourages a coordinated approach between airport operators and land use planning authorities to mitigate risks, and where risks are identified for new developments, the NASF recommends:

- developing a management program
- establishing management performance standards
- allowing for design changes and/or operating procedures where the land use is likely to increase the strike risk
- establishing appropriate habitat management
- creating performance bonds should obligations not be met
- monitoring by airport authorities
- reporting wildlife events as per ATSB requirements.

Table 5 details some key elements of the NASF.

Table 5. NASF and land use planning recommendations.

Section	Detail
18	<p>The guidelines can also be used when considering the establishment of new airports. When a greenfield 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.</p>
20	<p>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 dumps⁷ should be not be sited within 13km of airport property. 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 be not be sited within 13km of airport property.</p>
21	<p>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 (of the NASF). 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.</p>
22	<p>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. These plans could include:</p> <ul style="list-style-type: none"> • regular monitoring surveys; • wildlife hazard assessments by qualified ornithologists or biologists; • wildlife awareness and management training for relevant staff,

7 Primarily ICAO DOC 9184 - Airport Planning Manual Part 2 - Land Use and Environmental Control.

Section	Detail
	<ul style="list-style-type: none"> • establishment of bird⁸ population triggers; implementation of activities to reduce hazardous bird populations; and • adoption of wildlife deterrent technologies to reduce hazardous bird⁸ populations.
24	<p>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:</p> <ul style="list-style-type: none"> • 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 ATSB guidelines.
27	<p>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.</p>

Compared to other airport safeguarding documents, the NASF is of a high standard. It succeeds in meeting the objectives of ICAO reference documents⁹ and provides enough detail to develop risk-based land use plans in the vicinity of aerodromes. Section 5 elaborates on how the NASF can be applied for the Western Parkland City as an important land use planning tool.

⁸ The guideline specifies 'bird' populations but wildlife hazard studies around airports should include flying-foxes (where they occur) and terrestrial animals where applicable.

⁹ Primarily ICAO DOC 9184 - Airport Planning Manual Part 2 - Land Use and Environmental Control.

3.1.2. NSW Environmental Planning and Assessment Act 1979

The *Environment Planning and Assessment Act* institutes the state’s planning system and describes the Ministerial Directions under Section 9.1. Table 6 describes the Ministerial Directions that relate to safeguarding aviation and the Western Sydney Aerotropolis.

Table 6. Ministerial Directions in the *NSW Environment Planning and Assessment Act 1979*.

Direction
<p>3.5 Development Near Regulated Airports and Defence Airfields</p> <p>Not allow development types that are incompatible with the current and future operation of that airport.</p>
<p>7.8 Implementation of Western Sydney Aerotropolis Interim Land Use and Infrastructure Implementation Plan</p> <p>Objective</p> <p>(1) The objective of this direction is to ensure development within the Western Sydney Aerotropolis is consistent with Stage 1 Western Sydney Aerotropolis Land Use and Infrastructure Plan dated August 2018 (the Stage 1 land Use and Implementation Plan).</p> <p>Where this direction applies</p> <p>(2) The direction applies to Liverpool City Council, Penrith City Council, Blue Mountains City Council, Blacktown City Council, Camden Council, Campbelltown City Council, Fairfield City Council and Wollondilly Shire Council.</p> <p>When this direction applies</p> <p>(3) This direction applies when a relevant planning authority prepares a planning proposal for land within the Western Sydney Aerotropolis and land affected by the obstacle limitation surface and ANEF contours for Western Sydney Airport.</p>

3.1.3. Damage by Aircraft Act 1952

The *Damage by Aircraft Act* describes ‘unlimited liability’ to aircraft operators in the event of property damage/destruction or personal injury/loss of life by an aircraft or part thereof. In worst case situations following a significant strike, aircraft operators are may seek to clarify if aerodrome operators, and even land users in the vicinity of airports, showed adequate due diligence in their responsibility to safeguard operations against wildlife strikes.

Table 7. Relevant sections of the *Damage by Aircraft Act*.

Section	Detail
10	<ul style="list-style-type: none"> • Imposes strict and unlimited liability • Applies if a person or property on land or water suffers personal injury, loss of life, material loss, damage or destruction caused by: <ul style="list-style-type: none"> ○ Impact with aircraft in flight ○ Impact with aircraft that damaged or destroyed while in flight ○ Impact with persons, animal or thing that dropped or fell from aircraft in flight ○ Something that is a result of (1), (2) or (3) ○ If the act is applied, the owner or operator of the aircraft are jointly and severally liable. <p>Damages are recoverable under the <i>Damage by Aircraft Act</i> without proof of intention or negligence.</p>

3.1.4. Work Health and Safety Act 2011

The *Work Health and Safety Act* requires appropriate duty of care to employees and contractors to maintain a safe working environment. Although not directly linked to aviation and wildlife strike management, the presence of wildlife in workplaces can create health issues for workers. Therefore, managing land use activities that are attracting wildlife, particularly where birds are nesting or roosting, not only contributes to airport safeguarding but maintains a safe work environment.

Table 8. Relevant sections of the *Work Health and Safety Act*.

Section	Detail
19	<p>Primary Duty of Care:</p> <p>(2) A person conducting a business or undertaking must ensure, so far as is reasonably practicable, that the health and safety of other persons is not put at risk from work carried out as part of the conduct of the business or undertaking.</p>

3.2. International Standards

3.2.1. International Civil Aviation Organisation

As a member state to the ICAO, Australia must adhere to the rules and regulations stipulated by ICAO, including those relating to wildlife hazard management on and around airports. There are also series of guidance documents and best practice standards airports can refer to assist with wildlife hazard management. ICAO Annex 14, Volume 1 (Aerodrome Design and Operation) establishes requirements for the management of wildlife strikes, including the requirement for authorities to take actions to reduce the number and types of wildlife-attracting sites in the vicinity of airports, Table 9.

Table 9. ICAO Annex 14 requirements for wildlife hazard management on and around airports.

Section	Detail
9.4	<p>Wildlife strike hazard reduction</p> <p><i>Note. — The presence of wildlife (birds and animals) on and in the aerodrome, vicinity poses a serious threat to aircraft operational safety.</i></p> <p>The wildlife strike hazard on, or near, an aerodrome shall be assessed through:</p> <ul style="list-style-type: none"> a) the establishment of a national procedure for recording and reporting wildlife strikes to aircraft; b) the collection of information from aircraft operators, aerodrome personnel and other sources on the presence of wildlife on or around the aerodrome constituting a potential hazard to aircraft operations; and c) an ongoing evaluation of the wildlife hazard by competent personnel.
9.4.3	<p>Action shall be taken to decrease the risk to aircraft operations by adopting measures to minimize the likelihood of collisions between wildlife and aircraft.</p> <p><i>Note. — Guidance on effective measures for establishing whether or not wildlife, on or near an aerodrome, constitute a potential hazard to aircraft operations, and on methods for discouraging their presence, is given in the Airport Services Manual (Doc 9137), Part 3.</i></p>

Section	Detail
9.4.4	The appropriate authority shall take action to eliminate or to prevent the establishment of garbage disposal dumps or any other source which may attract 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.
9.4.5	Recommendation. — <i>States should give due consideration to aviation safety concerns related to land developments in the vicinity of the aerodrome that may attract wildlife.</i>

ICAO Airport Services Manual Doc. 9184: Part 2 Land Use and Environmental Control provides airport personnel with guidance on land use planning within the vicinity of aerodromes, and the need for good planning and control measures. It focusses on how the airport impacts on its surroundings, and vice versa, with regard to people, flora, fauna, the atmosphere, water courses, air quality, soil pollution, rural areas, and the environment in general. It frequently discusses the significance of how some land use in the vicinity of airports, such as landfills, can influence an airports strike risk profile. Appendix 2, Land-use Guidelines for the Avoidance of Bird Hazards, is particularly useful however it does remind readers that “Any land use that had the potential to attract birds in the airport vicinity should be subject of a study to determine the likelihood of bird strikes to aircraft using the airport”.

3.2.2. World Bird Strike Association

The World Birdstrike Association (WBA) (previously the International Bird Strike Committee (IBSC)) provides a series of standards relevant to all aspects of integrated wildlife hazard management programs, Table 10.

Table 10. IBSC Standards for Aerodrome Bird/Wildlife Control.

Reference	Recommendation
Standard 9	Airports should conduct an inventory of bird attracting sites within the ICAO defined 13 km bird circle, paying particular attention to sites close to the airfield and the approach and departure corridors. A basic risk assessment should be carried out to determine whether the movement patterns of birds/wildlife attracted to these sites means that they cause, or may cause, a risk to air traffic. If this is the case, options for bird management at the site(s) concerned should

Reference	Recommendation
	<p>be developed and a more detailed risk assessment performed to determine if it is possible and/or cost effective to implement management processes at the site(s) concerned. This process should be repeated annually to identify new sites or changes in the risk levels produced by existing sites. Where national laws permit, airports, or airport authorities, should seek to have an input into planning decisions and land use practices within the 13km bird circle for any development that may attract significant numbers of hazardous birds/wildlife. Such developments should be subjected to a similar risk assessment process as described above and changes sought, or the proposal opposed, if a significant increase in bird strike risk is likely to result.</p>

3.3. WSA Obligations

As an airport operator, WSA must manage wildlife hazards in accordance with the CASA MOS Part 139¹⁰. Table 11 summarises the main requirements.

Table 11. WSA wildlife hazard management obligations (CASA MOS Part 139).

Section	Requirement
17.01 (1)	<p>As part of the aerodrome serviceability inspection, the aerodrome operator must monitor and record at least the following:</p> <ul style="list-style-type: none"> a) the presence and behaviour of wildlife on the aerodrome b) wildlife activity that is visible: <ul style="list-style-type: none"> (i) in the vicinity of the aerodrome; or (ii) from the aerodrome.
17.01 (2)	<p>The aerodrome operator, in consultation with the local planning authority, must attempt to monitor sites within 13 km of the aerodrome reference point that attract wildlife.</p>
17.01 (3)	<p>The aerodrome operator must attempt to monitor any reported wildlife aircraft strike events at, or in the vicinity of, the aerodrome.</p>

¹⁰ A recent update of the MOS means that these provisions do not come into effect until August 2020, however it is noted that all the requirements in the previous MOS are accounted for in the updated version.

Section	Requirement
17.02 (1)	Any detected wildlife hazard must be assessed for its potential risk to aircraft operations.
17.02 (2)	If the aerodrome operator has a safety management system, or a risk management plan, mentioned in Chapter 25 (Safety Management Systems) or 26 (Risk Management Plans) respectively, the assessment must be conducted in accordance with the system or the plan.
17.02 (3)	<p>When conducting a wildlife hazard assessment, available data from the following must be considered:</p> <ul style="list-style-type: none"> a) wildlife observations b) reported aircraft strike events c) reported aircraft near miss events.
17.03 (1)	<p>For an aerodrome that, in the course of a financial year, has:</p> <ul style="list-style-type: none"> a) 50 000 or more air transport passenger movements; or b) 100 000 or more aircraft movements; <p>the aerodrome operator must prepare and implement a wildlife hazard management plan.</p>
17.03 (2)	<p>The plan must be prepared and implemented not later than 6 months after:</p> <ul style="list-style-type: none"> a) for paragraph (1) (a) — the date of publication, by the Department, of the air transport passenger movement numbers indicating that, for the first time under this MOS, there have been 50 000 or more air transport passenger movements for the aerodrome for the financial year; or b) for paragraph (1) (b) — the date the aerodrome operator becomes aware of information indicating that, for the first time under this MOS, there have been 100 000 or more aircraft movements at the aerodrome in the course of the financial year.
17.03 (3)	<p>If section 17.03 paragraph (2) (a) or (2) (b):</p> <ul style="list-style-type: none"> a) applied to an aerodrome operator; and b) subsequently ceased to apply to the operator; and c) subsequently would have applied to the operator again if such application were deemed to be for the first time under this MOS; <p>then the paragraph applies to the operator as if it were for the first time under this MOS.</p>

Section	Requirement
17.03 (4)	Section 17.03 Subsection (1) does not apply if: <ul style="list-style-type: none"> a) for aerodromes without scheduled international operations — wildlife hazard assessment demonstrates, using statistical and other data, that the wildlife hazard risk is low; and b) CASA, in writing, approves the assessment subject to conditions (if any).
17.03 (5)	CASA may direct an aerodrome operator in writing to prepare and implement a wildlife hazard management plan if CASA considers that this is necessary in the interests of aviation safety.
17.03 (6)	A wildlife hazard management plan must be included in, or referenced in, the aerodrome manual.
17.04 (1)	A wildlife hazard management plan must be prepared in consultation with a suitably qualified or experienced person, for example: <ul style="list-style-type: none"> a) an ornithologist, zoologist, biologist, ecologist; or b) a person with demonstrated expertise in the management of wildlife hazards to aviation.
17.04 (2)	The wildlife hazard management plan must at least: <ul style="list-style-type: none"> a) identify the key aerodrome or contracted personnel and define their responsibilities or functions in the plan; and b) identify sources and locations of wildlife attraction: <ul style="list-style-type: none"> (i) on the aerodrome; and (ii) in the vicinity of the aerodrome; which are likely to cause wildlife to transit the take-off, approach and transitional surfaces; and c) set out the procedures for the following in relation to wildlife hazards: <ul style="list-style-type: none"> (i) detection; (ii) monitoring; (iii) risk assessment and analysis; (iv) reporting to pilots through the AIP, NOTAM and ATC (if applicable); (v) mitigation, including passive and active strategies; and d) specify the liaison arrangements for local planning authorities within a radius of at least 13 km from the aerodrome reference point; and e) set out the aerodrome operator's strategy for wildlife hazard reduction; and f) include records of the qualifications and experience of key personnel identified in the plan.

Section	Requirement
17.04 (3)	<p>The aerodrome operator must:</p> <ul style="list-style-type: none"> a) implement the wildlife hazard management plan; and b) keep the plan under continuous review.
17.04 (4)	<p>For section 17.04 subsection (3), a review of the wildlife hazard management plan must be conducted in each of the following circumstances:</p> <ul style="list-style-type: none"> a) if an aircraft experiences multiple wildlife strikes; b) if an aircraft experiences substantial damage following any wildlife strike; c) if an aircraft experiences an engine ingestion of wildlife; d) if the ongoing presence of wildlife is observed on the aerodrome in size or in numbers reasonably capable of causing an event mentioned in paragraph (a), (b) or (c); e) at least every 12 months, but if during a period of 12 months the plan was reviewed; f) under paragraph (a), (b), (c) or (d), at least every 12 months after that review.
17.05 (1)	<p>If the presence of wildlife is assessed as constituting an ongoing hazard to aircraft, the aerodrome operator must advise the AIS provider in writing to include an appropriate warning notice in the AIP-ERSA in accordance with Chapter 5 (Aerodrome Information for the AIP and Aerodrome Manual) of this MOS.</p>
17.05 (2)	<p>Without affecting Section 17.05 subsection (1), if a wildlife hazard is assessed as being:</p> <ul style="list-style-type: none"> a) at a higher risk than usual; and b) of a short-term or seasonal nature; <p>then the aerodrome operator must ensure that a timely NOTAM warning of the hazard is given to pilots using the aerodrome.</p>
17.05 (3)	<p>Without affecting Section 17.05 subsections (1) or (2), if a wildlife hazard is assessed as being a serious and imminent threat to aviation safety at an aerodrome, the aerodrome operator must ensure that pilots using the aerodrome are directly advised on CTAF or UNICOM.</p>
17.06	<p>The aerodrome operator must implement controls to mitigate wildlife hazard risks within the boundary of the aerodrome.</p>

Section	Requirement
17.07 (1)	<p>Wildlife hazard monitoring and reporting personnel must be trained to competently do the following:</p> <ul style="list-style-type: none"> a) conduct wildlife observations and identify high-risk species; b) assess wildlife populations and describe their behaviour; c) record information; d) collect any remains of a wildlife strike on the aerodrome; e) attempt to facilitate the identification of: <ul style="list-style-type: none"> (i) any wildlife involved in a strike event; and (ii) any resulting damage to an aircraft; f) report the outcomes of observation, monitoring and strike collection activities.
17.07 (2)	<p>Personnel engaged in wildlife hazard mitigation must be trained to competently:</p> <ul style="list-style-type: none"> a) engage in active wildlife management without causing a hazard to aviation safety; and b) assess the effectiveness of any mitigation measures that are taken.
17.07 (3)	<p>The aerodrome operator must create training records for its monitoring and reporting personnel to show compliance with Section 17.07 subsections (1) and (2). Each record must be kept in safe custody for a period of at least 3 years after the record was created.</p>

4. Case Studies

Several case studies of off-airport wildlife hazard assessments are detailed below.

CASE STUDY: Canberra Airport and the Healthy Waterways Project

The ACT Healthy Waterways Project aimed to protect and improve long-term water quality in the ACT by reducing the level of nutrients, sediment and pollutants entering waterways. It involved the construction of ponds, wetlands, rain gardens and swales, along with creek restoration and channel reconnection. There were a number of considerations to select sites, including safeguarding Canberra Airport against wildlife strikes. Proposed sites in the vicinity of the airport were evaluated to determine their potential contribution to the airport's strike risk. The sites were chosen based on the NASF requirement to assess wildlife hazards at wetlands within 8 km of airports. A risk assessment for each site was based on the wildlife species that present a strike risk at Canberra Airport (and associated habitat requirements and behavioural characteristics); aircraft movements (including flight paths and aircraft types); the proximity and juxtaposition of the sites; and the overall design and construction plan for the individual sites. The assessment was further informed by the wildlife surveys conducted at each site.

Some sites did not go ahead due to the high risk, but others proceeded with mitigation. The types of mitigation applied included:

- Installing interpretive signage and enforcement to prevent feeding of wildlife.
- Modifying wetlands to remove islands and perching structures.
- Removing rock clumps and felled trees from waterlines.
- Increasing shallow bank gradients.
- Increasing water levels to greater than 1m.
- Using rock gabions to increase water depth and eliminate shallow verges.
- Modifying landscaping to remove plant species that attract hazardous wildlife.
- Eliminating open water sections of wetlands to minimise the attraction for landing waterbirds.

Outcome: Overall objective of the project achieved with modifications to safeguard the airport.

CASE STUDY: Engaging with land users

The following case study has been anonymised due to ongoing and outstanding actions.

A Queensland airport has for some time shared a boundary with a family owned and operated farm that can attract significant numbers of hazardous wildlife including Australian White and Straw-necked Ibis, Magpie Geese and various duck species. The main attractants to these birds were the food provide to livestock (horse and cattle), and various waterbodies on the property. This elevated the strike risk at the airport, particularly when flocks transited through critical airspace en-route to or from the farm. In 2019, the airport and the farm operator prepared a Memorandum of Understanding on how to best monitor and manage the risks associated with the farm activities. This included an agreement for the land owner to attend the airport's bi-annual wildlife hazard committee meetings, maintain regular communication with the airport regarding hazardous wildlife on site, reduce bird access to food and allow the airport to complete regular wildlife counts. In addition, the airport agreed to provide recommendations to the farm operator regarding mitigation of wildlife hazards.

Outcome: Agreement in place to monitor and manage a known off-airport wildlife hazard.

CASE STUDY: Sydney Airport and the NASF

Sydney Airport recognised the need to review existing habitats in the vicinity of the airfield to determine the strike risk they contribute and to develop a standardised process for assessing land use activities. In the absence of administrative jurisdiction to approve or reject planning decisions outside of their land, the airport relies on cooperation from local government planning authorities.

Sydney Airport reviewed and simplified the NASF Guideline C Attachment 1 to specifically address proposed developments/changes to existing land uses around the airport. The review also identified gaps relating to certain activities that could increase the wildlife hazard. Specifically, these related to site works and landscaping activities. Professional expertise was sought to establish criteria for projects at 3, 8, and 13km that trigger the development of a management plan, monitoring requirements, and the project referred to the airport. Criteria included:

- project scale (i.e. site area)
- number of trees likely to grow over 10 metres

- area of excavation works
- size of introduced water bodies/water courses/drains.

Outcome: A straightforward assessment process in place to ensure all land use activities with the potential to attract wildlife close to the airport are evaluated.

CASE STUDY: Water retention close to an airport

The following case study has been anonymised due to ongoing and outstanding actions.

A site, situated less than 350 m from an airport's runway centreline, was modified in the 1980s to create a stormwater retention system, but sedimentation has since filled the basin. The local council plans to modify the creek system, including the retention basin, to facilitate drainage, mitigate flood risks, and restore effective stormwater detention basin. This will involve excavating and dredging in the existing catchment and remove natural sediment deposition onto on-site treatment pads. The excavation will create a 200,000m³ stormwater detention basin and remove 16,400m² of vegetation. The project site was identified as potentially attractive to birds and other wildlife, which would contribute to the airport's wildlife strike risk. Council planners noted the potential hazard in the development application:

“Editor’s note: A development proposal in the vicinity of a strategic airport that may increase risk of wildlife strike should be referred to the airport manager for assessment. A development proposal in the vicinity of a defence or joint-user airfield that may increase risk of wildlife strike should be referred to Department of Defence for assessment”.

