Mackay Airport

Wildlife Hazard Management Plan

Version 3.0

Mackay Airport Proprietary Limited

Mackay Airport
FOR WORKDAYS AND HOLIDAYS

AVISURE
safety | aviation | wildlife

Executive Summary

This document forms the Wildlife Hazard Management Plan for Mackay Airport. It defines the risk that wildlife poses to air traffic and outline objectives, responsibilities and procedures for managing, assessing, monitoring and recording wildlife hazards for the management of that risk.

The Wildlife Hazard Management Plan has been prepared in accordance with the Civil Aviation Safety Authority Manual of Standards Part 139 to provide procedures to deal with the danger to aircraft operations caused by the presence of wildlife on or near the aerodrome and to ensure at least basic protection is provided such as grass cutting and fencing.

An analysis of strike data from Mackay Airport between July 2018 and June 2019 shows 26 confirmed on-airport and vicinity strikes, with five of these strikes affecting planned flight. Mackay Airport has a strike average of 1.82 confirmed strikes per 10,000 aircraft movements.

Risks assessments calculated 1 very high risk, 7 high risk and 17 moderate species. Risk assessments use survey data collected during site visits and five years of strike data. Refer to section 6 for results.

Avisure surveyed off-airport land uses that attracted, or had the potential to attract, wildlife and identified 12 within 3 km, 13 between 3-8 km, 2 between 8-13 km and an additional 2 potential hazardous habitats beyond 13km of Mackay Airport.

Four key sections form the framework of the Wildlife Hazard Management Plan:

1. The **Strategy** that addresses the overall commitment, legal framework, roles, and responsibilities to ensure that the WHMP is effectively implemented.
2. The **Wildlife Hazard Assessment** that provides information to effectively implement the tactical component of the Wildlife Hazard Management Plan.
3. The **Tactical Plan** that establishes the wildlife hazard context, the risk assessment, risk evaluation and risk mitigation. It also outlines how the risk is communicated, monitored and reviewed.
4. The **Safety Assurance** that outlines the process of managing change, continually improving the Wildlife Hazard Management Plan, and assessing achievement against the objectives.

The Wildlife Hazard Management Plan aims to reduce the frequency and severity of strikes by focussing management efforts on species and habitats that constitute significant hazards to aircraft operations. This is achieved by:

- Hazard detection
- Hazard monitoring
- Hazard communication
- Wildlife strike reporting
- Data management
- Hazard mitigation

Objective targets, key performance indicators, and monitoring are used to evaluate implementation of the Wildlife Hazard Management Plan.

Authorisation

The Wildlife Hazard Management Plan has been prepared in accordance with the Civil Aviation Safety Authority Manual of Standards Part 139 to provide procedures to deal with the danger to aircraft operations caused by the presence of wildlife on or near the aerodrome and to ensure at least basic protection is provided such as grass cutting and fencing.

Mackay Airport is responsible for coordinating this plan and the Manager Aviation Operations authorises it.

Philip Clark
Manager Aviation Operations
Mackay Airport Pty Ltd

05/02/20
Date

Record of Review

Version	Year	Description of Change	Signed
1.0	Feb. 2005	Wildlife Hazard Management Plan	Philip Clark Manager Aviation Operations
1.1	Nov. 2011	Wildlife Hazard Management Plan	Philip Clark Manager Aviation Operations
1.2	Feb. 2012	Wildlife Hazard Management Plan	Philip Clark Manager Aviation Operations
1.3	Sep. 2012	Updates to: • Risk assessment • Species action plans	Philip Clark Manager Aviation Operations
1.4	Sep. 2013	Updates to: • Culling and egg/nest removal • Risk assessments • Species actions plans	Philip Clark Manager Aviation Operations
1.5	Jul. 2014	Updates to: • Risk assessment • Species management table • Species action plans	Philip Clark Manager Aviation Operations
1.6	Jul. 2015	Updates to: • Risk assessment • Risk characterisation • Landscaping Policy • Species action plans	Philip Clark Manager Aviation Operations
1.7	Jul. 2016	Updates to: • Risk assessment • Risk Characterisation • Species Action Plans • Wildlife Count Procedure	Philip Clark Manager Aviation Operations