“Where local government seek to approve 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 manager and qualified bird and wildlife management experts”.

In response the council commissioned a wildlife management expert to assess the potential for the project to increase the wildlife strike risk. The assessment identified the following:

- Without modifications to the design of the project, the council should consider if alternative locations are available to meet its stormwater management requirements.
- Regulations and guidance are clear that waterbodies in proximity to airfields should be prevented or eliminated.

- Increased aircraft movements at the airport (particularly of faster and larger aircraft) increases the probability of strikes even if the number of birds at retention basin remains stable.
- The majority of birds previously recorded at the retention basin are waders and waterbirds which present a significant strike risk because of their large body mass and tendency to move in flocks.
- The airport has a limited strike history with large and/or flocking species. In the event of an increase in strikes with these species, the development at the retention basin may be implicated.
- Construction is likely to attract hazardous species for at least 12 weeks.
- Once completed, the site is likely to attract hazardous bird species. The preferred water depth for hazardous bird species is nearly evenly split between deep and shallow water options.
- Modifications to the project design will reduce the attractiveness of the site; however, unless the basin is inaccessible to birds, the site will attract hazardous species and they are likely to transit critical aircraft flight paths.
- If council modify this environment, and the modifications increase the strike risk, it is likely that the council will be held responsible.

Outcome: pending.

CASE STUDY: Tamworth Airport and organic waste

Tamworth Regional Council proposed to develop an Organic Recycling Facility within 1km of Tamworth Regional Airport. Because the NASF identifies organic waste and putrescible waste facilities as a high wildlife attraction risk and are considered incompatible within 3km of an airport, an assessment was sought. The assessment of the proposed facility found that, due to the creation of potential food resources and thermal updrafts, it would almost certainly attract hazardous species, such as Black Kite (*Milvus migrans*), Common Starling, Feral Pigeon (*Columba livia domestica*), Australian White Ibis (*Threskiornis molucca*), Australian Raven, Australian Magpie (*Gymnorhina tibicen*) and others. In addition, ponds and drainage systems could attract waterbirds such as ducks and waders such as egrets and Australian White Ibis. For this reason, along with some other concerns including odour, the planning authority decided to establish the facility in a different location.

Outcome: Proposed site rejected. An alternate site, located >10km from the airport, is under consideration.

CASE STUDY: Landscape centre and nursery

The following case study has been anonymised due to ongoing and outstanding actions.

A development application was submitted for bulk landscape supplies, a garden centre, wholesale nursery, and a food and drink outlet. The site is located between 0.9 and 1.2km of a major regional airport's runway threshold, and the airport commissioned an evaluation of the potential contribution to the strike risk. The evaluation found that aircraft on a standard approach to the airport will travel over the site at approximately 270 feet AGL which has raised wildlife strike concerns because 74% of all strikes and 66% of strikes causing substantial damage occur at less than 500 feet (Dolbeer, 2006). Aircraft departing over the proposed land use, under normal operations, would expect to transit the site between 600 and 1000 feet AGL. For departing aircraft at this height, the probability of wildlife conflict over the development site is less than on approach. However, the departure corridor could be significantly compromised at these heights if the new development attracts pelicans, raptors or other soaring/thermallling species which use these levels. The evaluation strongly suggested a formal risk assessment and mitigation study because each of the proposed activities could attract wildlife, as follows:

- Bulk landscape supplies, depending on the type of materials could provide foraging opportunities and nesting materials for a variety of risk species including Australian White Ibis.
- Flowering species grown on or adjacent to the site could attract flying-foxes at certain times of the year.
- Watering equipment and/or uncovered water storage associated with maintaining nursery species may attract water birds.
- Food and drink outlets: If food access and waste management are not managed properly, the site will provide foraging opportunities for a variety of bird species including Australian White Ibis. In addition, food outlets may increase the local density of other scavenger species (insects and rodents) which may in turn attract raptors into the airspace.

The NASF identifies Plant Nursery and Outdoor Restaurant as low risk land uses within the vicinity of aerodromes. However, the NASF also requires that these areas should be monitored for their wildlife attraction. If hazards are identified through monitoring, a mitigation plan must be implemented to ensure the development does not increase the wildlife strike risk.

Outcome: Development did not proceed.

CASE STUDY: Flying-foxes at Cairns Airport

In March 2007, in cooperation with CSIRO and Avisure, Cairns Airport commenced a flying-fox monitoring and management project in response to the high risk presented by flying-foxes on, and in the vicinity, of the airport. The project aimed to:

- identify the flying-fox strike risk at Cairns Airport
- examine the dynamics of flying-fox camps located in the Cairns region over time
- define the resource attractants for flying-foxes within and outside Cairns Airport
- identify flying-fox and aircraft conflict in terms of height and time
- develop management options for reducing the risk of flying-fox strikes at Cairns airport.

Outcomes:

- An understanding of flying-fox risks in terms of time of day, time of year, altitudes, and in response to vegetation fruiting/flowering, allowing risk periods to be predictive.
- An identification of the local flying-fox camps contributing to the airport strike risk.
- The establishment of a flying-fox monitoring procedure.
- The use of the Automatic Terminal Information Service, NOTAMs, and bird watch condition reporting to communicate peak risks to airlines and air traffic control.
- The positive action by airlines in response to hazard warnings.
- During high risk dusk periods, the encouragement of airlines to undertake full length departures; delay take-off; carry extra fuel in case of delayed landing (i.e. 'go-arounds' until flying-foxes have completed dusk transits of the airport).

- The removal of known attractants from Cairns Airport land (airside and landside).
- The implementation of a standard procedure for reviewing plant species lists proposed for any landscaping works.
- Ongoing liaison with local authorities to remain informed of any changes to local flying-fox camps (i.e. camp abandonment or new camp establishment) via Queensland Parks and Wildlife Service representative at Cairns Airport Bird and Wildlife Committee meetings

CASE STUDY: Outdoor sport and recreation facility

The following case study has been anonymised due to ongoing and outstanding actions.

A Queensland developer started works on an outdoor sport and recreation facility situated adjacent to the approach of an airport's main runway. The site attracts wildlife that has the potential to increase the wildlife strike risk at the airport who, in response to the development, engaged specialists to assess the contribution to the airport's strike risk. The assessment found that due to the creation of wetland habitat and other food and resources the site is attracting hazardous species including waterbird and grassland species such as Magpie Goose, egrets, ibis and lapwings. Because of the site's proximity to the airport it is very likely species attracted to the area will conflict with aircraft.

The NASF and the Queensland State Planning Policy identifies wetlands as a high wildlife attraction risk and are considered incompatible within 3 km of an airport. This advice is supported in a number of other aviation guidance documents and is reflected in the local council's regional planning scheme. The airport initially identified this risk in correspondence to the proponent, which required the development to incorporate measures to reduce potential attraction to birds and bats and that supporting studies by suitably qualified experts should be prepared. The proponent's development application stated: *"Appropriate measures would be implemented to mitigate any potential impacts on the airport, such as dust, bird and bat strike, lighting and glare etc"*. The application by the proponent concluded *"the proposed development is not expected to have any impacts on the safety and efficiency of the airport"*. However, there is no evidence that the planning consultant or the proponent adequately addressed the issue to meet the airport's requirements. The development application approval from the council did not stipulate conditions for wildlife attraction as requested by the airport.

The assessment strongly recommended denying bird access to one major waterbody of the proposal and that a management plan is established to ensure the remaining uses at the site are managed to mitigate wildlife strike risks issues prior to any further development or use of the site.

Outcome: a management plan has been prepared and the major water body has been netted to exclude birds.

CASE STUDY: Gold Coast Airport and the Desalination Plant

Located on the boundary of Gold Coast Airport, the proponents of the Gold Coast Desalination Plant liaised with the airport regarding their proposed facility prior to construction in 2006 over concerns about how the facility may contribute to the airports strike risk. This was before the implementation of the NASF Guideline C but was considered under Queensland's State Planning Policy relating to wildlife hazards in the vicinity of airports. The previous wastewater treatment plant had established populations of hazardous species on site, such as Australian White Ibis, and there were also concerns over how these populations would respond to the removal of vegetation, excavation and construction and whether they would be displaced onto the airfield.

The desalination plant operator completed a study to identify potential hazards, recommend mitigation actions, provide an on-going monitoring program, and deliver wildlife hazard management training to plant staff. The key areas that required attention during the construction included excavation and earthworks, topsoil management, construction crew food waste, wastewater drainage, landscaping designs and building design. Following the initial review, to mitigate the potential risk to Gold Coast Airport, daily wildlife dispersal was done at the construction site, directing wildlife away from the site and the airport.

Outcome: The Desalination Plant was constructed on the designated site with a management plan and procedures in place to monitor, detect and manage wildlife hazards. Key to the success of the program is the relationship with the airport which includes communicating wildlife activity and changes to plant operations to the Aerodrome Reporting Officers, and involvement in the airport's quarterly Runway Safety Committee.



Figure 3. Construction of the Gold Coast Desalination Plant.



Figure 4. The completed desalination facility and Gold Coast Airport.

CASE STUDY: Managing Black-backed Gulls at Wellington Airport

Southern Black-backed Gulls are the highest risk species at Wellington Airport. Between 2013 and 2017 the airport reported 175 gull strikes, including a multiple strike incident involving up to 20 gulls that caused aircraft damage and delay. Managing these gulls is complex due to the way they use a range of off-airport locations, and the airport recognised the need to better understand their movements on and off the airfield. In response, the airport engaged specialists to assess gull movements in a 13km radius of the airfield, engage with stakeholders, and establish a Black-backed Gull management committee. Key to the assessment was a monitoring study that aimed to better understand gull attractants and how gulls moved between these sites. This included GPS tracking and colour marking at landfills in the vicinity of Wellington Airport. This improved understanding is helping the airport and the committee to implement on- and off-airport mitigation to reduce the gull strike rate.

Outcomes:

Wellington Airport and its stakeholders are implementing the following staged approach:

- Stage 1 – BBG Working Group and BBG Interim Management Plan.
- Stage 2 – BBG Movement Study. A monitoring study to improve the understanding of BBG movement patterns around Wellington Airport to help prevent bird strike.
- Stage 3 – Improved BBG risk mitigation. Review the Stage 1 Interim Management Plan and implement on and off-airport management measures, coordinated by the BBG Working Group.



Figure 5. Application of orange dye (photo © Ecosure).



Figure 6. Gulls marked with the orange dye (photo © Ecosure).

CASE STUDY: Irrigation system in New Zealand

The following case study has been anonymised due to ongoing and outstanding actions.

A local council proposes to develop a wastewater irrigation facility on the boundary of an airport in New Zealand. The area will also be used to harvest silage. Both irrigation and silage production can be attractive to birds; accordingly, the council engaged specialists to assess the bird strike risk of the proposed development.

The assessment noted that for the wastewater irrigation facility to proceed and meet the requirements of good risk management practice, the council would need to ensure that hazardous birds are not attracted to the site and there are no increased bird movements across aircraft flight paths, causing a greater risk to air traffic. The irrigation site was already highly attractive to birds under grazing to very short grass along with shelter belts and water ponding around the bog area. If mitigation was not applied, this attraction could be exacerbated by the introduction of nutrient rich treated wastewater, which will flush invertebrates to the surface and provide food for the birds. The production of silage was also considered a potential bird attraction, particularly during cutting, which exposes insects and other prey items to birds and encourages fresh grass shoots that species such as Canada Geese can graze on. The removal of shelter belts and the installation of denser shelter belts could inflate populations of birds such as Chaffinches and Starling which already use these habitats for roosting. In attracting more birds to the site, and because of its proximity to the airport, conflict with aircraft was likely during take-off, landing and in circuits. Of particular concern were flocking birds and/or large birds. The consequences of a significant strike resulting in a forced landing or crash are also increased due to the absence of rescue and firefighting services at the airport.

The assessment recommended that the proposal to irrigate wastewater and produce silage only proceed in the proposed location if a comprehensive management plan is developed that details the mitigation required to manage the risk and is backed by regular monitoring and evaluation. Mitigation at the site should include adopting a long grass policy, eliminating standing water, infilling existing depressions and dispersing roosting birds. If applied well, mitigation could significantly reduce the risk currently created by the site. It is critical that risks are regularly monitored and reviewed and, if necessary, corrective actions taken to ensure the risk is maintained to acceptable levels.

Outcome: Council adopted a comprehensive management plan incorporating the recommended mitigation measures and monitoring.

5. The NASF and the Western Sydney Aerotropolis

5.1. NASF Gap Analysis: Land Use Types around WSA

The NASF is a generic framework designed for land use planners to incorporate its principles into jurisdictional guidelines and planning frameworks. Table 12 summarises key areas of the NASF that have been adapted to develop the Aerotropolis Aviation Wildlife Safeguarding Framework (AAWSF) that aims to help safeguard WSA against wildlife strikes.

Table 12. NASF sections that have been adapted/added to create the AAWSF.

NASF element	Options for the AAWSF
<p>Difficult to embed the elements of the NASF into a planning framework. Planning frameworks require certainty for acceptable versus unacceptable practice. Wildlife strike management is based on risk, so each land use requires an understanding of the specific context of that location in relation to surrounding habitat features that cause wildlife to utilise the airspace that could be co-occupied in space and time, with aircraft. The risk presented by a land use may not only relate to the airspace above the land use, but also to the interaction of it as a habitat feature with other habitat features in the landscape, potentially causing wildlife to intersect aircraft flightpaths. A land use may also contribute to the productivity of wildlife populations, by for instance, providing an unnatural supply of food resource.</p>	<p>Establish land use planning requirements as part of the Western Sydney Aerotropolis planning framework.</p> <p>Within this framework, include methods for assessing risks relative to adjacent land uses and the airport.</p>

NASF element	Options for the AAWSF
<p>Local and state governments may be reluctant to adopt it into their planning frameworks as it is a guidance document and not bound by law. There are no penalties or implications for local, state and territory planning departments for not adopting the principles.</p>	<p>Inform government stakeholders on wildlife attraction issues and give the opportunity to provide feedback on how to integrate minimising wildlife attraction into the land use planning framework.</p> <p>Ensure local governments included as stakeholders in the Planning Partnership are engaged on this matter, provided relevant information, and given the opportunity to provide feedback.</p>
<p>Ambiguity around responsibility for assessments, action plans, management, monitoring, etc.</p>	<p>Clarify these roles and responsibilities as part of the Aerotropolis planning and guidance documentation.</p>
<p>The use of the Aerodrome Reference Point (ARP) as the point from which to measure the 3km, 8km and 13km buffers is inadequate. The location of the ARP may mean the 3km buffer barely extends beyond the airport's perimeter fence.</p>	<p>Establish buffers based on distance from runway strips.</p>
<p>Insufficient, or ambiguous, land use types. The generic nature of the NASF means that the available options do not account for all possible land use types or relate to terminology used in each jurisdiction.</p>	<p>Elaborate on land use types to account for all (or as close to as possible) likely land uses throughout the Western Sydney Aerotropolis and ensure terminology used is consistent with standard instrument definitions.</p> <p>Remove the ambiguity for some land use types.</p>

5.1.1. Proposed changes to the NASF for the AAWSF

Table 13 presents a modified version of the NASF that addresses some of the items noted in Table 12. Changes focus on developing a more comprehensive list of land use categories and types, and sub-dividing the 3km and 8km wildlife buffers (Figure 8). Subdividing the wildlife buffers aims to reduce the number of wildlife infringing critical aircraft airspace by restricting land use activities on the north-west side of the airport. Restrictions in these areas does not necessarily mean rejecting development applications but will require land users to apply more stringent mitigation. The rationale to subdivide the wildlife buffers aims to reduce the movement of birds across the airfield (i.e. north west to south east and vice versa). Of particular concern are birds regularly transiting through critical airspace and aircraft manoeuvring areas. By restricting attractants on the north west side, wildlife may focus their activity in the south east area. This would reduce the strike risk (by minimising movements over the airfield) even if there are multiple sites that attract wildlife on the south east side that they use interchangeably.

All land uses whose actions are listed as ‘mitigate’ or ‘conditional’¹¹ in Table 13, should be assessed using the approach detailed in Section 7 to determine suitability. All land uses whose actions are listed as ‘incompatible’ should not proceed.

Appendix A lists the specific changes made from the original NASF.

¹¹ Conditional’ means that it may be acceptable depending on the nature of the land use, it’s location relative to WSA and other off-airport wildlife hazards, wildlife mitigation applied, particular design/operational features that exclude or deter wildlife.

Table 13. Aerotropolis Aviation Wildlife Safeguarding Framework (modified from the NASF for the Western Sydney Aerotropolis).

Land Use ¹²	Standard Instrument Definition	Wildlife Attraction Risk	Western Sydney Aerotropolis: Actions for Existing Developments					Western Sydney Aerotropolis: Actions for Proposed Developments / Changes to Existing Developments				
			3 km radius (Area A)	3 km radius (Area A)	8 km radius (Area B)	8 km radius (Area B)	13 km radius (Area C)	3 km radius (Area A)	3 km radius (Area A)	8 km radius (Area B)	8 km radius (Area B)	13 km radius (Area C)
			Sub-area A1	Sub-area A2	Sub-area B1	Sub-area B2		Sub-area A1	Sub-area A2	Sub-area B1	Sub-area B2	
Agriculture												
Abattoir	Livestock processing industry	Very High	Mitigate	Mitigate	Mitigate	Mitigate	Mitigate	Incompatible	Incompatible	Mitigate	Mitigate	Mitigate
Turf farm	Intensive plant agriculture	Very High	Mitigate	Mitigate	Mitigate	Monitor	Monitor	Incompatible	Incompatible	Mitigate	Monitor	Monitor
Piggery	Intensive livestock agriculture	High	Mitigate	Mitigate	Mitigate	Monitor	Monitor	Conditional	Mitigate	Mitigate	Monitor	Monitor
Orchard	Intensive plant agriculture	High	Mitigate	Mitigate	Mitigate	Monitor	Monitor	Conditional	Mitigate	Mitigate	Monitor	Monitor
Fish processing /packing plant	Livestock processing industry	High	Mitigate	Mitigate	Mitigate	Monitor	Monitor	Conditional	Mitigate	Mitigate	Monitor	Monitor
Aquaculture	Aquaculture	High	Mitigate	Mitigate	Mitigate	Monitor	Monitor	Conditional	Mitigate	Mitigate	Monitor	Monitor
Farm dam	Water storage facility	High	Mitigate	Mitigate	Mitigate	Monitor	Monitor	Conditional	Mitigate	Mitigate	Monitor	Monitor
Crops (e.g. wheat, grains, rice, legumes)	Agriculture	High	Mitigate	Mitigate	Mitigate	Monitor	Monitor	Conditional	Mitigate	Mitigate	Monitor	Monitor
Grain storage	Storage Premises (or ancillary)	High	Mitigate	Mitigate	Mitigate	Monitor	Monitor	Conditional	Mitigate	Mitigate	Monitor	Monitor
Cattle /dairy farm	Intensive livestock agriculture	Moderate	Mitigate	Monitor	Monitor	Monitor	Monitor	Mitigate	Mitigate	Mitigate	Monitor	Monitor
Poultry farm	Intensive livestock agriculture	Moderate	Mitigate	Monitor	Monitor	Monitor	Monitor	Mitigate	Mitigate	Mitigate	Monitor	Monitor
Plant nursery	Plant nursery	Moderate	Mitigate	Monitor	Monitor	Monitor	Monitor	Mitigate	Mitigate	Mitigate	Monitor	Monitor
Viticulture	Viticulture	Moderate	Mitigate	Monitor	Monitor	Monitor	Monitor	Mitigate	Mitigate	Mitigate	Monitor	Monitor
Market farms and gardens	Garden Centre	Moderate	Mitigate	Monitor	Monitor	Monitor	Monitor	Mitigate	Mitigate	Mitigate	Monitor	Monitor
Forestry	Forestry	Low	Monitor	Monitor	Monitor	No Action	No Action	Mitigate	Monitor	Mitigate	No Action	No Action
Horticulture	Horticulture	Low	Monitor	Monitor	Monitor	No Action	No Action	Mitigate	Monitor	Mitigate	No Action	No Action
Conservation and Natural Areas												
Wildlife sanctuary - wetland	Environmental protection works	High	Mitigate	Mitigate	Mitigate	Monitor	Monitor	Conditional	Mitigate	Mitigate	Monitor	Monitor
Conservation area - wetland	Environmental protection works	High	Mitigate	Mitigate	Mitigate	Monitor	Monitor	Conditional	Mitigate	Mitigate	Monitor	Monitor
Wildlife breeding/roosting	Environmental protection works	High	Mitigate	Mitigate	Mitigate	Monitor	Monitor	Conditional	Mitigate	Mitigate	Monitor	Monitor
Flying-fox camp	N/A – dependent on geographical context of camp	High	Mitigate	Mitigate	Mitigate	Monitor	Monitor	Conditional	Mitigate	Mitigate	Monitor	Monitor
Wetland	Wetland	High	Mitigate	Mitigate	Mitigate	Monitor	Monitor	Conditional	Mitigate	Mitigate	Monitor	Monitor
Wildlife sanctuary - dryland	Environmental protection works	Moderate	Mitigate	Monitor	Monitor	Monitor	Monitor	Mitigate	Mitigate	Mitigate	Monitor	Monitor
Conservation area - dryland	Environmental protection works	Moderate	Mitigate	Monitor	Monitor	Monitor	Monitor	Mitigate	Mitigate	Mitigate	Monitor	Monitor
Waterway (e.g. creeks, rivers)	Waterway	Moderate	Mitigate	Monitor	Monitor	Monitor	Monitor	Mitigate	Mitigate	Mitigate	Monitor	Monitor
Natural areas	Environmental facility or environmental protection works	Low	Monitor	Monitor	Monitor	No Action	No Action	Mitigate	Monitor	Mitigate	No Action	No Action
Recreation												
Showground	Recreation facility (outdoor) or (major)	High	Mitigate	Mitigate	Mitigate	Monitor	Monitor	Conditional	Mitigate	Mitigate	Monitor	Monitor
Fish cleaning facilities	N/A	High	Mitigate	Mitigate	Mitigate	Monitor	Monitor	Conditional	Mitigate	Mitigate	Monitor	Monitor
Public feeding of wildlife	N/A	High	Mitigate	Mitigate	Mitigate	Monitor	Monitor	Conditional	Mitigate	Mitigate	Monitor	Monitor

¹² Refer to Glossary for Standard Instrument definitions of land use types.

Land Use ¹²	Standard Instrument Definition	Wildlife Attraction Risk	Western Sydney Aerotropolis: Actions for Existing Developments					Western Sydney Aerotropolis: Actions for Proposed Developments / Changes to Existing Developments				
			3 km radius (Area A)	3 km radius (Area A)	8 km radius (Area B)	8 km radius (Area B)	13 km radius (Area C)	3 km radius (Area A)	3 km radius (Area A)	8 km radius (Area B)	8 km radius (Area B)	13 km radius (Area C)
			Sub-area A1	Sub-area A2	Sub-area B1	Sub-area B2	(Area C)	Sub-area A1	Sub-area A2	Sub-area B1	Sub-area B2	(Area C)
Urban open space (e.g. cycleways, green areas, pedestrian walkways)	Recreational area	Moderate	Mitigate	Monitor	Monitor	Monitor	Monitor	Mitigate	Mitigate	Mitigate	Monitor	Monitor
Racetrack / horse riding school	Recreation facility (outdoor)	Moderate	Mitigate	Monitor	Monitor	Monitor	Monitor	Mitigate	Mitigate	Mitigate	Monitor	Monitor
Golf course	Recreation facility (outdoor)	Moderate	Mitigate	Monitor	Mitigate	Monitor	Monitor	Mitigate	Monitor	Mitigate	Monitor	Monitor
Sports facility (tennis, bowls, etc)	Recreation facility (outdoor)	Moderate	Mitigate	Monitor	Mitigate	Monitor	Monitor	Mitigate	Monitor	Mitigate	Monitor	Monitor
Sports fields	Recreation area	Moderate	Mitigate	Monitor	Mitigate	Monitor	Monitor	Mitigate	Monitor	Mitigate	Monitor	Monitor
Park / Playground	Recreation area	Moderate	Mitigate	Monitor	Mitigate	Monitor	Monitor	Mitigate	Monitor	Mitigate	Monitor	Monitor
Picnic / camping ground	Camping ground	Moderate	Mitigate	Monitor	Mitigate	Monitor	Monitor	Mitigate	Monitor	Mitigate	Monitor	Monitor
Water sport facilities	Recreational facility (outdoor)	Moderate	Mitigate	Monitor	Mitigate	Monitor	Monitor	Mitigate	Monitor	Mitigate	Monitor	Monitor
Boat ramps	Boat ramp	Low	Monitor	Monitor	Monitor	No Action	No Action	Mitigate	Monitor	Mitigate	No Action	No Action
Recreational fishing areas	N/A	Low	Monitor	Monitor	Monitor	No Action	No Action	Mitigate	Monitor	Mitigate	No Action	No Action
Commercial												
Food processing	Agricultural produce industry or Livestock processing industry	High	Mitigate	Mitigate	Mitigate	Monitor	Monitor	Conditional	Mitigate	Mitigate	Monitor	Monitor
Fast food / drive-in / outdoor restaurant	Food and drink premises	High	Mitigate	Mitigate	Mitigate	Monitor	Monitor	Conditional	Mitigate	Mitigate	Monitor	Monitor
Earthworks	N/A - only during construction of other uses	Moderate	Mitigate	Monitor	Mitigate	Monitor	Monitor	Mitigate	Monitor	Mitigate	Monitor	Monitor
Warehouse (food storage)	Warehouse and distribution centre	Low	Monitor	Monitor	Monitor	No Action	No Action	Mitigate	Monitor	Mitigate	No Action	No Action
Shopping centre	Retail premises	Low	Monitor	Monitor	Monitor	No Action	No Action	Mitigate	Monitor	Mitigate	No Action	No Action
Marina	Marina	Low	Monitor	Monitor	Monitor	No Action	No Action	Mitigate	Monitor	Mitigate	No Action	No Action
Zoo	Animal boarding or training establishment	Low	Monitor	Monitor	Monitor	No Action	No Action	Mitigate	Monitor	Mitigate	No Action	No Action
Markets	Market	Low	Monitor	Monitor	Monitor	No Action	No Action	Mitigate	Monitor	Mitigate	No Action	No Action
Construction	N/A - only as ancillary to other purposes	Low	Monitor	Monitor	Monitor	No Action	No Action	Mitigate	Monitor	Mitigate	No Action	No Action
Office building	Office premises	Very Low	Monitor	No Action	No Action	No Action	No Action	Monitor	No Action	No Action	No Action	No Action
Hotel / motel	Hotel / motel	Very Low	Monitor	No Action	No Action	No Action	No Action	Monitor	No Action	No Action	No Action	No Action
Car park	Car park	Very Low	Monitor	No Action	No Action	No Action	No Action	Monitor	No Action	No Action	No Action	No Action
Cinemas	Entertainment facilities	Very Low	Monitor	No Action	No Action	No Action	No Action	Monitor	No Action	No Action	No Action	No Action
Warehouse (non-food storage)	Warehouse and distribution centre or Storage premises	Very Low	Monitor	No Action	No Action	No Action	No Action	Monitor	No Action	No Action	No Action	No Action
Petrol station	Service station	Very Low	Monitor	No Action	No Action	No Action	No Action	Monitor	No Action	No Action	No Action	No Action
Public transport facility	N/A	Very Low	Monitor	No Action	No Action	No Action	No Action	Monitor	No Action	No Action	No Action	No Action
Aerospace industry	N/A	Very Low	Monitor	No Action	No Action	No Action	No Action	Monitor	No Action	No Action	No Action	No Action
School/university	Educational establishment	Very Low	Monitor	No Action	No Action	No Action	No Action	Monitor	No Action	No Action	No Action	No Action
Utilities												
Organic waste facility - open	Waste or resource management facility	Very High	Mitigate	Mitigate	Mitigate	Mitigate	Mitigate	Incompatible	Incompatible	Mitigate	Mitigate	Mitigate
Putrescible waste facility - landfill - open	Waste disposal facility	Very High	Mitigate	Mitigate	Mitigate	Mitigate	Mitigate	Incompatible	Incompatible	Mitigate	Mitigate	Mitigate
Putrescible waste facility - transfer station - open	Waste or resource transfer station	Very High	Mitigate	Mitigate	Mitigate	Monitor	Monitor	Incompatible	Incompatible	Mitigate	Monitor	Monitor
Sewage / wastewater treatment facility	Sewage treatment plant	High	Mitigate	Mitigate	Mitigate	Mitigate	Mitigate	Conditional	Conditional	Mitigate	Mitigate	Mitigate
Water retention basins	Water storage facility	High	Mitigate	Mitigate	Mitigate	Monitor	Monitor	Conditional	Mitigate	Mitigate	Monitor	Monitor

Land Use ¹²	Standard Instrument Definition	Wildlife Attraction Risk	Western Sydney Aerotropolis: Actions for Existing Developments					Western Sydney Aerotropolis: Actions for Proposed Developments / Changes to Existing Developments				
			3 km radius (Area A)	3 km radius (Area A)	8 km radius (Area B)	8 km radius (Area B)	13 km radius (Area C)	3 km radius (Area A)	3 km radius (Area A)	8 km radius (Area B)	8 km radius (Area B)	13 km radius (Area C)
			Sub-area A1	Sub-area A2	Sub-area B1	Sub-area B2		Sub-area A1	Sub-area A2	Sub-area B1	Sub-area B2	
Waste collection points (commercial)	N/A	High	Mitigate	Mitigate	Mitigate	Monitor	Monitor	Conditional	Mitigate	Mitigate	Monitor	Monitor
Organic waste facility - enclosed	Waste or resource management facility	Moderate	Mitigate	Monitor	Mitigate	Monitor	Monitor	Mitigate	Monitor	Mitigate	Monitor	Monitor
Putrescible waste facility - landfill - enclosed	Waste disposal facility	Moderate	Mitigate	Monitor	Mitigate	Monitor	Monitor	Mitigate	Monitor	Mitigate	Monitor	Monitor
Putrescible waste facility - transfer station - enclosed	Waste or resource transfer station	Moderate	Mitigate	Monitor	Mitigate	Monitor	Monitor	Mitigate	Monitor	Mitigate	Monitor	Monitor
Non-putrescible waste facility - landfill	Waste disposal facility	Moderate	Mitigate	Monitor	Mitigate	Monitor	Monitor	Mitigate	Monitor	Mitigate	Monitor	Monitor
Dams	Water storage facility	Moderate	Mitigate	Monitor	Mitigate	Monitor	Monitor	Mitigate	Monitor	Mitigate	Monitor	Monitor
Stormwater drains	Water storage facility	Moderate	Mitigate	Monitor	Mitigate	Monitor	Monitor	Mitigate	Monitor	Mitigate	Monitor	Monitor
Non-putrescible waste facility - transfer station	Waste or resource transfer station	Low	Monitor	Monitor	Monitor	No Action	No Action	Mitigate	Monitor	Mitigate	No Action	No Action
Potable water treatment facility	Resource recovery facility	Low	Monitor	Monitor	Monitor	No Action	No Action	Mitigate	Monitor	Mitigate	No Action	No Action
Stormwater management facilities	Water storage facility	Low	Monitor	Monitor	Monitor	No Action	No Action	Mitigate	Monitor	Mitigate	No Action	No Action
Landscaping and Vegetation												
Landscaping: parks and gardens	Recreation area	Moderate	Mitigate	Monitor	Mitigate	Monitor	Monitor	Mitigate	Monitor	Mitigate	Monitor	Monitor
Landscaping: natural area revegetation	Environmental protection works	Moderate	Mitigate	Monitor	Mitigate	Monitor	Monitor	Mitigate	Monitor	Mitigate	Monitor	Monitor
Landscaping: streets and transport corridors	Road	Moderate	Mitigate	Monitor	Mitigate	Monitor	Monitor	Mitigate	Monitor	Mitigate	Monitor	Monitor
Landscaping: roads and motorways	Road	Moderate	Mitigate	Monitor	Mitigate	Monitor	Monitor	Mitigate	Monitor	Mitigate	Monitor	Monitor
Landscaping: rooftop gardens	N/A	Moderate	Mitigate	Monitor	Mitigate	Monitor	Monitor	Mitigate	Monitor	Mitigate	Monitor	Monitor

6. Western Sydney Aerotropolis Planning Framework

The principles of the AAWSF and assessing wildlife hazards will apply to all land use types as part of the Western Sydney Aerotropolis regardless of precinct. This also applies to performance outcomes, unless stated otherwise.

Table 14 identifies how wildlife hazard assessment may be/has been incorporated into the documents for the Western Sydney Aerotropolis planning framework.

Table 14. Incorporating wildlife hazard mitigation into Aerotropolis planning documentation.

Document	Incorporating wildlife hazard management
Western Sydney Aerotropolis Plan	Wildlife considerations incorporated into section 5 of the WSAP (Safeguarding the 24-hour airport) including mapping of the wildlife buffer zones.
Western Sydney Aerotropolis SEPP	Master plans and relevant development applications will be identified for referral to WSA and the relevant Commonwealth body. Wildlife hazard management will inform permissibility of uses.
Precinct Plans	Wildlife hazard management will inform the location of preferred land uses, public domain and landscape outcomes, whilst balancing the achievement of the parkland vision.
Master Plans	Wildlife hazard management will inform the location of preferred land uses, public domain and landscape outcomes, whilst balancing the achievement of the parkland vision.
Western Sydney Aerotropolis Development Control Plan	Relevant objectives, performance outcomes and acceptable solutions will be identified.
Mamre Road Precinct Development Control Plan	Relevant objectives, performance outcomes and acceptable solutions will be identified.
Western Sydney Employment Area SEPP	Master plans and relevant development applications will be identified for referral to WSA and the relevant Commonwealth body. Wildlife hazard management will inform permissibility of uses.

7. Risk Minimisation and Management

7.1. Aviation Safeguarding (Wildlife)

7.1.1. Objectives

- a) Safeguard the future operations of the Airport, including 24-hour operations and provide appropriate protections for the surrounding community.
- b) Ensure compatible development that exhibits design excellence occurs on surrounding land.

7.1.2. Acceptable solutions for land uses and wildlife hazards

Table 15 lists wildlife hazard acceptable solutions (AS) for inclusion in the draft Western Sydney Aerotropolis DCP – Phase 2. The AS proposed aligns with the relevant the Performance Outcome (PO) described in the DCP Phase 1 (PO11 Development does not cause wildlife to create a safety hazard in the operational airspace of the airport). It is noted that the AS relating to landscaping will be further refined via upcoming workshops that will aim to develop a comprehensive species palette and planting guidelines that help safeguard the airport against wildlife hazards whilst achieving the Aerotropolis and Western City Parklands vision.

Performance Outcomes		Acceptable Solutions	
PO11	Development does not cause wildlife to create a safety hazard in the operational airspace of the airport	Requirements for Specified Use	
		AS01	<p>Applications for the following uses within the 3 and 8 km wildlife buffers must be accompanied with a wildlife hazard assessment and wildlife management plan that incorporates relevant mitigation and monitoring measures:</p> <ul style="list-style-type: none"> • Agricultural produce industry • Agriculture • Aquaculture • Camping ground • Garden Centre • Intensive livestock agriculture • Intensive plant agriculture • Livestock processing industry* • Plant nursery • Recreation facility (outdoor) • Recreation facility (major) • Recreational area • Sewage treatment plant

Table 15. Acceptable solutions to help safeguard WSA against wildlife strike risks.

Performance Outcomes		Acceptable Solutions	
			<ul style="list-style-type: none"> • Waste or resource management facility* • Waste or resource transfer station* • Water storage facility <p><i>Note - * Within 3km Livestock processing industry, Waste or resource management facilities and transfer stations that include any external storage, processing or handling are prohibited.</i></p>
		AS02	<p>Applications for the following uses within the 13 km wildlife buffer must be accompanied with a wildlife hazard assessment and wildlife management plan that incorporates relevant mitigation and monitoring measures:</p> <ul style="list-style-type: none"> • Livestock processing industry* • Waste or resource management facility* • Waste disposal facility* • Sewage treatment plant <p><i>Note - * Within 3km Livestock processing industry, Waste or resource management facilities and transfer stations that include any external storage, processing or handling are prohibited.</i></p>
		AS03	<p>Wildlife hazard assessment reports must assess the wildlife attraction risk of the land use, the design of the building and ancillary works including proposed landscaping, water facilities (incl. stormwater infrastructure), waste management, and temporary risks associated construction activity.</p>
		AS04	<p>Where monitoring is required to be undertaken in accordance with the Wildlife Management Plan, copies of the report are to be submitted to the airport lessee company within 28 days of completion.</p>

Performance Outcomes		Acceptable Solutions	
		AS05	The Wildlife Management Plan must respond to the findings and recommendations of the wildlife hazard assessment.
		AS06	<p>A waste management plan for the operation of the use must be submitted for the following uses within the 3, 8 and 13km buffer:</p> <ul style="list-style-type: none"> • Agriculture • Agricultural produce industry • Aquaculture • Camping Grounds • Eco-tourist facility • Food and Drink Premises • Garden Centre • Hotel • Intensive plant agriculture • Intensive livestock agriculture • Kiosk • Livestock processing industry* • Plant Nursery • Recreation facility (outdoor) • Recreation facility (major) <p><i>Note - * Within 3km Livestock processing industry, Waste or resource management facilities and transfer stations that include any external storage, processing or handling are prohibited.</i></p>

Performance Outcomes		Acceptable Solutions	
		Requirements for all Land Uses Within 3km, 8km and 13km Wildlife Buffers	
		AS07	<ul style="list-style-type: none"> All waste bins are to be designed and installed with fixed lids, and Any bulk waste receptacle or communal waste storage area must be contained within enclosures that cannot be accessed by birds or flying foxes.
		AS08	Landscaping within the Enterprise Zone and Agribusiness Zone must comply with the Landscape Design Guidelines dated May 2020 in Appendix (B), except where the property is subject to biodiversity certification conditions or identified as one of the key government commitments (Table 1).
		AS09	Any stormwater detention within the 3km and 8km wildlife buffer is to be designed to fully drain within 48 hours after a rainfall event.

7.1.3. Wildlife Hazard Assessment

Assessment relies on the actions identified for each land use type in the AAWSF (i.e. no action, monitor, mitigate, conditional, incompatible), Table 13. Figure 7 describes the proposed assessment process.

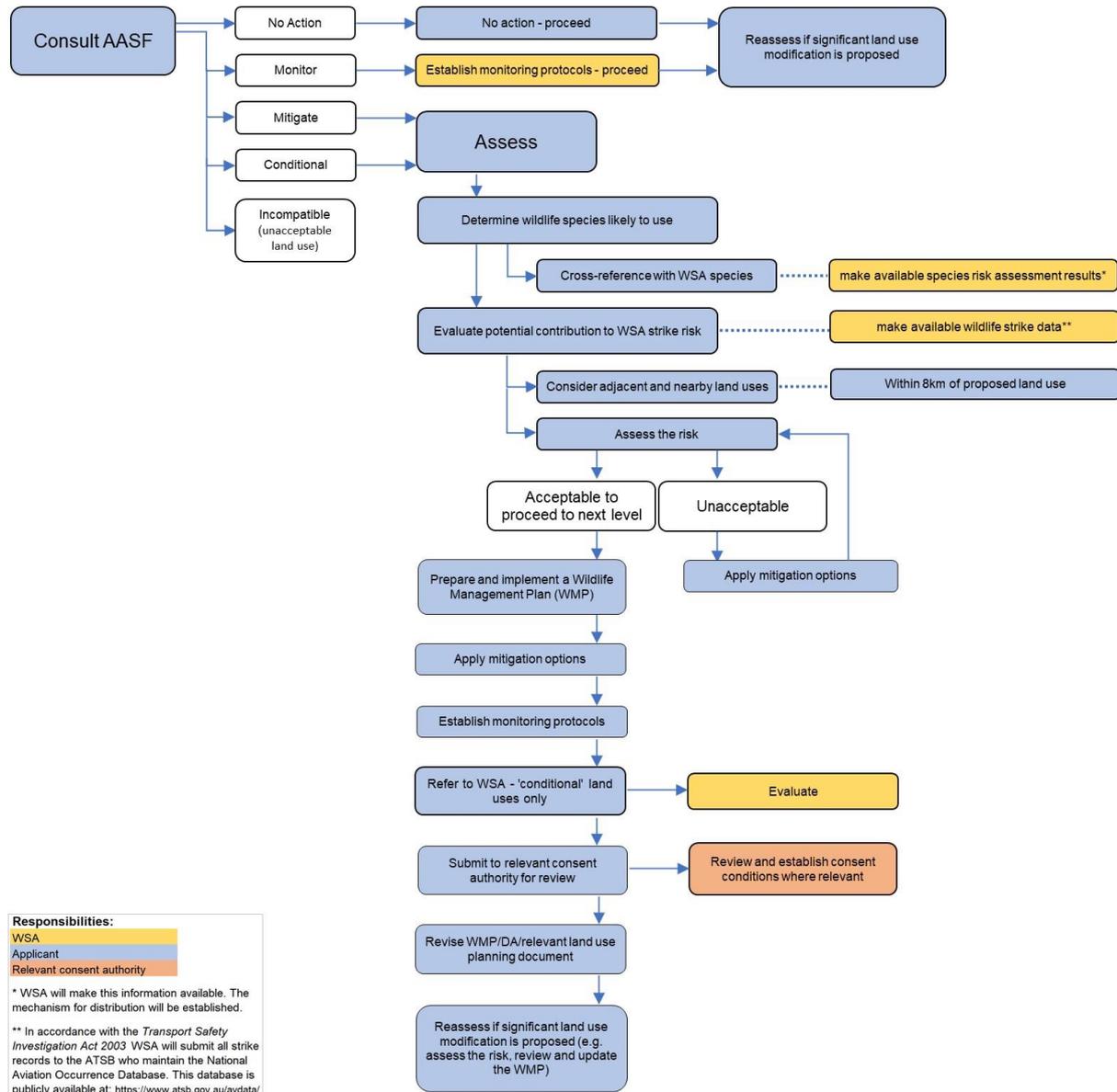


Figure 3. Western Sydney Aerotropolis wildlife hazard assessment process.