Version	Year	Description of Change	Signed
1.8	Jul. 2017	Updates to: • Risk assessment • Risk Characterisation • Species Action Plans	Philip Clark Manager Aviation Operations
2.0	Jul. 2018	• WHMP re-issue • Full document re-write • Risk assessment • Risk characterisation	Philip Clark Manager Aviation Operations
3.0 Draft	Jul. 2019	• WHMP re-issue • Full document re-write • Risk assessment • Risk characterisation • Updated SOPs • Updated SAPs	Philip Clark Manager Aviation Operations
3.0 Final	Jan. 2020	• Minor amendments • Created separate document for SAPs and SOPs	Philip Clark Manager Aviation Operations

On receipt of this revision, please destroy all previous and now obsolete copies.

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Glossary

Active Management	The use of short-term management techniques such as distress calls, pyrotechnics, trapping and culling to disperse or remove birds.
Aerodrome/Airfield	Any location where aircraft take off, land and are stored and maintained. An airfield consists of at least one runway for an aircraft to take off and land, and may contain a helipad, buildings such as control towers, hangars and terminal buildings.
Aerodrome Operator	The aerodrome is operated by Mackay Airport Proprietary Limited.
Aircraft	Any machine that can derive support in the atmosphere from reactions of the air rather than the reactions of air against the earth's surface.
Aircraft Operator	A person, organisation or enterprise engaged in, or offering to engage in, aircraft operations.
Airside	A defined area of land or water intended to be used either wholly or in part for the arrival, departure and movement of aircraft which is access controlled.
Air Traffic Control	Ground based aircraft control and information service.
Apron	A defined area on a land aerodrome intended to accommodate aircraft for the purpose of loading or unloading passengers or cargo, refuelling, parking or maintenance.
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.
Critical Area	Areas within or in proximity to the runway strip, approach and landing paths, and movement areas of an aerodrome.
Diurnal	Wildlife that are active during the daytime.
Firearm	A shotgun, rifle or other weapon as defined under State and Commonwealth Legislation.
Foraging	When animals search for and obtain food.
Hazard	A source of potential harm or a situation with potential to cause loss.
Incident	An occurrence, other than an emergency/disaster, associated with the operation of an aircraft that impacts on the safety of operations.
Log Book	Sequential recording system used to record daily events, including significant events and actions entered by the ASO.
Manoeuvring Area	Airport areas used for taxiing, take-off and landing of aircraft, excluding the aprons.
Movement Area	Airport areas used for the movement of aircraft, including aprons and manoeuvring areas.

Migratory	When animals pass periodically from one region to another.
Nocturnal	Wildlife that are active during the night time.
Passive Management	The modification of habitat, including buildings and other manmade structures to render it less attractive to wildlife.
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.
Risk	The chance of something happening that will have an impact upon objectives. It is measured in terms of consequences and probability.
Roost	When birds repeatedly return to a particular place in numbers to loaf or spend the night.
Runway	A defined area on an aerodrome prepared for the take-off and landing of aircraft.
Runway Strip	A defined area around a runway, marked by gable markers, that is considered part of the runway.
Significant Strike	A significant strike is when there is damage or an adverse effect on flight. This includes aborted or non-standard procedure, precautionary or forced landing, delay/cancellation, diversion, accident or affects the serviceability of the aerodrome.
Taxiway	A defined path on an aerodrome established for the movement of aircraft between one part of the aerodrome and another including: • Aircraft stand taxi lane: A portion of an apron designated as a taxiway and intended to provide access to aircraft stands only. • Apron taxiway: A portion of the apron designated as a taxiway and intended to provide access to aircraft parking positions.
Transit	When birds fly from one place to another.
Wildlife	Wildlife refers to animals that may pose hazards to aircraft when struck. This includes birds, bats and terrestrial mammals such as rabbits, hares, foxes, dogs etc.
Wildlife Count	Standardised and regular counts of birds and other animals. Usually completed by Airport Operations Coordinator.
Wildlife Strike	A **reported wildlife strike** is deemed to have occurred whenever: • 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 • 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.