7.1.4. Evaluation Criteria

Determine potential species use

This should be guided by wildlife species known to occur in the area. This information may be derived from:

- NSW BioNet¹³
- Atlas of Living Australia¹⁴
- Atlas of Australian Birds/BirdData¹⁵
- existing studies (e.g. EIS)
- the results of targeted on-site wildlife surveys.
- expert knowledge

The assessor should consider the type of attractants supported by the development (e.g. access to water bodies or foraging opportunities).

Cross reference potential risks against WSA risks

Once potential species are determined, the assessor should cross-reference with the most current wildlife risk assessment results completed by WSA for their on-airport risks. WSA will provide updated species risks.

Evaluate the likelihood contribution to the strike risk

1. Assess the likely attraction of the site to wildlife. Consider species composition, numbers, flocking nature, size, behaviour.
2. Consider the presence of other wildlife attractants within 8km of the proposed land use and likely movement of wildlife between. Evaluate possible incursion into aircraft flight paths.
3. Assess risk based on above.

Assess the risk

Complete a robust risk assessment.

¹³ www.bionet.nsw.gov.au/

¹⁴ www.ala.org.au/

¹⁵ www.birdlife.org.au/conservation/science/data-extraction-services

Apply mitigation options

Table 17 recommends mitigation options and management guidance for consideration.

Establish monitoring protocols

Establish a regular monitoring program that:

- Monitors the presence and behaviour of wildlife.
- Monitors for evidence of wildlife shelter/nesting provided by infrastructure (e.g. buildings, equipment) and/or vegetation.
- Identifies attractants (e.g. water, food).
- Monitors the effectiveness of wildlife mitigation equipment, techniques, designs etc.

Monitoring should be standardised to identify trends and emerging risks over time. Monitoring frequency should be congruent with the hazard level.

Note - WSA should monitor off-airport land uses where the action in accordance with the AAWSF is 'monitor'. The land user is responsible for monitoring, where required, for land uses where the action in accordance with the AAWSF is 'mitigate' or 'conditional'.

Prepare and implement Wildlife Management Plan (WMP)

For land uses assessed as having a moderate or greater risk before mitigation is applied, a WMP should be developed that include:

- regular monitoring surveys (see above *Establish monitoring protocols*)
- wildlife hazard assessments by qualified ornithologists or biologists
- wildlife awareness and management training for relevant staff
- establishment of wildlife population triggers
- implementation of activities to reduce hazardous wildlife populations; and
- adoption of wildlife deterrent technologies to reduce hazardous wildlife populations
- performance indicators to evaluate implementation and compliance to consent conditions

- a review process to regularly assess implementation against performance indicators, identify gaps, and ensure currency
- allocation of roles and responsibilities for plan implementation and review.

7.1.5. Demonstrating compliance

Development consent may establish conditions for compliance, which may include monitoring, specific management requirements, wildlife management or action plans, and/or reporting.

7.1.6. Assessor requirements

For the development of an airport’s Wildlife Hazard Management Plan CASA require, as per Section 17.04(1) of the MOS, the airport to consult with a suitably qualified or experienced person, for example an ornithologist, zoologist, biologist, ecologist; or a person with demonstrated expertise in the management of wildlife hazards.

Wildlife strike risk assessors for developments in the vicinity of WSA and those responsible for developing a Wildlife Management Plan should align with CASA requirements (Table 16).

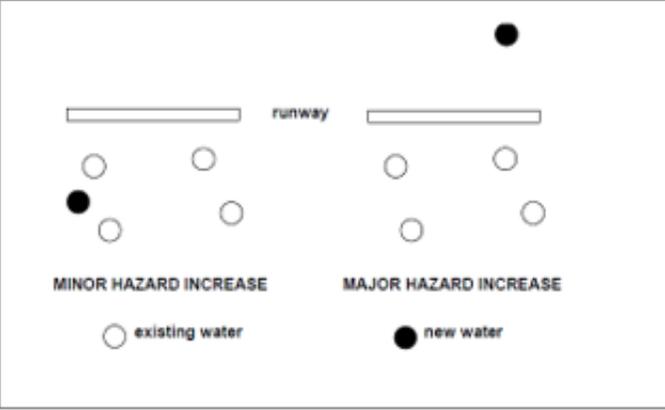
Table 16. Requirements for personnel completing wildlife hazard assessments.

Wildlife Assessor Requirements for Western Sydney Aerotropolis Land Uses	
Qualifications	Degree in ornithology, zoology, biology, ecology, or aviation ecology.
Experience	At least 2 year’s demonstrated experience in managing wildlife hazards on and around aerodromes, including assessments of off-airport land uses.

7.1.7. Mitigation

The recommendations and mitigation options listed in Table 17 are based on principles and concepts that have been applied worldwide to help safeguard airports against the risk of wildlife strikes. It is acknowledged that not all the recommendations listed here are feasible in every situation, however it is strongly recommended that they are applied, to some extent, wherever possible and where required to meet acceptable risk outcomes. The types of mitigation applied will vary depending on the land use type, the nature and extent of the hazard, and the location of the hazard relative to the airport, aircraft flight paths and other nearby hazards. Monitoring underpins all wildlife hazard mitigation and airport safeguarding. Robust standardised monitoring programs that regularly collect meaningful data will inform decisions relating to wildlife management programs, identify emerging risks, and determine wildlife activity trends over time.

Table 17. Mitigation options and management recommendations for wildlife hazards in the Western Sydney Aerotropolis.

Area of Mitigation	Recommendation / mitigation option	
Landscaping	Refer Appendix B	
Water	<p>Consider the impacts of potentially conflicting airspace between birds and aircraft when introducing a new waterbody in relation to the runway (see image. Source: UK, CAA CAP 680).</p>	

Area of Mitigation	Recommendation / mitigation option
	<p>Detention¹⁶ areas should fully drain within 48 hours.</p>
	<p>The continuous water surface area of retention basins should not exceed 100m². Wildlife hazard assessments should consider this within the context of distance from the airport and location relative to other off-airport hazards. If the surface area exceeds 100m², consider exclusion options (see below) or installing structures to break the continuity of the surface area (note – care must be taken to ensure these structures do not provide opportunities for birds to perch or roost. This may be considered at the design stage or retrospectively fitted with devices such as anti-perching spikes).</p>
	<p>Net retention basins (or other permanent water) if surface area exceeds 100m². Wildlife hazard assessments should consider this within the context of distance from the airport and location relative to other off-airport hazards.</p> <div style="display: flex; justify-content: space-around;">   </div>
	<p>Cover retention basins and other permanent water sources with exclusion devices (see examples below).</p>

¹⁶ Detention areas are considered those facilities that only store water for temporary period, as opposed to retention areas that permanently store water.

Area of Mitigation	Recommendation / mitigation option	
		
		

17 Shade balls (source: <https://commons.wikimedia.org/wiki/User:Junkyardsparkle>)

18 Flagged wires over drainage channel. Photo source: Andy Baxter

19 Floating/permeable cover (source: www.ieccovers.com)

Area of Mitigation	Recommendation / mitigation option
	<p>Water depth between 0.5m and 1.18m is less likely to attract hazardous flocking bird such as pelicans, swans, and cormorants; or upending ducks such as Pacific Black Ducks; or wading birds such as ibis and egrets. Wildlife hazard assessments should consider this within the context of distance from the airport and location relative to other off-airport hazards.</p>
	<p>Bank slopes for retention and detention areas and stormwater drains should not exceed 4V:1H. Narrow-sided retention and detention ponds are very effective at deterring birds from accessing water from the banks. Use of gabion or other edging treatment (see images below) can assist with maintaining steep banks and minimising erosion.</p> <div style="display: flex; justify-content: space-around;">   </div>
	<p><i>Note: in areas where public safety may be compromised with the use of steep-sided banks, consider installing walkways or platforms over the banks (these should adhere to all relevant safety requirements).</i></p> <div style="display: flex; justify-content: space-around;">   </div> <p style="text-align: center;"><small>source: WSAP 2019</small></p>

Area of Mitigation	Recommendation / mitigation option
	<p>Grass swales with longer grass (maintained at between 200 and 400mm) may reduce the wildlife attraction however monitoring should check for rodents, reptiles and small mammals who may use the longer vegetation as a refuge. Their presence can attract birds, particularly birds of prey who can present a serious strike risk (e.g. Black Kite).</p> <p>Breaking up large areas of surface water can help deter some water birds from landing on them (e.g. ducks, swans, pelicans). Islands, however, should be avoided.</p> <p>Drains and culverts can provide an ideal nesting habitat for species such as Fairy Martins and Welcome Swallows. Drains should be completely circular, free of 90° angles, including at the central join. This will prevent stable foundations for nest building. To limit access by birds drains, including circular drains, can be fitted with exclusion devices to prevent access for birds and vertebrate pests.</p> <p>Use underground drains and water storage where possible to reduce the availability of water to wildlife.</p> <p>Use rain gardens where possible to reduce the availability of water to wildlife.</p>
Built environment	<p>Ensure waste collection is at a suitable frequency to ensure public bins do not overflow.</p> 

Area of Mitigation	Recommendation / mitigation option
	<p>Enclosing waste receptacle areas provides an extra barrier to prevent bird access.</p>   <p>Source: www.urbanshed.ca</p>
	<p>Ensure all waste bins (public, commercial, industrial) are lidded to restrict access to opportunistic urban forages such as Feral Pigeon and Australian White Ibis, and waste collection is at a suitable frequency to ensure bins do not overflow.</p>
	<p>Assess and evaluate designs for lighting, communication structures, buildings, and other infrastructure to identify ways to proactively reduce the wildlife attraction. This can minimise any retrospective efforts required to reduce the attraction by installing exclusionary devices or retrofitting structures.</p>
	<p>Where perching, roosting or nesting activity is detected on structures, install exclusionary devices such as netting or anti-perching spikes. Carefully evaluate any retrospective installation of exclusionary devices to ensure they are effective.</p>  

Area of Mitigation	Recommendation / mitigation option
Agriculture	<p data-bbox="533 336 1384 363">Design enclosed facilities to restrict access, ensure doors remain closed.</p> <div style="display: flex; justify-content: space-around;">    </div> <p data-bbox="533 738 842 762">Source: www.qgs-greenhouse.com</p> <p data-bbox="1025 738 1267 762">Source: www.agratech.com</p> <p data-bbox="1547 738 1805 762">Source: www.roughbros.com</p> <p data-bbox="533 799 1043 826">Avoid grain and legume crops (or enclose).</p> <p data-bbox="533 874 1514 901">Enclose grain storage facilities and ensure any spilt grain is immediately recovered.</p>
Flying-foxes ²⁰	<p data-bbox="533 954 1480 981">Adhere to the planting guidelines to limit flying-fox food resources near the WSA.</p>
Colonial Bird Roosting and Nesting Sites	<p data-bbox="533 1114 1995 1189">If nesting or roosting is detected, arrange to restrict breeding success (e.g. by removing eggs and nests or egg oiling) and/or roost dispersal under relevant NSW permit.</p>

20 Applies if existing natural areas are supporting colonial populations that are presenting a serious strike risk to the airport (in that instance WSA would liaise directly with the land owner and NPWS regarding management options). For any newly created colonies, the landowner should inform WSA of the risk who would then liaise with NPWS regarding management. Note that just the existence of the colony doesn't necessarily mean management is required. An assessment may evaluate the colony as presenting a low risk.

Area of Mitigation	Recommendation / mitigation option
	Trim tree branches to reduce nesting opportunity. under relevant NSW permit.
	Remove viny weeds to reduce nesting opportunities.
	Most nesting and roost of colonial species is associated with the nearby availability of food resources that must be restricted to limit population growth.
Waterways, wetlands and waterbodies	Remove (or do not add) islands and perching structures.
	Remove (or do not add) rock clumps on waterline.
	Remove (or do not add) felled trees in water (to reduce as perching opportunities).
Urban Utilities	Do not install an open putrescible waste facilities with 3km of WSA.
	Do not install a putrescible waste facility within 13km of WSA (unless a wildlife hazard assessment determines it to be low risk).
	At the design stage, evaluate the need to design and build covered or uncovered water retention facilities. This may be assessed using a number of factors including proximity to WSA and aircraft flight paths, the position of the facility relative to other nearby land uses that attract wildlife, and the species likely to use the facility.
	Establish protocols to detect and remove bird nests under a Licence to Harm Protected Animal under the <i>Biodiversity Conservation Act 2016</i> issued by the Department of Planning, Industry and Environment (Environment, Energy and Science). Protocols should consider the health and safety of personnel completing the works.

Area of Mitigation	Recommendation / mitigation option
Management Plan	If the land use/activity is assessed as 'moderate' or higher in the wildlife hazard assessment, prepare and implement a Wildlife Management Plan that adhered to the recommendations detailed in Section 7.1.4.
Monitoring ²¹	Establish a regular ²¹ and standardised monitoring regime that: <ul style="list-style-type: none"> • Determines the actual level of wildlife attraction • Identifies temporal variation of wildlife activity (i.e. how wildlife use the site at different times of the day, year or climatic phase) • Identifies emerging risks • Validates plant species choice and landscaping structure, or other mitigation applied.
	Monitor monthly: wildlife activity at land uses assessed as high to very-high risk.
	Monitor quarterly: wildlife activity at land uses assessed as moderate risk.
	Monitor annually: wildlife activity at land uses assessed as very-low to low risk.

²¹ Frequency of monitoring should be congruent with the level of risk.

Area of Mitigation	Recommendation / mitigation option
Construction Activity ²²	<p data-bbox="533 312 2045 480">Include wildlife hazard management as part of Construction Environment Management Plans (CEMP). This will assist with identifying potential wildlife attractions and identify ways to mitigate any risks. It can also help deter any wildlife becoming attracted, and habituated, to the site who may create hazardous conditions once the airport is operational. The CEMP can include options for managing wildlife hazards associated with:</p> <ul data-bbox="577 517 1025 799" style="list-style-type: none"> <li data-bbox="577 517 763 544">• Earthworks <li data-bbox="577 580 1025 608">• Soil and other material stockpiles <li data-bbox="577 644 927 671">• Temporary infrastructure <li data-bbox="577 708 875 735">• Water retention area <li data-bbox="577 772 875 799">• Waste management. <p data-bbox="533 852 2045 927">Where appropriate, grade the ground on commencement of construction and throughout to reduce the number and extent of low-lying areas and ground depressions that can accumulate water after rain.</p>

7.1.8. Responsibilities

Table 18 details the recommended responsibilities for identifying, monitoring, assessing and managing wildlife hazards in the Western Sydney Aerotropolis. Although these responsibilities reflect the current approach to land use planning and land use management, it is recommended that a single authority is established to consider the vision and commitments for the Western Parkland City and coordinates implementation of the planning framework, including safeguarding the airport against wildlife strikes.

Table 18. Stakeholders and responsibilities.

Entity	Responsibilities
WSA	Monitor ²³ existing off-airport land uses that attract wildlife ²⁴ .
	Facilitate regular stakeholder meetings to discuss wildlife hazards within 13km of the airport and their management.
	Make available the results of on-airport species risk assessments to stakeholders.
	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.
	Describe liaison agreements with planning authorities in the airport's WHMP ²⁵ .
	Review any development applications which have the potential to attract wildlife to an extent that may significantly impact the wildlife strike risk at the airport (these will only be referred to WSA in particular circumstances in accordance with the assessment process described in Figure 7).

23 WSA should monitor off-airport land uses where the action in accordance with the AAWSF is 'monitor'. The land user is responsible for monitoring, where required, for land uses where the action in accordance with the AAWSF is 'mitigate' or 'conditional'.

24 In accordance with MOS Part 139 Section 17.01 (2): The aerodrome operator, in consultation with the local planning authority, must attempt to monitor sites within 13 km of the aerodrome reference point that attract wildlife.

25 In accordance with MOS Part 139 Section 17.04 (2)(d): Specify the liaison arrangements for local planning authorities within a radius of at least 13 km from the aerodrome reference point.

Entity	Responsibilities
	<p>Establish an on-airport wildlife hazard management program that integrates passive and active management actions, establishes mechanisms for strike reporting, wildlife monitoring, risk assessment.</p> <p>Provide up-to-date overlay mapping for operational airspace to local and state government as required.</p>
<p>Relevant Consent Authority</p>	<p>Ensure planning instruments align with the Western Sydney Aerotropolis planning framework, including:</p> <ul style="list-style-type: none"> • Western Sydney Aerotropolis Plan • Western Sydney Aerotropolis Precinct Plans • Western Sydney Aerotropolis Development Control Plan. <p>Ensure mapping in planning instruments align with the 3km, 8km and 13 km wildlife buffers.</p> <p>Notify WSA of development proposal/applications which may elevate the wildlife strike risk²⁶.</p> <p>Ensure all development proposals/applications adhere to the performance outcomes detailed in the Western Sydney Aerotropolis planning framework.</p> <p>Ensure all relevant development proposals/applications consider the AAWSF and wildlife hazard assessment requirements detailed in the Western Sydney Aerotropolis planning framework.</p> <p>Ensure appropriate wildlife hazard conditions are included in development approvals.</p>
<p>Land Use Owners or Managers</p>	<p>Ensure all relevant development proposals/applications consider the AAWSF and wildlife hazard assessment requirements detailed in the Western Sydney Aerotropolis planning framework.</p> <p>Assess existing land use, and proposed modification to existing land use, against the AAWSF and using the associated assessment process.</p>

²⁶ The NASF (Guideline C) recommends 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.

Entity	Responsibilities
	For existing land uses that attract wildlife, allow WSA, or their delegates, site access to monitor ²³ and evaluate wildlife activity.
	For new land uses that attract wildlife, regularly monitor ²³ wildlife in accordance with procedures developed in site-specific Wildlife Management Plans.
	Arrange resources, as required, to: <ul style="list-style-type: none"> • assess wildlife hazards • develop and implement Wildlife Management Plans • mitigate and monitor wildlife hazards • Report on wildlife hazards and mitigation efforts • implement corrective actions for unacceptable risks.
	Adhere to any wildlife hazard conditions associated with development approvals or approved biodiversity conservation sites such as BSAs.
	Adhere to the performance outcomes detailed in the Western Sydney Aerotropolis planning framework.
Western Sydney Planning Partnership	Establish the planning framework and statutory requirements for the wildlife hazard management in the Western Sydney Aerotropolis.
Western City & Aerotropolis Authority	Integrate wildlife hazard management, as established by the Planning Partnership, into the Western Sydney Aerotropolis master planning, precinct management, and infrastructure planning, as well as any other relevant strategic plans for western Sydney.
Greater Sydney Commission	Provide assurance of the WSAP and associated documentation.

8. Managing Wildlife Hazards around WSA

This section describes each of the main types of wildlife attraction, lists the relevant planning principles described in the WASP, and summarises the concepts of managing to reduce and monitor wildlife.

8.1. Landscaping in the Vicinity of WSA

8.1.1. Western Sydney Aerotropolis Values and Planning Principles

With a landscape-led approach to planning, the Western Sydney Aerotropolis will create and enhance the green space. This will satisfy commitments to tree planting, align with the biodiversity principles in the Cumberland Plain Conservation Plan, provide open space and parklands, enhance ecological value, and mitigate impacts against threatened species.

Table 19 lists the Western Sydney Aerotropolis’s landscaping and vegetation-based Planning Principles (WASP 2019).

Table 19. Western Sydney Aerotropolis Planning Principles relevant to landscaping and tree planting.

Objective	Principle	
Productivity: Objective 3	PR7	Appropriately design, construct and locate development to safeguard 24/7 airport operations.
	PR9	Requirement development to accord with the NASF Guideline.
Sustainability: Objective 4 A landscape-led approach to urban design and planning	SU1	Retain and enhance natural features such as waterways, vegetation and landform and culturally significant landscapes.
	SU2	Integrate Blue–Green Grid links and public open spaces, maximising opportunities for connections, an urban tree canopy and active use of the floodplain.
	SU5	Develop a connected regional parkland network linking with the Wianamatta–South Creek corridor that shapes the Aerotropolis and provides amenity and ecological value and create a high quality ridgeline and linear parks adjacent to, and integrated with, riparian corridors that retain water.

Objective	Principle	
	SU6	Retain and increase the urban tree canopy and green cover across the Aerotropolis consistent with the Region Plan target of 40 per cent and the Premier's Priority for Greening our city.
	SU7	Retain, enhance and co-locate vegetation on ridgelines with active open space and use it to guide building heights.
	SU9	Meet the requirements of the biodiversity conservation program in the Cumberland Plain Conservation Plan and approved strategic biodiversity certification and strategic assessment protecting land with biodiversity value, and provide a sensitive urban interface that supports and enhances corridors and reserves.
	SU10	<p>Avoid, minimise and mitigate impacts on threatened species and endangered ecological communities, habitat corridors, and riparian and aquatic habitats to prioritise length, connectivity and representativeness to maintain ecological function. Protect the integrity and continuity of wildlife by:</p> <ul style="list-style-type: none"> • protecting priority habitat corridors to support migrating species, birds and arboreal mammals • using public land for biodiversity conservation with an appropriate management regime • expanding vegetation corridors if impacted by utility installations.
	SU11	Retain and protect wetland environments to support plant animal communities and to mitigate wildlife attraction or wildlife strike.
Sustainability: Objective 6 A resilient and adaptable Aerotropolis	SU15	Plan for compatible land uses within the floodplain, provide safe evacuation and egress from flood events and consider climate change, culvert blockage and floodplain revegetation.
	SU19	Protect high value terrestrial and aquatic ecosystems to enhance biodiversity and protect environmental values.

Objective	Principle	
Liveability: Objective 9 A collaborative approach to planning and delivery	LV1	Create a compact urban form in areas of high accessibility with a rich urban tree canopy and along creeks so that residents live within a 10-minute walk of quality green, open and public space consistent with the Premier's Priority for Greener Public Spaces.
Liveability: Objective 10 Social and cultural infrastructure that strengthens communities	LV5	Create valued public and private places and activate open spaces in line with Better Placed, Greener Places and the Premier's Priority for Greener Public Spaces.

Landscaping to satisfy the Western Parkland City vision contradicts the principles of airport safeguarding against wildlife hazards and has not been adequately addressed in some of the key Aerotropolis landscaping and planning documentation to date, Table 20 (this excludes those areas listed in Table 1 as key government commitments). This WMA report aims to address some of these issues, and more detailed planning with the Planning Partnership and relevant stakeholders will further refine landscaping outcomes.

Table 20. Landscaping the Western Sydney urban environment. Principles, objectives and concepts derived from Aerotropolis and Western Sydney planning and design documentation, and considerations for wildlife hazards and airport safeguarding.

Reference	Landscaping Principle/Concept	Comment
Western Sydney Street Design Guidelines	<p>New Priorities for Streets</p> <p>Streets as ecosystems:</p> <p>Prioritise environmental outcomes of streets such as urban heat, water quality, biodiversity, and liveability</p> <p>Measure the environmental performance of streets ... for street trees to contribute to NSW government urban street canopy targets.</p>	<p>Does not consider safeguarding the airport and managing wildlife attraction within 13km of WSA.</p> <p>Note - only applies to areas outside of those areas identified as government commitments (Table 1). Within these government commitment areas, the requirements specified in the Design Guidelines will apply.</p>

Reference	Landscaping Principle/Concept	Comment
	<p>Place-based Analysis</p> <p>User needs:</p> <p>Embrace diversity and collect knowledge, opinions and perspectives from a wide range of user groups. The best solutions often appear when a diverse set of people with disparate views collaborate.</p>	<p>This principle should also be applied to airport safeguarding against wildlife strike.</p>
	<p>Iterative Design</p> <p>Trials and Prototypes:</p> <p>Explore specific problems in detail through small scale interventions, trials, and prototypes.</p>	<p>This principle should also be applied to airport safeguarding against wildlife strike.</p>
	<p>Street design objectives:</p> <p>Objective 5: Continuous canopy cover is achieved on both sides of every street.</p>	<p>Does not consider safeguarding the airport and managing wildlife attraction within 13km of WSA.</p> <p>Note - only applies to areas outside of those areas identified as government commitments (Table 1).</p>
	<p>Street Types:</p> <p>Local streets (types 1-3, residential laneway, local collector)</p> <p>Mixed used streets (high street, retail laneway, industrial street, sub-arterial road).</p>	<p>Consider plant species choice and structure to minimise wildlife attraction close to the airport (e.g. at least within 3km of WSA) for some street types.</p> <p>For example: Local Street Type 1 (Residential Neighbourhood) could maintain desired structure but uses no tree species known to attract birds and flying foxes.</p> <p>Note - only applies to areas outside of those areas identified as government commitments (Table 1).</p>

Reference	Landscaping Principle/Concept	Comment
	<p>Part C Components of Great Streets</p> <p>Part C of the Guidelines covers the various components that need to be considered and coordinated throughout the planning, design, implementation, maintenance, and monitoring of streets.</p>	<p>Guiding Principles and Design Standards (particular those in section C3 The Green and Blue Grid) do not consider safeguarding the airport and managing wildlife attraction within 13km of WSA.</p>
	<p>C8 Innovation</p> <p>The Guidelines' vision and objectives will rely on continued innovation in the planning, delivery and maintenance of streets in Western Sydney. Innovation will involve a variety of new methods and approaches. This can range from new community and stakeholder consultation methods, and research partnerships with third parties, to new materials, post-completion monitoring, and new 'smart city' technologies.</p>	<p>This principle should also be applied to airport safeguarding against wildlife strike.</p>
WSAP	<p>Planning Principles (see Table 18).</p>	<p>Broad principles that do not specifically address vegetation or landscaping.</p>
<p>Draft Western Sydney Aerotropolis Development Control Plan 2019 - Phase 1</p>	<p>Section 1.8 Western Parkland City – Landscape Led Approach</p> <p>c) preserve, extend and restore the green – develop a green infrastructure framework structured around the Wianamatta-South Creek green spine and tributaries where biodiversity land is conserved, along with remnant vegetation, water features and habitat linkages across ridges to link catchments, cultural values and view lines;</p>	
	<p>Section 4.1.2:</p> <p>PO11 Development does not cause wildlife to create a safety hazard in the operational airspace of the airport.</p>	<p>Note - only applies to areas outside of those areas identified as government commitments (Table 1).</p>

Reference	Landscaping Principle/Concept	Comment
	<p>Section 3.2.2:</p> <p>PO1 Native vegetation communities, significant tree habitat and canopy are protected and enhanced.</p> <p>PO3 Native vegetation and tree canopy within open space areas are maintained and enhanced.</p>	<p>Consider plant species choice and structure to minimise wildlife attraction close to the airport (e.g. at least within 3km of WSA).</p> <p><i>Note</i> - only applies to areas outside of those areas identified as government commitments (Table 1).</p>
	<p>Section 5.1.1.2</p> <p>PO10 Provide increased tree canopy consistent with Greener Places integrated with built form in the landscape and is of a scale to enhance scenic landscapes and provide sufficient shade and amenity in centres.</p>	<p>As above.</p>
	<p>Section 5.1.2.2</p> <p>PO5 All streets should be green, shaded, landscaped and provide an urban tree canopy which does not cause wildlife to create a safety hazard in the operational airspace of the Airport.</p>	<p>As above.</p>
	<p>Section 5.1.3.2</p> <p>PO27 Increase the tree canopy cover (with appropriate species) and landscaping to reduce ambient temperatures and urban heat island.</p>	<p>As above.</p>
	<p>Section 5.1.7.2</p> <p>PO12 Native vegetation which supports habitat for native fauna and biodiversity is protected and enhanced.</p>	<p>As above.</p>

8.1.2. Landscaping and Wildlife

Native trees, decorative trees, fruit trees, shrubs, gardens and turf can be particularly attractive to wildlife because they offer feeding, sheltering, roosting, and nesting opportunities. Shrubs and trees that produce nectar, berries, fruit or seeds will attract birds and flying-foxes. Even the insects that use trees can attract a suite of bird species. Supplementing wildlife use of landscaping are drains, water retention facilities, and areas that are temporarily or semi permanently inundated after rain. Landscaping in the vicinity of an airport should consider how proposed planting schedules (species and structure) may attract wildlife.

Of particular concern are plants that attract flying-foxes (*Pteropus* species), large birds such as cockatoos and ibis, and flocks of birds such as corellas and galahs who may establish large communal roosts and foraging territories. Critical to an airport's strike risk is the interchangeable use of on- and off-airport wildlife attractants. These complex movement patterns on and around airports are difficult to predict, however proactive measures to mitigate risks, such as excluding or minimising known plant attractants from landscaping schedules, can make significant contributions to reducing an airports strike rate.

Grass, when maintained at short lengths provide wildlife with the opportunity to forage, loaf, and establish breeding territories. Some of Australia's highest strike risk wildlife show a preference for short grass, including Masked Lapwing, Little Corella (*Cacatua sanguinea*), Galah, Australian Magpie (*Gymnorhina tibicen*), Australian White Ibis (*Threskiornis molucca*), Straw-necked Ibis, and Feral Pigeon (*Columba livia domestica*). As a food source, some grasses are more attractive than others, particularly when seeding. Conversely, grasslands that are maintained at heights beyond 400 mm, can attract a suite of other hazards by providing refuge for rodents, small mammals and reptiles, which can attract raptors such as Nankeen Kestrel (*Falco cenchroides*), Black Kite and Wedge-tailed Eagle. Grass maintained at these lengths can also attract large terrestrial mammals such as macropods, various vertebrate pests like foxes and rabbits, and even some birds who like to establish ground nests in tall grass.

Green roofs, one of the innovative approaches being considered for the Aerotropolis, can create a wildlife hazard when installed close to airports. Despite the benefits of green roofs (i.e. temperature control, rainwater filter, reduced stormwater pollution, visual amenity), the types of plant species used and the availability of water can create a wildlife attraction if not adequately designed and maintained.



Figure 9. All landscaping designs should be assessed to determine the level of attraction to flocking species such as Sulphur-crested Cockatoos.



Figure 10. Flying-foxes are a particular risk to aviation because of their tendency to flock, large body mass, and their nocturnal movements that make them difficult to detect. Inappropriate landscaping can attract significant numbers of flying-foxes.



Figure 11. A preference for short grass by ground foragers such as magpies is clear. Short grass makes it easier to access invertebrates in the soil.



Figure 12. Masked Lapwings establish breeding territories and nests in short grass. They aggressively defend these territories, even against aircraft.

8.1.3. Managing the wildlife attraction to landscaping

Determining the attractiveness of landscaping depends on the wildlife populations in the local area and the range of other resources that are available. It can be difficult to predict with certainty how wildlife populations will utilise the new landscape and so preference should be given to using plant species that are known to be least attractive to wildlife. Regular and long-term monitoring will determine if wildlife attraction is significant, and risk assessments will help determine the impact on aviation risk. If monitoring determines that the risk is unacceptable, it may be necessary to remove one or a number of species of plants from the landscape if found to be the main attracting feature. Table 18 summarises monitoring responsibilities.

Tables 17 and 26 summarises the mitigation and monitoring options.

Appendix B recommends acceptable and unacceptable plant species based on location within the wildlife buffer zones.

8.2. Water in the Vicinity of WSA

8.2.1. Western Sydney Aerotropolis Values and Planning Principles

Water will play a critical role in the Western Parkland City. Aerotropolis planning will incorporate the biodiversity principles in the Cumberland Plain Conservation Plan which revitalises and enhances riparian systems; enhances habitats for threatened species; reduces the impacts of flood; manages and recycles stormwater; maintains important hydrological systems and retains water in the landscape to enhance ecological and aesthetic values and cools the urban landscape; and, supports land uses and utilities that require water storage. Biodiversity certification requirements, in accordance with the *Biodiversity Conservation Act 2016*, and strategic assessment in accordance with the *Environment Protection and Biodiversity Conservation Act 1999* will also drive how water management is applied in relevant areas of the Aerotropolis.

Table 21 lists the Western Sydney Aerotropolis’s water-based Planning Principles (WASP 2019).

Table 21. Aerotropolis Planning Principles relevant to water.

Objective	Principle	
Sustainability: Objective 4 A landscape-led approach to urban design and planning.	SU1	Retain and enhance natural features such as waterways, vegetation and landform and culturally significant landscapes.
	SU2	Integrate Blue–Green Grid links and public open spaces, maximising opportunities for connections, an urban tree canopy and active use of the floodplain.
	SU3	Retain water in the landscape by maximising permeable surfaces and developing appropriate urban typologies.
	SU5	Develop a connected regional parkland network linking with the Wianamatta–South Creek corridor that shapes the Aerotropolis and provides amenity and ecological value and create a high quality ridgeline and linear parks adjacent to, and integrated with, riparian corridors that retain water.
	SU10	Avoid, minimise and mitigate impacts on threatened species and endangered ecological communities, habitat corridors, and riparian and aquatic habitats to prioritise length, connectivity

Objective	Principle	
		<p>and representativeness to maintain ecological function. Protect the integrity and continuity of wildlife by:</p> <ul style="list-style-type: none"> • protecting priority habitat corridors to support migrating species, birds and arboreal mammals • using public land for biodiversity conservation with an appropriate management regime • expanding vegetation corridors if impacted by utility installations.
	SU11	Retain and protect wetland environments to support plant animal communities and to mitigate wildlife attraction or wildlife strike.
	SU13	Plan stormwater and wastewater in the Wianamatta–South Creek Catchment to minimise potential hydrologic and hydraulic impacts on ecology, creek structure, infrastructure, water quality and the natural water cycle. Integrate water sensitive urban design and use stormwater or recycled water to irrigate streets and public open space to support public amenity and urban cooling. Co-locate industrial water users, where appropriate.
Sustainability: Objective 8 A resilient and adaptable Aerotropolis	SU15	Plan for compatible land uses within the floodplain, provide safe evacuation and egress from flood events and consider climate change, culvert blockage and floodplain revegetation.
	SU17	Design, build and manage flood management assets to benefit native habitat, aesthetics, public recreation and amenity.
	SU19	Protect high value terrestrial and aquatic ecosystems to enhance biodiversity and protect environmental values.
	SU20	Adopt an integrated water management approach that considers urban form and streetscape, trunk drainage land and assets, waterway health and flood management.

8.2.2. Drainage

Drains with slow moving water, or where water accumulates for extended periods of time, can be very attractive to wildlife. The attraction is enhanced where drain banks are gently sloped because it provides easy access to the water. Heavily vegetated drains can act as a refuge for many water birds. For areas that have complex drainage systems, birds are more likely to use areas interchangeably, creating a strike risk as they transit through the airspace.

Low lying areas, or areas that temporarily accumulate water after rain, can also be problematic in some circumstances. Not only do they provide access to additional freshwater, but the resulting waterlogged soils bring worms and other soil invertebrates close to surface where they are easily accessible to ground foragers such as ibis, lapwings and magpies.



Figure 13. Gently sloped drain with permanent water is very attractive to wildlife.



Figure 14. Drains with permanent water and no aquatic vegetation provide large surface areas for ducks and other waterfowl to loaf and forage.



Figure 15. Drains that hold even small volumes of water can attract wildlife.



Figure 16. Drains with gentle sloping banks free of vegetation attract birds who do not land on the water's surface.

Culverts not only act as a refuge, but also provide a suitable nesting structure for some birds such as Fairy Martins.



Figure 17. Drain culverts mimic natural structures for nesting Fairy Martin.



Figure 18. Open culverts in dry drains provide refuge and shelter for terrestrial animals such as rabbits, cats, and foxes.



8.2.3. Retention and Detention Basins

Retention and detention basins provide an important hydrological function, but they act as artificial wetlands and can be particularly attractive to wildlife where the water is easily accessible (i.e. from the banks or on the surface area of the water) and where adjacent vegetation offers safety and refuge. During dry periods, when other regional water supplies may be dry, artificial wetlands like retention basins can attract significant numbers of wildlife. Even detention basins which hold water temporarily, can be attractive.

When assessing a habitat that has the potential to attract birds it is important to analyse the impacts of potentially conflicting airspace between birds and aircraft. 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 wildlife will not be inclined to transit through critical

airspace; just as a relatively low attraction habitat may pose a significant risk due to its close proximity and position, causing wildlife to transit through critical airspace.



Figure 21. Open detention basins, with semi-permanent water can attract large numbers of birds. Waterfowl from farm dams and ponds are likely to use waterbodies on the airport.



Figure 22. Large retention basins have the capacity to support significant populations of ducks and other waterfowl, as well as large water birds such as pelicans and swans.



Figure 23. Retention or detention areas with inadequate fencing and gently sloped banks have the potential to attract terrestrial animals such as kangaroos.



Figure 24. During dry weather, the attraction of permanent water in retention ponds can be significant.

Tables 17 and 26 summarises the mitigation and monitoring options.

8.3. The Built Environment in the Vicinity of WSA

8.3.1. Western Sydney Aerotropolis Values and Planning Principles

The built environment can provide a range of perching, roosting and nesting opportunities for wildlife. For example; building eaves provide nesting platforms for Fairy Martins (*Petrochelidon ariel*); warehouses provide shelter for roosting Common Starlings; light structures provide platforms for raptor nests; large open areas can provide safe loafing areas for wildlife, bridges can provide perching and nesting platforms for Feral Pigeons, poor management of rubbish bins and skips can attract opportunistic foragers like Australian White Ibis, and so on. The Western Sydney Aerotropolis will support a complex built environment where a land use type may be assessed as low risk, or categorised as requiring 'no action' in accordance with the

AAWSF, but where a particular nuance in building design may attract birds and contribute to WSA strike risk.

Table 22 lists the Western Sydney Aerotropolis’s built environment-based Planning Principles (WASP 2019).

Table 22. Aerotropolis Planning Principles relevant to the built environment.

Objective	Principle
All 10	All 47

8.3.2. Buildings

Buildings can provide structures to build nests, such as eaves for Fairy Martins or ledges for Peregrine Falcons.



Figure 25. More than 100 Fairy Martin nests established at a water treatment plant.

8.3.3. Roads and Bridges

Whilst roads themselves are not a direct wildlife attraction, roadside landscaping can be depending on the species selected, their structure and access to water. In addition, animals that have been struck and killed by vehicles (i.e. roadkill), can attract large opportunistic scavengers such as raptors and crows, which can be a concern when located close to airfields.

Often the complex support structures under bridges provide nesting and roosting opportunity for birds such as Feral Pigeons. These not only provide structural support but can offer a relatively predator-free environment.



Figure 26. Pigeons perching and roosting under bridge (source: E. Hands 2016).

8.3.4. Waste

The availability of food and organic waste generated by human activity (i.e. putrescible waste) can be a significant wildlife attraction on airports where waste receptacles allow wildlife access, either because of a lack of lids, inadequate lids, or where lids are not closed by users. Scavenging birds such as Australian Raven, Silver Gull (*Chroicocephalus novaehollandiae*), Feral Pigeon and Australian White Ibis take advantage of overflowing bins, or bins that are accessible to birds (i.e. not enclosed or lidded). Rodents may also take advantage of available rubbish, which can then attract raptors.



Figure 27. Open bins can not only attract birds, but also cats, rodents, and other scavengers.



Figure 28. Overflowing bins can create a wildlife attraction, which when located close to aircraft movement areas, can create a serious strike risk.



Figure 29. Bins that are routinely left open, or that have no lids, encourage populations of birds to use as a regular forage site.



Figure 30. Overflowing bins can attract wildlife. The frequency of rubbish collection should be commensurate with the volume of waste created.

8.3.5. Parks and Recreational Areas

Vegetation in parks and recreational areas can encourage wildlife to establish foraging areas, roosts, or even breeding sites. Areas with attractive vegetation coupled with access to water may further encourage this, particularly if foraging areas are close by. Recreational areas with large areas of short grass can also attract wildlife. Of particular concern in urban parks and gardens close to airports is the feeding of wildlife by members of the public. Apart from the health risks to the animals themselves, the regular availability of supplemental food can increase wildlife populations, including bird who may transit through aircraft airspace to access public feeding areas. Temporary wildlife hazards may also be created in response to food waste made available during and after festivals, markets and other events.



Figure 31. Public feeding of wildlife can be problematic for aviation safety when done close to airports.



Figure 32. Urban parks and gardens provide foraging and loafing opportunity.

Tables 17 and 26 summarises the mitigation and monitoring options.

8.4. Agriculture

8.4.1. Western Sydney Aerotropolis Values and Planning Principles

Agribusiness is proposed as one of the Western Sydney Aerotropolis land zones in the Agribusiness Precinct on the western side of the airport. The precinct will support a high-tech approach to agriculture, freight and logistics, and focus on providing an innovative approach to the fresh food supply chain.

The Aerotropolis's Planning Principles (WASP 2019) do not specifically address agriculture, however it is assumed that the Agribusiness Precinct will make significant contributions to the region's economic viability and strategic goals.