	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: • no wildlife carcass or remains are found, and • there is no physical evidence on the aircraft of the strike having occurred. A **confirmed wildlife strike** is deemed to have occurred whenever: • aircrew report that they *definitely* 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. A **wildlife near miss** is deemed to have occurred whenever a pilot takes evasive action to avoid birds or animals. 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. 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. 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.
Wildlife Survey	Standardised surveys that capture data regarding wildlife species, their behaviours and their distribution. Completed by suitably trained and qualified wildlife ornithologists or biologists.

Abbreviations

AAWS	Australian Animal Welfare Strategy
AC	Advisory Circular
ADA	Authority to Drive Airside
AFRU	Aerodrome Frequency Response Unit
AGL	Above Ground Level
AIP	Aeronautical Information Package
AMSL	Above Mean Sea Level
AOM	Aerodrome Operations Manual
ARFF	Aircraft Rescue and Firefighting
ARP	Aeronautical Reference Point
ASIC	Aviation Security Identification Card
ASMS	Aerodrome Safety Management System
ASO	Aerodrome Safety Officer
ASRI	Aerodrome Survey Risk Index
AS/NZS	Australian Standard/New Zealand Standard
ATC	Air Traffic Control
ATIS	Automatic Terminal Information Service
ATSB	Australian Transport Safety Bureau
AUA	Authority to Use Airside
CAMBA	China-Australia Migratory Bird Agreement
CASA	Civil Aviation Safety Authority
CASR	Civil Aviation Safety Regulation
CCTV	Closed-circuit Television
CEO	Chief Executive Officer
CTAF	Common Traffic Advisory Frequency
DES	Department of Environment and Science
DME	Distance Measuring Equipment
DMP	Damage Mitigation Permit
EPBC	Environment Protection & Biodiversity Conservation Act
ERSA	En Route Supplement Australia
FOD	Foreign Object Debris
GA	General Aviation
GMMA	General Manager Mackay Airport

IBSC	International Bird Strike Committee
ICAO	International Civil Aviation Organization
IR	Infringement Rate
JAMBA	Japan-Australia Migratory Bird Agreement
KPI	Key Performance Indicator
MAO	Manager Aviation Operations
MAPL	Mackay Airport Pty Ltd
MOS	Manual of Standards
MOU	Memorandum of Understanding
NASF	National Airport Safeguarding Framework
NC Act	Nature Conservation Act
NDB	Non-Directional Beacon
NOTAM	Notice to Airmen
NSW	New South Wales
PAPI	Precision Approach Path Indicator
PPE	Personal Protective Equipment
QLD	Queensland
RSPCA	Royal Society for the Prevention of Cruelty to Animals
RPT	Regular Public Transport
ROKAMBA	Republic of Korea-Australia Migratory Bird Agreement
RWY	Runway
SAP	Species Action Plan
SAS	Supervisor Airside Safety
SMS	Safety Management System
SOP	Standard Operating Procedure
SRI	Survey Risk Index
SWP	Safe Work Procedure
TWY	Taxiway
UTC	Coordinated Universal Time
VOR	VHF Omnidirectional Range
WHA	Wildlife Hazard Assessment
WHMC	Wildlife Hazard Management Committee
WHMP	Wildlife Hazard Management Plan
WHN	Wildlife Hazard Notification
YBMK	Mackay Airport ICAO Code

Table of Contents

1. Introduction

Mackay Airport (YBMK)[1] is a Certified Aerodrome owned and operated by Mackay Airport Pty Ltd (MAPL). MAPL is responsible for the safe and secure operation, maintenance, commercial development and strategic planning functions of YBMK.