It is unlikely that traditional agriculture, which involves activities like ploughing and harvesting on a large open scale and which can attract significant numbers of wildlife, is proposed for the Aerotropolis. Although the Agribusiness Precinct is likely to support high intensity agriculture using enclosed facilities, careful design and assessment is critical given its proximity to the airport. This is particularly relevant to any storage facilities and their accessibility to wildlife, including birds, rodents and other opportunistic foragers.



Figure 33. Farm dams can attract significant numbers of water birds.



Figure 34. Poor food storage can attract considerable numbers of opportunistic foragers such as Feral Pigeons.

Tables 17 and 26 summarises the mitigation and monitoring options.

8.5. Commercial Industry in the Vicinity of WSA

8.5.1. Western Sydney Aerotropolis Values and Planning Principles

One of the elements for the Western Sydney Aerotropolis to achieve a sustainable and viable circular economy will be the establishment of a range of commercial activities. This will include

advanced manufacturing, defence and aerospace industries, professional services, research facilities, STEM-focused education facilities, medical and health services and related infrastructure, retail, and various other commercial endeavours.

Table 23 lists the Western Sydney Aerotropolis’s commercial-based Planning Principles (WASP 2019).

Table 23. Aerotropolis Planning Principles relevant to commercial industry.

Objective	Principle	
Productivity: Objective 2 High-value jobs growth is enabled, and existing employment enhanced	PR5	Develop vibrant centres with high quality public domain, a rich urban tree canopy, and well-designed buildings and areas that attract workers and investment.
	PR6	Establish a centres hierarchy, including future centres, in line with the Region Plan (Strategy 22.2).

How commercial activities will contribute to the airport’s wildlife strike risk will depend on activity type, land use, design and wildlife access to water, food and shelter.

Tables 17 and 25 summarises the mitigation and monitoring options.

8.6. The Natural Environment in the Vicinity of WSA

8.6.1. Western Sydney Aerotropolis Values and Planning Principles

The Western Sydney Aerotropolis will aim to make significant contributions to encourage and enhance the natural environment, particularly in the Wianamatta-South Creek Precinct which will have a strong emphasis on waterway and catchment health. In general, the Western Sydney Aerotropolis will aim to satisfy commitments to tree planting, align with the biodiversity principles in the Cumberland Plain Conservation Plan, enhance ecological value, and mitigate impacts against threatened species.

Table 24 lists the Western Sydney Aerotropolis’s natural environment-based Planning Principles (WASP 2019).

Table 24. Aerotropolis Planning Principles relevant to the natural environment.

Objective	Principle	
<p>Sustainability: Objective 4</p> <p>A landscape-led approach to urban design and planning</p>	SU1	Retain and enhance natural features such as waterways, vegetation and landform and culturally significant landscapes.
	SU2	Integrate Blue–Green Grid links and public open spaces, maximising opportunities for connections, an urban tree canopy and active use of the floodplain.
	SU5	Develop a connected regional parkland network linking with the Wianamatta–South Creek corridor that shapes the Aerotropolis and provides amenity and ecological value and create a high quality ridgeline and linear parks adjacent to, and integrated with, riparian corridors that retain water.
	SU6	Retain and increase the urban tree canopy and green cover across the Aerotropolis consistent with the Region Plan target of 40 per cent and the Premier’s Priority for Greening our city.
	SU9	Meet the requirements of the biodiversity conservation program in the Cumberland Plain Conservation Plan and approved strategic biodiversity certification and strategic assessment protecting land with biodiversity value, and provide a sensitive urban interface that supports and enhances corridors and reserves.
	SU10	<p>Avoid, minimise and mitigate impacts on threatened species and endangered ecological communities, habitat corridors, and riparian and aquatic habitats to prioritise length, connectivity and representativeness to maintain ecological function. Protect the integrity and continuity of wildlife by:</p> <ul style="list-style-type: none"> • protecting priority habitat corridors to support migrating species, birds and arboreal mammals • using public land for biodiversity conservation with an appropriate management regime • expanding vegetation corridors if impacted by utility installations.

Objective	Principle	
	SU11	Retain and protect wetland environments to support plant animal communities and to mitigate wildlife attraction or wildlife strike.
	SU12	Provide open space buffers and asset protection zones to conservation areas wholly within urban capable footprints.

8.6.2. Flying-foxes

There are seven known active flying-fox colonies in the Western Sydney area. Although six of these colonies lie outside of the 13 km wildlife buffer, flying-fox can travel 100 kilometres in a single night with a foraging radius of up to 50 kilometres from their camp (McConkey et al. 2012) and have been recorded travelling over 500 kilometres in two days between camps (Roberts et al. 2012). Flying-foxes potentially present a significant wildlife strike risk for WSA due to their strike history at Australian airports. In general, airports that have significant flying-fox populations close to the airport, or that have large areas of suitable foraging habitat, experience an additional peak in strikes during dusk and post-dusk periods as flying-foxes depart their roosts and begin their nightly foraging.

Key to managing this strike risk will be a more comprehensive understanding of their spatial and temporal use of the region, as well as managing potential food sources through well considered landscaping planting schedules and plant species use.

8.6.3. Colonial Bird Roosting and Nesting Sites

Nesting and roosting sites for colonial wildlife may comprise of hundreds or even thousands of individuals. Examples of colonial species include Australian White Ibis, Little Corella, Rainbow Lorikeet (*Trichoglossus moluccanus*), Common Myna (*Acridotheres tristis*), Common Starlings and flying-foxes. Although the number of individuals in these colonies can impact an airport's strike risk, how they move through the landscape to access foraging locations from their roosts and nesting grounds can be more significant. This is especially important if they infringe critical aircraft airspace en route to foraging areas. Confounding this is the opportunistic behaviour of many colonial nesters who tend to adapt well to the urban environment. In these environments, access to reliable sources of water and food encourages high population growth that can extend well beyond normal levels.



Figure 35. Wildlife breeding colonies in urban areas can elevate the strike risk at an airport.

8.6.4. Waterways, Wetlands and Waterbodies

Naturally occurring waterways, wetlands and other water bodies (e.g. lakes), including those with permanent or ephemeral water, attract wildlife to drink, forage, nest and shelter. Revitalisation of these systems in urban environments often improves waterway health and provides supplementary vegetation through revegetation and revitalisation works. The colonial species described in Section 8.6.3 can take advantage of these areas and establish breeding or roosting sites.



Figure 36. Water, in all its forms, attracts wildlife.

Tables 17 and 26 summarises the mitigation and monitoring options.

8.7. Urban Utilities in the Vicinity of WSA

8.7.1. Western Sydney Aerotropolis Values and Planning Principles

Efficient water/waste management and public transport systems will be a critical foundation to the functioning of the Western Sydney Aerotropolis. Innovative approaches to delivering these urban utilities will add significant value to the region, provide a highly liveable environment for residents, and help achieve a circular economy with high business development and growth.

Table 25 lists the Western Sydney Aerotropolis’s urban utilities-based Planning Principles (WASP 2019).

Table 25. Aerotropolis Planning Principles relevant to urban utilities.

Objective	Principle	
<p>Sustainability: Objective 5 A sustainable, low carbon Aerotropolis that embeds the circular economy.</p>	SU14	<p>Use low carbon, high efficiency strategies to reduce emissions and energy use in line with NSW net zero emissions target and mitigate urban heat through urban development and building design. Use innovative and integrated approaches to achieve higher standards of resource recovery, waste management, water management and renewable energy.</p>
<p>Infrastructure and Collaboration: Objective 7 Infrastructure that connects and services the Western Parkland City as it grows.</p>	IC1	<p>Integrate passenger and freight transport with urban design at the Aerotropolis-wide, precinct and local scale to achieve quality movement and place outcomes.</p>
	IC2	<p>Locate and stage high quality active and public transport, utility and digital networks to align with projected land uses and secure corridors and sites early.</p>
	IC4	<p>Ensure the interoperability of systems align with NSW government connected infrastructure and Internet of Things policies.</p>

8.7.2. Waste Management Facilities

Waste management, particularly putrescible waste, close to airports can be one of the biggest contributors to an airport’s wildlife strike risk. ICAO make direct reference to eliminating landfills within 13 km of airports (see Annex 14 details in Table 9) and Dolbeer (2006) sites numerous cases where liability for wildlife strike damages has been attributed to airport operators due to strikes involving species that feed at nearby landfills. The availability of waste, which is often supplemented with onsite water sources, can attract significant numbers of opportunistic scavengers such as ibis, gulls, pelicans, kites, crows, and pigeons. Landfills that support bird populations can also contribute regional overpopulation issues. Even transfer station, if not well managed or adequately enclosed, can be problematic.



Figure 37. Putrescible waste landfills can attract unacceptably high numbers of birds.

8.7.3. Water Management Facilities

Facilities that treat water or sewage can be highly attractive to wildlife if open water sources are accessible. Treated sewage contains high nutrient levels which in turn attracts insects that can enhance the attraction to foraging birds. Apart from this, treatment facilities offer a relatively predator free environment and it is not uncommon for wildlife populations to establish permanent territories at these facilities given the opportunity. Landscaping and the built environment at these facilities can supplement the attraction.



Figure 38. Open water at sewage and water treatment facilities can be highly attractive to wildlife.

8.7.4. Transport

Roads and other transport infrastructure can attract wildlife, particularly where there is access to water and vegetation. Roadside landscaping is an integral component of road construction that aims to provide character, assist with soil stabilisation, filter pollutants, and contribute to fulfilling biodiversity and conservation objectives, however it may attract unacceptable numbers of wildlife close to aircraft flight paths, elevating the strike risk. This also applies to the beatification and amenity of public transport stations.

Tables 17 and 26 summarises the mitigation and monitoring options.

8.8. Construction Activity in the Vicinity of WSA

Once WSA is operational, land users and planning authorities will need to consider how construction activities close to the airport, particularly within the 3km wildlife buffer, may attract wildlife and elevate the strike risk. Construction activities can elevate wildlife activity above normal levels. Areas of temporary water retention can attract ducks and other water birds. Earthworks expose soils that attract birds to forage on the exposed invertebrates and temporary stockpiles of soil or other material can provide additional loafing and perching opportunities for birds. Pipes and other construction material can provide temporary shelter and, in some cases, birds such as Fairy Martins have established nests in these materials. In some circumstances the lack of effective contractor induction programs can result in workers inadvertently attracting wildlife by not managing their food waste, by feeding the wildlife, and by simply not recognising potential or actual wildlife hazards.



Figure 39. Soil stockpiles and exposed soil can attract wildlife.



Figure 40. Construction earthworks can create temporary, but significant, attractants that can attract wildlife.

Tables 17 and 26 summarises the mitigation and monitoring options.

The recommendations and mitigation options listed in Table 26 are in addition to those described in Section 7 (Table 17) and based on principles and concepts that have been applied worldwide to help safeguard airports against the risk of wildlife strikes. These are not requirements. They are designed to give land users guidance on how wildlife hazards and attractants can be managed.

It is acknowledged that not all the recommendations listed here are feasible in every situation, however it is strongly recommended that they are applied, to some extent, wherever possible and where required to meet acceptable risk outcomes. To achieve the Western Parkland City vision and safeguard the airport, land users and operators are encouraged to consider

innovative and unconventional options that are founded in the principles listed in Tables 17 and 26 (e.g. in a scenario whereby the surface area of a permanent creek is large enough to attract pelican and ducks to land on the surface, it may be less attractive to reconfigure the creek design to create a series of narrow meandering channels).

Monitoring underpins all wildlife hazard mitigation and airport safeguarding. Robust standardised monitoring programs that regularly collect meaningful data will inform decisions relating to wildlife management programs, identify emerging risks, and determine wildlife activity trends over time.

Table 26. Additional recommendations for managing wildlife hazards in the Western Sydney Aerotropolis.

Area of Mitigation	Recommendation / mitigation option	
Landscaping	Refer Appendix B	
	Facilitate a workshop with relevant stakeholders to develop a suitable species palette and guidelines for use within 13km of the airport that balances safeguarding the airport against wildlife strikes and achieving the landscaping vision of the Western Sydney Aerotropolis and Western Parkland City.	
Built environment	Install signage to discourage public feeding of wildlife (particularly in wildlife buffers 3km and 8km).	
	Establish a penalty system to distribute fines to members of the public who feed wildlife or enforce any existing local government rules on this matter (particularly in wildlife buffers 3km and 8km).	

Area of Mitigation	Recommendation / mitigation option
Natural environment ²⁷ : Flying-foxes	Ensure new colonies don't establish within 13 km of WSA. Site specific management plans may be required which should comply with the NSW Flying-fox Camp Management Code of Practice 2018 (under the Biodiversity Conservation Regulation 2017), and the NSW Flying-fox Camp Management Policy 2015.
Risk Assessment	<p>The risk assessment method should consider:</p> <ul style="list-style-type: none"> • Species (behaviour, mass, tendency to flock or roost communally). • Land use/activity type. • Location relative to WSA and the approach/departure paths. • Location relative to nearby land uses that attract, or have the potential to attract, wildlife. • Species strike risk based on WSA strike data (when available). In the absence of WSA data, use strike data for the Sydney region (or NSW, or Australia) derived from the ATSB strike database. • WSA species risks.

27 Applies if existing natural areas are supporting colonial populations that are presenting a serious strike risk to the airport (in that instance WSA would liaise directly with the landowner and NPWS regarding management options). For any newly created colonies, the landowner should inform WSA of the risk who would then liaise with NPWS regarding management. Note that just the existence of the colony doesn't necessarily mean management is required. An assessment may evaluate the colony as presenting a low risk.

Area of Mitigation	Recommendation / mitigation option
Active Management	<p>In areas such as the key government commitments, or where, despite mitigation, unacceptable wildlife activity is observed, work with WSA to apply active control such as wildlife dispersal, roost disturbance, breeding disruption (e.g. egg and nest removal, or egg oiling), lethal control.</p> <p>Breeding disruption and lethal control can only occur under a Licence to Harm Protected Animal under the <i>Biodiversity Conservation Act 2016</i>, issued by the Department of Planning, Industry and Environment (Environment, Energy and Science), unless the target species is categorised as introduced.</p>
Responsibility	<p>Assemble a coordination body comprised of key Western Sydney land use planning stakeholders to coordinate the implementation of the Aerotropolis planning framework.</p>

9. Conclusion

Off-airport land uses and the various flying-fox colonies in the region are likely to make significant contributions to the Western Sydney Airport's strike risk once operational. However, applying land use planning principles around the airport that pre-emptively mitigate wildlife risks place the Western Sydney Planning Partnership in an enviable position. Safeguarding airport operations in this context usually require land users to apply retrospective mitigation which can be expensive, resource intensive, and often with poor results.

The modified wildlife buffers, the AAWSF, and the proposed wildlife assessment process provides a standardised approach to evaluating potential wildlife hazards, regardless of land use type. This process, when embedded in the planning framework along with performance outcomes, will help achieve the vision of the Western Sydney Aerotropolis whilst safeguarding the airport.

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Appendices

- A. Changes made to the National Airports Safeguarding Framework.
- B. Guidelines for plant species use in Western Sydney Aerotropolis landscaping.
- C. Additional aviation industry guidance.

Appendix A: Changes made to the NASF

Table A1. Changes made to the NASF to create the Aerotropolis Aviation Wildlife Safeguarding Framework.

Area	Change
Wildlife Buffers	Sub-divided 3km and 8 km buffers
Actions	Added action: 'Conditional'
Actions	Redistributed actions based on risk categories and distance from airport
Agriculture	Added land use: Abattoir
Agriculture	Added land use: Aquaculture
Agriculture	Added land use: Crops (e.g. wheat, grains, rice, legumes)
Agriculture	Added land use: Farm Dam
Agriculture	Added land use: Grain Storage
Agriculture	Added land use: Horticulture
Agriculture	Added land use: Market Farms and Gardens
Agriculture	Added land use: Orchard
Agriculture	Added land use: Viticulture
Agriculture	Removed land use: Fruit Tree Farm
Agriculture	Changed risk category: Plant Nursery from Low to Moderate
Conservation	Changed category name from Conservation to Conservation and Natural Areas
Conservation	Divided Wildlife Sanctuary and Conservation Area into separate land uses
Conservation	Divided Wetland and Dryland in to separate land uses
Conservation	Added land use: Wildlife Breeding/Roosting
Conservation	Added land use: Flying-fox Camp
Conservation	Added land use: Waterway (e.g. creeks, rivers)
Conservation	Added land use: Natural Areas
Conservation	Added land use: Wetland

Area	Change
Recreation	Added land use: Boat Ramps
Recreation	Added land use: Fish Cleaning Facilities
Recreation	Added land use: Public Feeding of Wildlife
Recreation	Added land use: Recreational Fishing Areas
Recreation	Added land use: Sports Fields
Recreation	Added land use: Urban Open Space (e.g. cycleways, green areas, pedestrian walkways)
Recreation	Added land use: Water Sport Facilities
Commercial	Added land use: Aerospace Industry
Commercial	Added land use: Construction
Commercial	Added land use: Earthworks
Commercial	Added land use: Marina
Commercial	Added land use: Markets
Commercial	Added land use: Public Transport Facility
Commercial	Added land use: School/University
Commercial	Added land use: Zoo
Commercial	Changed risk category: Fast food/Drive-in/Outdoor Restaurant from Low to High
Utilities	Separated Food/Organic Waste Facility into open and enclosed and uses
Utilities	Separated Putrescible Waste Facility - Landfill into open and enclosed land uses
Utilities	Separated Putrescible Waste Facility - Transfer Station into open and enclosed land uses
Utilities	Added land use: Dams
Utilities	Added land use: Stormwater Drains
Utilities	Added land use: Stormwater Management Facilities
Utilities	Added land use: Waste Collection Points (commercial)
Utilities	Added land use: Water Retention Basins

Area	Change
Utilities	Changed risk category: Food/Organic Waste Facility - Open from High to very High
Utilities	Changed risk category: Putrescible Waste Facility - Landfill - Open from High to Very High
Utilities	Changed risk category: Sewage/Wastewater Treatment Facility from Moderate to High
Utilities	Changed risk category: Non-putrescible Waste Facility - Transfer Station from Moderate to Low
New category	Added Landscaping and Vegetation
Landscaping and Vegetation	Added land use: Landscaping – Parks and Gardens
Landscaping and Vegetation	Added land use: Landscaping – Natural Area Revegetation
Landscaping and Vegetation	Added land use: Landscaping – Streets and Transport Corridors
Landscaping and Vegetation	Added land use: Landscaping – Roads and Motorways
Landscaping and Vegetation	Added land use: Landscaping – Rooftop Gardens

Appendix B: Guidelines for plant species use in Aerotropolis landscaping

Table B1 describes Avisure’s planting and landscaping guidelines developed to reduce the wildlife attraction on and in the vicinity of airports to help minimise the wildlife strike risk. It is recognised that elements of these guidelines contradict the landscaping objectives and principles developed for the Western Parkland City and may not be possible in some areas, particularly in areas that support the key government commitments detailed in Table 1. Table B1 comments on the appropriateness of each guideline to landscaping proposed throughout the Aerotropolis. It also suggests possible ways to incorporate and adapt the principles of the guidelines into Aerotropolis landscaping, although it is noted that more detailed stakeholder contribution to refine this is scheduled⁷.

Table B2. Planting guidelines and recommendations to reduce the wildlife attraction.

Area	Recommendation	Comment for application in Aerotropolis planning
Landscape and Vegetation Management Plan	Develop a plan that provides planting and species guidelines, identifies acceptable and unacceptable species, and provides guidance for landscaping to reduce the overall wildlife attraction.	Fully applicable. Aerotropolis stakeholders may consider adapting into existing landscaping plans and guidelines (e.g. Western Sydney Street Design Guidelines, Development Control Plans, Precinct Plans, etc.) or creating a standalone reference.

⁷ The Western Sydney Planning Partnership will coordinate dedicated workshops to refine the approach to Aerotropolis landscaping.

Area	Recommendation	Comment for application in Aerotropolis planning
Assessment and evaluation	For proposed landscaping works that do not meet approved guidelines, request an evaluation and assessment from a suitably qualified aviation ecologist.	Fully applicable.
Species selection	Select landscape plants that minimise the attraction of birds and flying-foxes.	Applicable and highly recommended. Specific guidelines should be developed for species selection based on the wildlife buffers.
	Do not plant trees and shrubs which bear edible berries, fruits, seeds or nuts, or flower profusely.	Applicable and highly recommended. Whilst all plants bear berries, fruits, seeds, nuts or flowers, this principle suggests excluding or minimising those species identified as significantly attractive to wildlife.
	Avoid species from the Proteaceae family. Commonly used landscaping species include, <i>Banksia</i> spp, <i>Grevillea</i> spp, <i>Hakea</i> spp. The nectar produced by these species can attract flying-foxes and various nectar feeding (nectivorous) birds such as lorikeets.	Applicable and highly recommended. This principle recommends replacing this group of plants with species that are less attractive to wildlife. Can be applied to specific locations in the Aerotropolis such as sub-area A1 in the 3 km wildlife buffer. Some species from this family are low wildlife attractants and may be suitable in some areas. Considering the wildlife attraction when designing planting schedules can help minimise the use of high risk ones.

Area	Recommendation	Comment for application in Aerotropolis planning
	<p>Avoid species from the Myrtaceae family. Commonly used landscaping species include <i>Callistemon</i> spp, <i>Corymbia</i>, <i>Eucalyptus</i> spp, <i>Lophostemon</i> spp, <i>Melaleuca</i> spp, <i>Syzygium</i> spp, <i>Xanthostemon</i> spp. Many species in this family produce large volumes of nectar that can be highly attractive to flying-foxes and various nectivorous birds. Studies at other airports have shown significant response to flowering <i>Melaleuca</i> by flying-foxes that have created severe strike risks.</p>	<p>Applicable and highly recommended.</p> <p>This principle recommends replacing this group of plants with species that are less attractive.</p> <p>Can be applied to specific locations in the Aerotropolis such as sub-area A1 in the 3 km wildlife buffer.</p> <p>Some species from this family are low wildlife attractants and may be suitable in some areas. Considering the wildlife attraction when designing planting schedules can help minimise the use of high risk ones.</p>
	<p>Avoid species from the Moraceae family. Commonly used landscaping species include <i>Ficus</i> spp (Figs) due to their decorative and aesthetic appeal. Fig fruits are highly attractive to flying-fox and other fruit eating (frugivorous) birds.</p>	<p>Applicable and highly recommended.</p> <p>This principle recommends replacing this group of plants with species that are less attractive.</p> <p>Can be applied to specific locations in the Aerotropolis such as sub-area A1 in the 3 km wildlife buffer.</p>
	<p>Avoid palm species. These extend across a range of families and should only be used when a strict documented regime of regular fruit/flower cluster removal occurs.</p>	<p>Applicable and highly recommended.</p> <p>This principle recommends replacing this group of plants with species that are less attractive.</p> <p>Can be applied to specific locations in the Aerotropolis such as sub-area A1 in the 3 km wildlife buffer.</p>

Area	Recommendation	Comment for application in Aerotropolis planning
	<p>Where the aforementioned species already exists in landscaped areas, and they are contributing an unacceptable risk to WSA, evaluate options to mitigate the risk (including removal and replacement with more suitable species).</p>	<p>Applicable and highly recommended if monitoring determines an unacceptable level of wildlife attraction relative to the airport.</p> <p>It is noted that in areas of high biodiversity value this may be inappropriate.</p>
<p>Design recommendations</p> <ul style="list-style-type: none"> • Trees (mature height >5m) • Shrubs (mature height 300m-5m). 	<p>Avoid clumps of trees and shrubs because they provide more shelter and more concentrated feeding areas than individual or small groups of plants.</p>	<p>Restricted.</p> <p>It is recognised that this principle contradicts the Parkland vision relating to canopy cover, biodiversity objectives and urban heat management.</p> <p>We recommend applying wherever possible close to the airfield (e.g. potential locations in the Aerotropolis such as sub-area A1 in the 3 km wildlife buffer).</p> <p>For those areas where applying this principle is not possible, plant species should be carefully selected to reduce the wildlife attraction.</p>

Area	Recommendation	Comment for application in Aerotropolis planning
	<p>Apply the following conditions when planting trees along access and other roads to the airport:</p> <ul style="list-style-type: none"> • Maximum mature height of any tree: 10m. • No more than 5 trees planted in any one group. • Average interval between tree groups not less than 200m. • Minimum interval between tree groups is 100m. • Single trees are planted >50m to any other single tree or tree groups. • Trees constitute no more than 5% of total tree/shrub plantings. 	<p>Restricted.</p> <p>It is recognised that this principle contradicts the Parkland vision relating to canopy cover, biodiversity objectives and urban heat management.</p> <p>We recommend applying wherever possible close to the airfield (e.g. potential locations in the Aerotropolis such as sub-area A1 in the 3 km wildlife buffer).</p> <p>For those areas where applying this principle is not possible, plant species should be carefully selected to reduce the wildlife attraction.</p>
	<p>Apply the following conditions to shrub plantings:</p> <ul style="list-style-type: none"> • Shrubs do not exceed 5m mature height. • Shrubs which produce nectar, fruits or seed (e.g. Banksia, Grevillea, Hakea) are not planted in groups of more than 5 per group and such groups are not be planted <50m to specimens of the same species or groups of any species which may similarly attract birds or flying-fox at the same time of the year. 	<p>Restricted.</p> <p>It is recognised that this principle contradicts the Parkland vision relating to canopy cover, biodiversity objectives and urban heat management.</p> <p>We recommend applying wherever possible close to the airfield (e.g. potential locations in the Aerotropolis such as sub-area A1 in the 3 km wildlife buffer).</p> <p>For those areas where applying this principle is not possible, plant species should be carefully selected to reduce the wildlife attraction.</p>

Area	Recommendation	Comment for application in Aerotropolis planning
Ground Cover (mature height <300m)	Use low prostrate ground cover plants, avoiding profusely fruiting or seeding species. Use ground cover species rather than grasses to reduce the wildlife attraction and minimise ongoing maintenance costs.	Applicable. Should be applied where possible.
	Avoid grasses that produce a lot of seed for rough grass or soil stabilisation.	Applicable and highly recommended. This principle recommends replacing this group of plants with species that are less attractive. Can be applied to specific locations in the Aerotropolis such as sub-area A1 in the 3 km wildlife buffer.
	Avoid grassed areas in gardens that require regular irrigation. Minimise the use of sprinklers and ensure taps do not drip. Encourage the use of water efficient technologies that may replace the need for traditional grasses and turf.	Restricted. It is recognised that this principle contradicts the Parkland vision relating to amenity in public places and the provision of sports fields. We recommend applying wherever possible close to the airfield (e.g. potential locations in the Aerotropolis such as sub-area A1 in the 3 km wildlife buffer). May focus on industry and commercial areas rather than residential areas.

Area	Recommendation	Comment for application in Aerotropolis planning
Maintenance	<p>Where they are contributing an unacceptable risk to WSA, evaluate options to mitigate the risk (including removal and replacement with more suitable species).</p> <p>Lopping and pruning to alter the structure of trees and shrubs can reduce food and perches and make the plants unsuitable for roosting or nesting. It can, however, be difficult if not impossible, to lop or prune some species of trees such as palms to the extent necessary to prevent birds from roosting or nesting. In such cases, the only effective way of removing the bird problem may be to remove the trees. Therefore, use palms sparingly, or not at all, in landscaping.</p>	Applicable if monitoring identifies significant wildlife hazards.
	Regularly prune and lop trees and shrubs to improve their health and vigour and prevent the establishment of communal roosts and nesting colonies which, if allowed to establish, can be difficult to remove.	Applicable if monitoring identifies significant wildlife hazards.
Landscaping works when airport is operational	Tube stock planting, hydro mulching or the establishment of other vegetation close to airports should be carefully monitored to determine any increase in wildlife activity. Management (e.g. wildlife dispersal) may be required if wildlife activity is elevating the strike risk at the airport.	Fully applicable.

Table B2 evaluates the wildlife attraction of plant species known to occur in Western Sydney (sourced from Tozer, the WSA EIS, and proposed planting schedules for roadside landscaping) along with other species that may be considered acceptable for use in landscaping throughout the Aerotropolis. The table also recommends suitability for use in the WSA wildlife buffers. The 13km buffer was excluded to allow more flexibility with landscaping. This table will be further refined following landscape-focused workshops scheduled with the Western Sydney Planning Partnership. These workshops will also better inform the acceptable species palette.

Table B3. Species selection.

Type	Botanical Name	Common Name	Bird attractant ²⁹	Flying-fox attractant ²⁹	Description	Recommended for use/inclusion in palette							
						3km (A1)		3km (A2)		8km (B1)		8km (B2)	
						Yes	No	Yes	No	Yes	No	Yes	No
Tree	<i>Araucaria cunninghamii</i>	Hoop Pine	<input type="checkbox"/>	<input type="checkbox"/>	May be used for perching or roosting. Monitoring is required to determine if communal birds (e.g. lorikeets) use as roosts. Avoid planting in rows/groups.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Tree	<i>Fraxinus 'Raywoodii'</i>	Claret Ash	<input type="checkbox"/>	<input type="checkbox"/>	May be used for perching or roosting. Monitoring is required to determine if communal birds (e.g. lorikeets) use as roosts. Avoid planting in rows/groups.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Tree	<i>Acacia implexa</i>	Hickory Wattle	<input type="checkbox"/>	<input type="checkbox"/>	May be used for perching or roosting, some parrot (e.g. rosellas) and pigeon species may forage on the seed pods. Monitoring required.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Tree	<i>Corymbia maculata</i>	Spotted Gum	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Species from the Myrtaceae family are generally attractive to birds and flying-foxes.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Tree	<i>Eucalyptus crebra</i>	Narrow-leaved Ironbark	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Species from the Myrtaceae family are generally attractive to birds and flying-foxes.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Tree	<i>Eucalyptus moluccana</i>	Grey Box	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Species from the Myrtaceae family are generally attractive to birds and flying-foxes.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Tree	<i>Eucalyptus tereticornis</i>	Forest Red Gum	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Species from the Myrtaceae family are generally attractive to birds and flying-foxes.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Tree	<i>Banksia oblongifolia</i>	Dwarf Banksia	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Species from the Proteaceae family are generally attractive to birds and flying-foxes.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Tree	<i>Banksia spinulosa</i>	Hairpin Banksia	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Species from the Proteaceae family are generally attractive to birds and flying-foxes.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Tree	<i>Callistemon viminalis</i>	Weeping Bottlebrush	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Species from the Proteaceae family are generally attractive to birds and flying-foxes.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Tree	<i>Leptospermum polygalifolium</i>	Tantoon	<input type="checkbox"/>	<input type="checkbox"/>	Insect attractant. May attract small numbers of small birds. Monitoring required.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Tree	<i>Melaleuca nodosa</i>	Prickly-leaved Paperbark	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Species from the Myrtaceae family are generally attractive to birds and flying-foxes. Low height may exclude flying-foxes.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Tree	<i>Acacia elata</i>	Cedar Wattle	<input type="checkbox"/>	<input type="checkbox"/>	May be inappropriate due to Obstacle Limitation Surface (OLS). Monitoring required.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Tree	<i>Alphitonia excelsa</i>	Red Ash	<input type="checkbox"/>	<input type="checkbox"/>	May be inappropriate due to OLS. Monitoring required.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

²⁹ Indicates an unacceptable level of attraction.

Type	Botanical Name	Common Name	Bird attractant ²⁹	Flying-fox attractant ²⁹	Description	Recommended for use/inclusion in palette							
						3km (A1)		3km (A2)		8km (B1)		8km (B2)	
						Yes	No	Yes	No	Yes	No	Yes	No
Tree	<i>Brachychiton populneus</i>	Kurrajong	<input type="checkbox"/>	<input type="checkbox"/>	May be inappropriate due to OLS. Monitoring required.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Tree	<i>Casuarina glauca</i>	Swamp Oak	<input type="checkbox"/>	<input type="checkbox"/>	May be inappropriate due to OLS. Monitoring required.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Tree	<i>Jacksonia scoparia</i>	Dogwood	<input type="checkbox"/>	<input type="checkbox"/>	Monitoring required.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Shrub/small tree	<i>Persoonia linearis</i>	Narrow-leafed Geebung	<input type="checkbox"/>	<input type="checkbox"/>	Fruits may attract some terrestrial animals (macropods, possums) and some birds. Monitoring required.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Shrub/small tree	<i>Pittosporum revolutum</i>	Rough-fruited Pittosporum	<input type="checkbox"/>	<input type="checkbox"/>	Monitoring required.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Shrub/small tree	<i>Pomaderris lanigera</i>	Woolly Pomaderris	<input type="checkbox"/>	<input type="checkbox"/>	Monitoring required.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Shrub	<i>Bursaria spinosa</i>	Native Blackthorn	<input type="checkbox"/>	<input type="checkbox"/>	Monitoring required.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Shrub	<i>Callistemon citrinus</i> 'White Anzac'	White Anzac Bottlebrush	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Species from the Myrtaceae family are generally attractive to birds and flying-foxes.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Shrub	<i>Indigofera australis</i>	Australian Indigo	<input type="checkbox"/>	<input type="checkbox"/>	Insect attractant. May attract small numbers of small birds. Monitoring required.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Shrub	<i>Melaleuca thymifolia</i>	Thyme Honey Myrtle	<input type="checkbox"/>	<input type="checkbox"/>	Insect attractant. May attract small numbers of small birds. Monitoring required.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Shrub	<i>Daviesia ulicifolia</i>	Gorse Bitter Pea	<input type="checkbox"/>	<input type="checkbox"/>	Insect attractant. May attract small numbers of small birds. Monitoring required.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Shrub	<i>Dillwynia sieberi</i>	Prickly Parrot Pea	<input type="checkbox"/>	<input type="checkbox"/>	Insect attractant. May attract small numbers of small birds. Monitoring required.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Shrub	<i>Dodonaea viscosa</i> subsp. <i>cuneata</i>	Wedge Leaf Hop Bush	<input type="checkbox"/>	<input type="checkbox"/>	Insect attractant. May attract small numbers of small birds. Monitoring required.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Shrub	<i>Melaleuca decora</i>	Decorative Paperbark	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Species from the Myrtaceae family are generally attractive to birds and flying-foxes.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Shrub	<i>Boronia floribunda</i>	Boronia	<input type="checkbox"/>	<input type="checkbox"/>	Monitoring required.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Shrub	<i>Hibbertia aspera</i>	Rough Guinea Flower	<input type="checkbox"/>	<input type="checkbox"/>	Monitoring required.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Shrub	<i>Leucopogon juniperinus</i>	Prickly beard-heath	<input type="checkbox"/>	<input type="checkbox"/>	Monitoring required.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Type	Botanical Name	Common Name	Bird attractant ²⁹	Flying-fox attractant ²⁹	Description	Recommended for use/inclusion in palette							
						3km (A1)		3km (A2)		8km (B1)		8km (B2)	
						Yes	No	Yes	No	Yes	No	Yes	No
Shrub	<i>Philotheca myoporoides</i>	Long-leaf Wax Flower	<input type="checkbox"/>	<input type="checkbox"/>	Monitoring required.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Shrub	<i>Westringia fruticosa</i>	Coastal Rosemary	<input type="checkbox"/>	<input type="checkbox"/>	Monitoring required.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Shrub	<i>Westringia longifolia</i>	Coastal Rosemary	<input type="checkbox"/>	<input type="checkbox"/>	Monitoring required.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Cover	<i>Imperata cylindrica</i>	Blady Grass	<input type="checkbox"/>	<input type="checkbox"/>	Monitoring required.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Cover	<i>Lomandra 'Katrinus'</i>	Mat Rush	<input type="checkbox"/>	<input type="checkbox"/>	Monitoring required.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Cover	<i>Lomandra 'Tanika'</i>	Mat Rush	<input type="checkbox"/>	<input type="checkbox"/>	Monitoring required.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Cover	<i>Axonopus fissifolius</i>	Carpet Grass	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Seed head removal required. Attractive to ground foragers (e.g. lapwings, parrots, magpies, ducks) if height maintained <150mm. Prevents weed eruptions (which may deter granivores such as parrots). Monitoring required.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Cover	<i>Coolabah oats</i>	Oats	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Likely to attract granivores.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Cover	<i>Cynodon dactylon</i>	Common Couch	<input type="checkbox"/>	<input type="checkbox"/>	Seed head removal required. Attractive to ground foragers (e.g. lapwings, parrots, magpies, ducks) if height maintained <150mm. Monitoring required.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Cover	<i>Echinochloa utilis</i>	Japanese Millet	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Seeds attract ground foragers. Pacific Black Duck – often involved in wildlife strikes.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Cover	<i>Secale cereale</i>	Rye Corn	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Attracts granivores, small mammals and invertebrates.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Cover	<i>Trifolium pratense</i>	Red Clover	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Attracts deer in the USA. May act as an attractant for Spotted Deer (high risk, see Table 1). May attract small nectivorous and insectivorous birds.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Cover	<i>Capillipedium spicigerum</i>	Scented Top Grass	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Seeds may attract granivorous birds. Seed removal may be required. Monitoring required.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Cover	<i>Chloris truncata</i>	Windmill Grass	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Seeds may attract granivorous birds. Seed removal may be required. Monitoring required.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Cover	<i>Cymbopogon refractus</i>	Barbed Wire Grass	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Seeds may be eaten by rosellas. Monitoring required.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Cover	<i>Dichanthium sericeum</i>	Queensland Bluegrass	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Seeds eaten by finchs, mannikins, galahs, cockatiels, corella and parrots.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Cover	<i>Lomandra longifolia</i>	Mat Rush	<input type="checkbox"/>	<input type="checkbox"/>	Dense plantings can create refuge for European Rabbit. Monitoring required.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Cover	<i>Microlaena stipoides</i>	Weeping Grass	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Seeds eaten by cockatoos, parrots, pigeons and finches.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Type	Botanical Name	Common Name	Bird attractant ²⁹	Flying-fox attractant ²⁹	Description	Recommended for use/inclusion in palette							
						3km (A1)		3km (A2)		8km (B1)		8km (B2)	
						Yes	No	Yes	No	Yes	No	Yes	No
Cover	<i>Themeda triandra</i>	Kangaroo Grass	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Seeds eaten by cockatoos, parrots, pigeons and finches Food sources for kangaroos.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Cover	<i>Baumea rubiginosa</i>	Soft Twigrush	<input type="checkbox"/>	<input type="checkbox"/>	Can create refuge and habitat for some waterbirds (e.g. ducks, herons, swamphens). Monitoring required.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Cover	<i>Bolboschoenus caldwellii</i>	Club Sedge	<input type="checkbox"/>	<input type="checkbox"/>	Can create refuge and habitat for some waterbirds (e.g. ducks, herons, swamphens). Monitoring required.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Cover	<i>Bolboschoenus fluviatilis</i>	River Bulrush	<input type="checkbox"/>	<input type="checkbox"/>	Can create refuge and habitat for some waterbirds (e.g. ducks, herons, swamphens). Monitoring required.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Cover	<i>Carex appressa</i>	Tall Sedge	<input type="checkbox"/>	<input type="checkbox"/>	Can create refuge and habitat for some waterbirds (e.g. ducks, herons, swamphens). Monitoring required.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Cover	<i>Ficinia nodosa</i>	Knobby Club Rush	<input type="checkbox"/>	<input type="checkbox"/>	Can create refuge and habitat for some waterbirds (e.g. ducks, herons, swamphens). Monitoring required.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Cover	<i>Gahnia sieberiana</i>	Red-fruited Saw-sedge	<input type="checkbox"/>	<input type="checkbox"/>	Can create refuge and habitat for some waterbirds (e.g. ducks, herons, swamphens). Monitoring required.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Cover	<i>Juncus usitatus</i>	Common Rush	<input type="checkbox"/>	<input type="checkbox"/>	Can create refuge and habitat for some waterbirds (e.g. ducks, herons, swamphens). Monitoring required.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Cover	<i>Philydrum lanuginosum</i>	Frogmouth	<input type="checkbox"/>	<input type="checkbox"/>	Can create refuge and habitat for some waterbirds (e.g. Ducks, herons, swamphens). Monitoring required.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Cover	<i>Schoenoplectiella mucronata</i>	Bog Bulrush	<input type="checkbox"/>	<input type="checkbox"/>	Can create refuge and habitat for some waterbirds (e.g. Ducks, herons, swamphens). Monitoring required.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Cover	<i>Schoenoplectus validus</i>	Softstem Bulrush	<input type="checkbox"/>	<input type="checkbox"/>	Can create refuge and habitat for some waterbirds (e.g. Ducks, herons, swamphens). Monitoring required.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Cover	<i>Gahnia sieberiana</i>	Red-fruited Saw-sedge	<input type="checkbox"/>	<input type="checkbox"/>	Can create refuge and habitat for some waterbirds (e.g. ducks, herons, swamphens). Monitoring required.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Appendix C: Additional aviation industry guidance

We recommend referring to the following Airport Practice Notes published by the Australian Airports Association (available at www.airports.asn.au):

- Airport Practice Note 9: Wildlife Hazard Management at Airports 2016.
- Airport Practice Note 6: Managing Bird Strike Risk Species Information Sheets 2015.

The following tables summarise relevant recommendations from various regulation and guidance material to minimise the wildlife attraction on airports. These recommendations are for aviation, specifically for airport sites, however the principles may be applicable and useful for off-airport land use and design.

Drains and Culverts

Table C1. National and international requirements and recommendations for drain and culvert management on airports to manage wildlife hazards.