The Wildlife Hazard Management Plan (WHMP) has been developed in accordance with Civil Aviation Safety Authority (CASA) Manual of Standards (MOS) Part 139 using information provided by YBMK. The MOS Part 139 requires Australian airport operators to establish a management program that minimises or eliminates existing wildlife hazards.

1.1. Background

The consequence of wildlife strikes with aircraft can be very serious. Worldwide, in civil and military aviation, fatal wildlife strike incidents, have resulted in 500 human fatalities and 600 aircraft losses since aviation commenced, most of those within the last 30 years (Shaw et al 2018). Wildlife strikes cost the commercial civil aviation industry an estimated US$1.2 billion per annum and involve more than just the repair of damaged engines and airframes (Allan 2002). Even apparently minor strikes which result in no damage can reduce engine performance, cause concern among aircrew and add to airline operating costs.

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

Historically, over 90% of reported strikes have occurred on or close to airports (ICAO, 1999). Consequently, the primary focus of management programs is directed here with the responsibility resting on airport owners and operators. It is, however, important that the whole airport community (including airline operators) and surrounding land managers are aware of bird and wildlife strike as an issue and that all stakeholders become involved in the process of reducing the hazard birds represent to aircraft operations. It is imperative that the risk presented from bird attracting land uses adjacent to the airport is managed effectively.

1 ICAO airport reference code.

1.2. Function

The WHMP outlines the management methods employed by YBMK to manage the dynamic risk that wildlife poses to air traffic at YBMK using the Deming Wheel of plan-do-check-act whilst complying to relevant legislation (Figure 1).

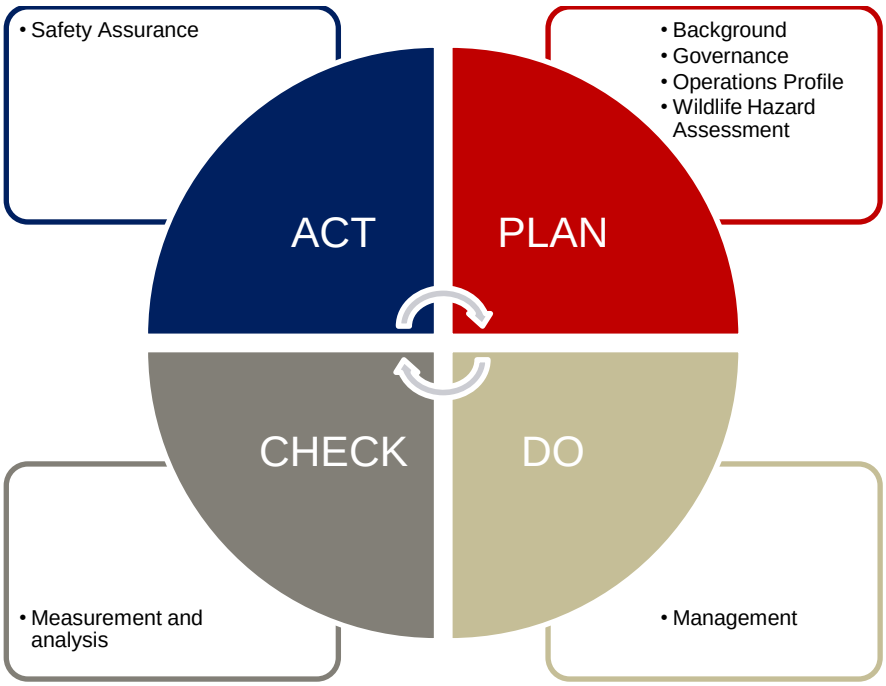

Figure 1. WHMP structure

1.3. Aims

The YBMK Wildlife Management Program and this WHMP aims to:

- Reduce the frequency and severity of strikes by focusing management efforts on species and habitats that constitute significant hazards to aircraft operations at YBMK.
- Develop, embed and continually encourage a strike reporting culture supported by YBMK management.
- Minimise the risk of wildlife strike through a continuous process of identifying, recording and reviewing risks, objectives, targets and indicators.
- Reduce the costs of unscheduled maintenance associated with wildlife strike.
- Preserve life and aviation capability through reducing the risk of wildlife strike.
- Reduce wildlife mortality.
- Develop, implement and maintain mechanisms that encourage open communication between all involved parties.

- Ensure the availability of skilled and trained resources to develop, implement, maintain and improve the WHMP.
- Ensure all personnel are trained and competent in their respective wildlife hazard management responsibilities.
- Ensure safe firearm use and no incidents occur because of wildlife control activities.
- Reduce the risk of wildlife strike to so far as reasonably practicable.

1.4. Objectives

Table 1. Mackay Airport WHMP objectives.

Area	Objectives
Legislation and Regulation	To develop, implement and maintain procedures and systems to ensure operations comply with applicable legislation, regulations, standards and industry best practice.
Assurance	1. To review the WHMP: • annually and reassess the risk • following serious incidents • in response to operational or legislative changes. 2. To conduct regular internal and external audits. 3. To clearly define accountabilities and responsibilities for all YBMK personnel, contractors and stakeholders.
Culture	1. To develop, embed and continually encourage a positive culture where wildlife management is a priority and the WHMP is recognised and valued. 2. To develop, embed and continually encourage a reporting culture supported by YBMK senior management.
Risk Management	1. To understand and minimise the risk of wildlife strike through a continuous process of identifying, recording and reviewing risks, objectives, targets and indicators. 2. To reduce the costs of unscheduled maintenance associated with wildlife strike. 3. To preserve life and aviation capability through reducing the risk of wildlife strike. 4. To reduce wildlife mortality.

Area	Objectives
Communication	To develop, implement and maintain effective mechanisms that encourage open communication, delivery of key messages and awareness of responsibilities under the WHMP to all YBMK personnel, business partners and contractors.
Training	1. To ensure the availability of skilled and trained resources to develop, implement, maintain and improve the WHMP. 2. To ensure all personnel are trained and competent in their respective wildlife hazard management responsibilities. 3. To have no firearm incidents.
Infrastructure and Facilities	To develop, implement and maintain a maintenance system that ensures new and existing infrastructure and facilities are kept clean, safe and operational to reduce the wildlife attraction.
Participation and Action	1. Define roles, responsibilities and procedures for managing wildlife risk. 2. To actively encourage YBMK staff, aircraft operators, airlines and aircraft operators, visitors, business partners and contractors to help implement the WHMP. 3. To encourage activities that promote and establish positive wildlife management on airport.

2. Governance

This section outlines the legal framework, document governance and the roles and responsibilities of the personnel responsible for the implementation of this WHMP.

2.1. Legal and other requirements

CASA enacts and enforces the Civil Aviation Safety Regulations (CASR) 1998. Managing wildlife strike risk on and around airports must consider a suite of national and international legislative and regulatory requirements. This WHMP complies with the following legislative/regulatory requirements and recommendations:

- Civil Aviation Safety Regulations 1998, Part 139.B.2 – Aerodrome Manual
- CASA Manual of Standards – Part 139 – Aerodromes
    - Section 10.1.4 – Aerodrome Safety Management System
    - Section 10.2.7 – Birds or Animals on, or in the Vicinity of the Movement Area
    - Section 10.14 – Bird and Animal Hazard Management
    - Section 13.17 – Runway and Runway Strip Conditions
- *Air Navigation Act* Section 19A & B
- *Transport Safety Investigation Act 2003*
- *Airports Act 1996*
- International Civil Aviation Organization (ICAO) Annex 14, Volume 1 (Aerodrome Design and Operation)
- ICAO Annex 14, Volume 2 (Aerodromes - Heliports)
- ICAO Airport Services Manual Doc. 9184: Part 2 Land Use and Environmental Control
- ICAO Airport Services Manual Doc. 9137: Airport Services Manual Part 3, Wildlife Control and Reduction.