Reference	Section	Detail
ICAO Airport Services Manual Doc 9137 4th Ed. 2012	4.5.8	Water bodies in many parts of the world can be a particular hazard because they can be very attractive to birds. It may be possible for these to be modified by netting them to exclude birds, fencing them to deny access to birds that walk in, have the sides steepened or made less attractive in other ways.
	7.3	Surface water is often highly attractive to birds. Exposed water should be eliminated or minimized to the greatest extent possible on airport property as follows: ... Larger water bodies, such as storm-water retention lagoons, can be covered with wires or netting to inhibit birds from landing. Larger water bodies that cannot be eliminated should have a perimeter road so that bird/wildlife-control personnel can quickly access all parts of the water body to disperse birds. Water bodies and ditches should have steep slopes to discourage wading birds from feeding in shallow water.

Reference	Section	Detail
CASA AC 139-28(0) 2011	10.4	Pre-emptive treatments. These are generally applied to the aerodrome environment and can include but not limited to: (b) Covering open water sources, drains, etc.
CASA MOS Part 139 Aerodromes	6.2.23.3	<i>Surface of graded area of runway strips</i> Effective drainage (but not involving open drains) must ensure that water does not pool or pond in the graded area of a runway strip.
	12.1.12.03.7	<i>Serviceability Inspections</i> The serviceability inspection must include the following: (b) monitoring the presence and behaviour of any wildlife on, or likely to be on, the aerodrome, and identifying seasonal and environmental conditions which may act as an attractant (d) checking for off-aerodrome wildlife attraction sources, observable from the aerodrome site, for example, mowing activities, seeding, standing water bodies, uncovered waste disposal, deceased wildlife or offal;
IBSC Standards	1 Background	Habitat management, such as improving drainage, installing fences, modifying vegetation cover etc. is frequently expensive. It is often difficult to obtain resources for programmes which, in the case of vegetation modification, may take a number of years to fully implement, and the benefits of which are not always immediately apparent to airport managers. Commitment to the process from senior managers is therefore essential and a named member of the airport's senior management should take responsibility for ensuring that this, and other parts of the bird/wildlife hazard management programme are carried out properly.

Reference	Section	Detail
ICAO Airport Services Manual Doc 9137 4th Ed. 2012	7.3 (b)	Drainage ditches. When drainage ditches clog up with vegetation or eroded soil and the flow of water is impeded, insect and other aquatic life flourish, thereby attracting birds if remaining unnetted. In order to address such issues, culverting the ditches is recommended. Clearing the ditches at regular intervals is important. They should be graded so that the water will run off as rapidly as possible. Grass and other vegetation should be cut on the sloping banks. Where practicable, the water attractant can be eliminated by replacing ditches with buried drain pipes.
ACI Wildlife Hazard Management Handbook 2013	Annex A (Habitat Management)	Where construction measures, such as drainage, cannot be undertaken, airport operators should identify water bodies that are used by significant numbers of hazardous wildlife and undertake action to limit the access of wildlife to these bodies. Placing floating balls, netting or overhead wires, can be excellent solutions, depending on the species present.
Transport Canada – Sharing the Skies ¹⁴	Chapter 8 (Water-habitat Management)	Open drainage/ditches - Increase the slope of banks to eliminate shelter areas.
		Water bodies - Set up barriers to prevent access to water using material such as nylon mesh and wires.
Federal Aviation Administration ¹⁵	AC 150 / 5200-33B	Strongly recommends that off-airport storm water management systems be designed and operated so as not to create above-ground standing water if they are located within 10,000 feet (3km) or 5 miles (8km) if the attractant could cause hazardous wildlife movement across the approach or departure airspace.

Reference	Section	Detail
CAA CAP772 Birdstrike Risk Management for Aerodromes	2.4 Water	<p>2.4.1 Watercourses and drainage ditches provide cover and food, especially for ducks and herons. Wherever possible, watercourses on the aerodrome should be culverted underground. Where culverting is not possible, effective bird exclusion or control systems such as netting enclosures extending to the aerodrome perimeter should be deployed as necessary to protect new developments and existing water bodies and watercourses. Channels should be maintained free of bank side and emergent vegetation to minimise flooding and damage to nets.</p>
		<p>2.4.2 Netting enclosures are the most efficient approach but are practical only for smaller ponds and watercourses. However, an enclosure also removes the need for any other control measures or habitat modification. A less reliable form of enclosure is to 'cover' the open water with reed beds, or Carr (wetland alder or willow woodland) but there are practical problems with establishing and maintaining the vegetation and there exists the possibility of a Starling roost forming.</p>
		<p>2.4.6</p> <ul style="list-style-type: none"> a) the water should be as deep as possible (over 4 m) to minimise bottom growing vegetation. c) banks should be as steep as possible (preferably vertical), with minimal vegetation; to prevent birds from walking in and out of the water. d) there should be a vertical lip or fence to prevent birds from walking in and out of the water.
		<p>2.4.7 All water features, including those with bird exclusion systems, should wherever possible be sited so that the bird movements they create do not conflict with aircraft, taking into account their locations relative to both aircraft flightpaths and other water bodies in the aerodrome vicinity.</p>

Ground Depressions

Table C2. National and international requirements and recommendations for ground depression management on airports to manage wildlife hazards.

Reference	Section	Detail
ICAO Airport Services Manual Doc 9137 4 th Ed. 2012	7.3 (a)	<i>Depressions and water bodies.</i> Pits or depressions that fill with water after rains should be levelled and drained. Larger water bodies, such as storm-water retention lagoons, can be covered with wires or netting to inhibit birds from landing. Larger water bodies that cannot be eliminated should have a perimeter road so that bird/wildlife-control personnel can quickly access all parts of the water body to disperse birds. Water bodies and ditches should have steep slopes to discourage wading birds from feeding in shallow water.
ACI Wildlife Hazard Management Handbook 2013	Annex A (Habitat Management)	Insofar as possible, very wet land and stagnant water on aerodromes should be drained. The presence of water is a major factor in attracting wildlife, particularly birds, aquatic mammals and amphibians and creates habitat for aquatic invertebrates that often hatch synchronously in large numbers thereby attracting large numbers of insect predators (e.g. birds, bats).
Transport Canada – Sharing the Skies ³⁰	Chapter 8 (Water-habitat Management)	Open drainage/ditches - Drain ditch bottoms to eliminate standing water used by birds and mammals.
CAA CAP772 Birdstrike Risk Management for Aerodromes	2.4 Water	2.4.3 Drainage of wet and waterlogged grass should be installed, or the site regraded to eliminate hollows that hold standing water.

Detention Basins

Table C3. National and international requirements and recommendations for detention basin management on airports to manage wildlife hazards.

Reference	Section	Detail
Federal Aviation Administration ³¹	AC 150 / 5200-33B	Stormwater detention ponds should be designed, engineered, constructed, and maintained for a maximum 48-hour detention period after the design storm and remain completely dry between storms.
		To facilitate the control of hazardous wildlife, the FAA recommends the use of steep-sided, rip-rap lined, narrow and linearly shaped water detention basins.
		When it is not possible to place these ponds away from an airport's Air Operations Area, airport operators should use physical barriers, such as bird balls, wires grids, pillows, or netting, to prevent access of hazardous wildlife to open water and minimize aircraft-wildlife interactions.
		When physical barriers are used, airport operators must evaluate their use and ensure they will not adversely affect water rescue.
		All vegetation in or around detention basins that provide food or cover for hazardous wildlife should be eliminated.
		If soil conditions and other requirements allow, the FAA encourages the use of underground storm water infiltration systems, such as French drains or buried rock fields, because they are less attractive to wildlife.
Transport Canada – Sharing the Skies ³⁰	Chapter 8 (Water-habitat Management)	<p>Open drainage/ditches - Increase the slope of banks to eliminate shelter areas.</p> <p>Water bodies - Set up barriers to prevent access to water using material such as nylon mesh and wires.</p>

Reference	Section	Detail
CAA CAP772 Birdstrike Risk Management for Aerodromes	2.4 Water	<p>2.4.1 Watercourses and drainage ditches provide cover and food, especially for ducks and herons. Wherever possible, watercourses on the aerodrome should be culverted underground. Where culverting is not possible, effective bird exclusion or control systems such as netting enclosures extending to the aerodrome perimeter should be deployed as necessary to protect new developments and existing water bodies and watercourses. Channels should be maintained free of bank side and emergent vegetation to minimise flooding and damage to nets.</p>
		<p>2.4.2 Netting enclosures are the most efficient approach but are practical only for smaller ponds and watercourses. However, an enclosure also removes the need for any other control measures or habitat modification. A less reliable form of enclosure is to 'cover' the open water with reed beds, or Carr (wetland alder or willow woodland) but there are practical problems with establishing and maintaining the vegetation and there exists the possibility of a Starling roost forming.</p>
		<p>2.4.6</p> <ul style="list-style-type: none"> a) the water should be as deep as possible (over 4 m) to minimise bottom growing vegetation. c) banks should be as steep as possible (preferably vertical), with minimal vegetation; to prevent birds from walking in and out of the water. d) there should be a vertical lip or fence to prevent birds from walking in and out of the water.
		<p>2.4.7 All water features, including those with bird exclusion systems, should wherever possible be sited so that the bird movements they create do not conflict with aircraft, taking into account their locations relative to both aircraft flightpaths and other water bodies in the aerodrome vicinity.</p>

Grass

Table C4. National and international requirements and recommendations for grass management on airports to manage wildlife hazards.

Reference	Section	Detail
ICAO Airport Services Manual Doc 9137 4 th Ed. 2012	4.2	Control Program: d) a process of habitat and land management both on the airport and in its vicinity in order to reduce the attractiveness of the area to birds/wildlife. Where applicable and relevant, this should include effective grass management techniques and, where applicable, a long/tall grass policy for "on-airfield" areas.
	4.5	Management of Infrastructure, Vegetation and Land Use: 4.5.4 Vegetation composition (grass) should be kept at a height that is considered unattractive to hazardous birds/wildlife, while accepting that this may not be applicable in arid locations. The attractiveness of vegetation is a balance between food presence, food accessibility and protection against predators: <ul style="list-style-type: none"> • earthworms, insects, rodents and other animals are present in and on the soil and in the vegetation. The vegetation itself and its seed are food for plant and seed eaters; • food accessibility depends on vegetation height and density. Long, dense vegetation will inhibit most hazardous birds/wildlife from moving around, detecting and accessing the food; • birds/wildlife safeguard themselves from predators by hiding and/or fleeing. Long, dense vegetation is preferred as a hiding place by agoraphobian species. These species avoid the open space of the runway and short vegetation. On the other hand, claustrophobic species avoid long, dense vegetation and prefer to stay in the open space of the runway and short vegetation where they have a wide view to see predators well in advance to enable them to flee on time; and • birds/wildlife feeding on seeds will avoid the airport if its vegetation is mowed during the flowering season. When these flowers attract insects that are attracting aerial feeders (for example swallows, swifts and bee-eaters), the vegetation should be cut before the flowering season in order to maximize deterrence of local wildlife species, and the height and species composition of the vegetation should be managed to minimize food sources.

Reference	Section	Detail
	Chapter 7	<p>Habitat Management and Site Modification</p> <p>... the management of an airport's airside ground cover to minimize its attractiveness to wildlife is a critical activity.</p> <p>Recommendations include:</p> <ul style="list-style-type: none"> • Studies in Europe have indicated that maintaining a monoculture of tall or long (150 mm to 200 m high) dense grass can discourage gulls, lapwings and similar birds from landing and feeding on soil invertebrates. However, studies and observations in North America, parts of Africa and Asia indicate that tall grass does not discourage certain large birds such as geese, herons and egrets. • When seeds are the most important food source, the vegetation should be mowed during the flowering season. • Mowing activities may attract birds to feed by exposing invertebrates and rodents. The height of the vegetation and the timing and frequency of mowing on an airport should be oriented to minimizing hazardous wildlife and not to any other horticultural benefits which may arise from the ground cover. • Consult with professional biologists and horticulturists to develop a vegetation type and mowing regime appropriate for the growing conditions and wildlife at the location. The main principles to follow are to use a vegetation cover and mowing regime that do not result in a build-up of rodent numbers or the production of seeds, forage or invertebrates desired by wildlife.
Transport Canada – Sharing the Skies	Chapter 8	<p>Solutions – The Airport & Surroundings.</p> <p>Keep grass length at 10 to 15 cm (average length in Canada) to reduce loafing and feeding activity (please note that site-specific studies are required in order to determine optimum grass length).</p> <p>Keep grass areas free of broad-leaf weeds, which attract some mammal species and provide a food source.</p> <p>Spray insecticides and herbicides beside runways to eliminate seeds and insects.</p>

Reference	Section	Detail
		<p>Prior to implementation of a long-grass program, careful consideration should be given to the potential for increased collateral hazards. Long-grass fields may reduce gull and starling numbers but may create new habitats for other species such as ground-nesting birds, and small mammals such as voles, hares and rabbits.</p>
<p>CAA CAP772 Birdstrike Risk Management for Aerodromes</p>	<p>2.6</p>	<p>Aerodrome Grass Management:</p> <p>2.6.1 ... Grass maintained at a height of 150 to 200 mm (6" to 8") makes it more difficult for birds to locate prey at or below the surface, spoils the security effect, and reduces populations of soil invertebrate food sources. If maintained at this height, bird numbers on the aerodrome can be reduced significantly, particularly waders, small Gulls, Plovers, Corvids and Starlings. This method of grass management is often referred to as a long grass policy.</p>
		<p>2.6.2 All grass areas within the aerodrome boundary, including the margins adjacent to runways and taxiways should be included in the grass maintenance scheme.</p>
		<p>2.6.5 Long grass regimes are usually effective only when the aerodrome bird control organisation is involved in planning, monitoring and regulating the maintenance programme.</p>

Vegetation and Landscaping

Table C5. National and international requirements and recommendations for vegetation and landscaping on airports to manage wildlife hazards.

Reference	Section	Detail
ICAO Airport Services Manual Doc 9137 4 th Ed. 2012	Chapter 7	<i>c) Trees and shrubs.</i> Much care must be taken when selecting and spacing plants for airport landscaping. Avoid plants that produce fruits and seeds desired by wildlife. Also avoid the creation of areas of dense cover for roosting by flocking species of birds. Thinning the canopy of trees or selectively removing trees to increase their spacing can help eliminate bird roosts that form in trees on airports.
CAA CAP772 Birdstrike Risk Management for Aerodromes	4 Safeguarding	4.6 The following factors should be taken into consideration when assessing the potential increase in risk: b) any proposed landscaping or habitat designs.
ACI Wildlife Hazard Management Handbook 2013	4.2.1	On-airport Habitats Landscaping then usually involves seeding open areas for grass or other appropriate plant coverage to avoid soil erosion. Grass and plant species must be selected taking into account maintenance and watering needs, seeds and fruit, and shelter and nesting for wildlife.
	Annex A Habitat Management	Landscaping of Aerodromes. The planting of trees, bushes and other plants has the undesired effect of attracting wildlife, and particularly birds. The management of the wildlife hazard should be considered part of the project planning from the very beginning. Care should be taken with the selection of sites for planting and the varieties used which can have a significant impact on the presence of wildlife. In all cases, plants which produce food such as berries and fruit should be avoided. Also, continuous stands of vegetation should be avoided. Preferably, trees should be spaced so that they do not form a continuous canopy and shrubs should not be planted under the canopy of trees and should also be spaced so as to not touch each other. Open form trees and shrubs should be selected, avoiding coniferous trees and shrubs which provide year-round shelter.

Fencing

Table C6. National and international requirements and recommendations for fencing on airports to manage wildlife hazards.

Reference	Section	Detail
CASA MOS Part 139 Aerodromes	10.2.10.1	The inspection must check for damaged fences, open gates and signs of attempted entry by either animals or humans.
Australian Standard 1725-3003 (Chain-link Fabric Security Fences) and 1725.1- 2010 (Chain-link Fabric Security Fences and Gates)	2.14 (2)	The Transport Security Plan (TSP) must set out security measures and procedures to monitor and control access to landside and airside security zones, including measures to detect and deter unauthorised access to those zones.
	3.15 (1)	The requirements for the fencing of, and the provision of other physical barriers to entry to, the airside area of a security-controlled airport are: (a) subject to subregulation (2), a barrier sufficient to delineate the airside area; and (c) patrolling, electronic surveillance or any other suitable measures to inspect the barriers for damage and to deter and detect unauthorised access to the airside area.
ICAO Airport Services Manual Doc 9137 4th Ed. 2012	4.5.3	A complete perimeter fence of adequate height is the prime method of preventing hazardous wildlife, other than birds, from gaining access to the airfield areas. Fences and gates should be left closed and regularly checked.
ACI Wildlife Hazard Management Handbook 2013	4.2.1	On-Airport Habitats A perimeter fence around the airport airside areas is often required for safety and security reasons. The ability to exclude local wildlife will be a key consideration with designing and constructing a boundary fence.

Reference	Section	Detail
IBSC Standards	1	<p>Background</p> <p>Habitat management, such as improving drainage, installing fences, modifying vegetation cover etc. is frequently expensive. It is often difficult to obtain resources for programmes which, in the case of vegetation modification, may take a number of years to fully implement, and the benefits of which are not always immediately apparent to airport managers. Commitment to the process from senior managers is therefore essential and a named member of the airport's senior management should take responsibility for ensuring that this, and other parts of the bird/wildlife hazard management programme are carried out properly.</p>

Airside Infrastructure

Table C7. National and international requirements and recommendations for airside infrastructure to manage wildlife hazards.

Reference	Section	Detail
CAA CAP772 Birdstrike Risk Management for Aerodromes	2	<p>Habitat Management</p> <p>2.2.2 Bins and skips should be of designs that exclude birds (e.g. with drop down or swinging lids) and should be emptied before they overflow.</p> <p>2.3.2 Dilapidated buildings should be proofed and repaired to prevent access by roosting and nesting birds. Wherever possible, new buildings should be designed:</p> <ul style="list-style-type: none"> • to deny access to the interior and roof spaces; • with self-closing doors or with plastic strip curtains or other mechanisms to prevent access by birds; • without flat roofs; and • with minimal roof overhangs and without ledges beneath overhangs and external protrusions.

Reference	Section	Detail
		2.3.3 All areas of rooftops should be easily accessible to enable action against nesting Gulls, which most commonly colonise large flat or shallow-pitched roofs. However, they will also use steeply sloping roofs where the nests can be lodged behind vents, skylights, etc.
ICAO Airport Services Manual Doc 9137 4th Ed. 2012	7.4	<p>Shelter</p> <p>Structures Architects should consult biologists during the design phase of buildings, hangars, bridges and other structures at airports to minimize exposed areas that birds can use for perching and nesting. When perching sites are present in older structures (such as rafter and girded areas in hangars, warehouses and under bridges) access to these sites can often be eliminated with netting. Anti-perching devices, such as spikes, can be installed on ledges, roof peaks, rafters, signs, posts and other roosting and perching areas to keep certain birds from using them. Changing the angle of building ledges to 45 degrees or more will deter birds. However, it is emphasized that incorporating bird exclusion or deterrence into the design of structures is the most effective, long-term solution.</p>
ACI Wildlife Hazard Management Handbook 2013	4.2.1	<p>On-Airport Habitats</p> <p>Wildlife hazard issues must be taken into account at the airport infrastructure planning stages.</p>
	Annex A	<p>Habitat Management</p> <p>Analysis of buildings can identify places that can be used by wildlife. The elimination of these potential shelters will decrease the numbers of animals present. All dilapidated or ruined buildings, on or in the direct vicinity of the aerodrome, should either be repaired or demolished. Those structures are often colonized by wildlife that uses them as shelters and for breeding purposes.</p> <p>Signs and lights along runways and taxiways are ideal perches for birds, and particularly raptors, which use them as observation posts when hunting. Limiting their use as perches can be an excellent solution to reduce the presence of birds. The installation of metal spikes, preferably the 'rotating 3-spike version', prevents birds from landing on them.</p>

Waste Management

Table C8. National and international requirements and recommendations for waste management to manage wildlife hazards.

Reference	Section	Detail
ICAO Airport Services Manual Doc 9137 4th Ed. 2012	7.2	Food b) Food waste. Airports should require wildlife-proof storage of food waste, prohibit bird/wildlife feeding and promote good sanitation and litter control programmes.
ACI Wildlife Hazard Management Handbook 2013	Annex A	An aerodrome has the potential to offer a great variety of food sources to wildlife. The main sources of food for wildlife are: Rubbish/garbage/waste, especially food waste.
CAA CAP772 Birdstrike Risk Management for Aerodromes	4	Bird Attractant Habitats: On-Aerodrome 4.2.4 Wastes from in-flight and terminal catering areas, litterbins in car parks and viewing terraces, etc. attract Gulls, Feral pigeons, Corvids, Starlings and other Passerines (perching birds).
		4.3.2 The presence of other, less prominent features such as open drainage ditches, ponds, scrub, bushes and trees, earth banks, and waste food also provide more habitats, for larger numbers of birds and additional species, to exploit.



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