Wildlife hazard management requires a complex legal framework that addresses:

- Aerodrome safety and compliance
- Firearms safety and compliance
- Ethical behaviour.

A detailed list of legislation is included in Appendix A.

2.1.1. Permits

YBMK requires various permits to manage wildlife hazards, including:

- Damage Mitigation Permit (DMP) (*Nature Conservation Act 1992* (NC Act)) issued by the Department of Environment and Science: WA0005594.

YBMK personnel require the following authorisations to operate in the airside area, including:

- Authority to Drive Airside (ADA)
- Authority to Use Airside (AUA)
- Aviation Security Identification Card (ASIC)
- Firearms licence.

All YBMK firearms are licenced under *Weapons Act 1990*. YBMK complies with the requirements regarding the use, maintenance, storage, and transportation of firearms.

2.2. Documentation Governance

The WHMP is a subsidiary document of the Aerodrome Safety Management System (ASMS) and the Aerodrome Operations Manual (AOM).

YBMK internal WHMP Procedures support the WHMP and provide details for the correct and safe implementation of the WHMP by YBMK staff and contractors. These procedures are not publicly available.

Procedures include:

Serviceability Inspections and Wildlife Patrols	Wildlife Strike Reporting
Airside Wildlife Counts	Habitat and Land Management
Off-airport Wildlife Counts	WHMP Review
Wildlife Hazard Notification	Wildlife Dispersal Training
Identifying and Handling of Wildlife Remains	Flying-fox Count
Wildlife Dispersal	Firearm Safety and Use
Wildlife Culling	Firearm Licensing and Authorisation
Data Review	Using Ammunition and Firearms
Perimeter Fence Inspections	Cleaning Firearms

2.3. Roles and Responsibilities

The key staff for ensuring safe operations are:

- Chief Executive Officer (CEO)
- General Manager Mackay Airport (GMMA)
- Manager Aviation Operations (MAO)
- Supervisor Airside Safety (SAS)
- Aerodrome Safety Officers (ASO)

The CEO assumes overall responsibility for WHMP implementation. Refer Appendix A for details on accountability.

2.4. Stakeholder Engagement

Input from various on- and off-aerodrome stakeholders helps YBMK to achieve an effective and integrated approach to wildlife hazard management. This is realised through the Wildlife Hazard Management Committee (WHMC). The WHMC is an important avenue for sharing information, identifying risks and ensuring stakeholders are engaged in collaborative management of these risks. Roles and responsibilities are outlined in Appendix A.

2.5. Communication

Managing the wildlife strike risk requires a cooperative effort amongst key stakeholders communicating the hazard so that appropriate mitigation measures can be implemented. Communicating wildlife hazards to aircrew increases their awareness, which subsequently informs decision-making that can avoid a strike. In addition, communicating wildlife hazards to aerodrome operators helps inform their awareness, contributing to improved wildlife management practices and a safer environment for aircraft operations.

YBMK communicates relevant information of the wildlife hazard management program as follows:

- Annual WHMP update
- Quarterly program report
- Monthly wildlife info-cards
- Notice to Airmen (NOTAM) (as required)
- Air Traffic Information Service (ATIS) (as required).

2.6. Training

YBMK provides wildlife hazard management training to all personnel charged with wildlife management responsibilities. Training focuses on identifying and managing wildlife hazards, assessing and communicating risks, as well as strike reporting, bird identification and regulatory requirements.

YBMK collates and maintains training records and provides additional training as required.

YBMK delivers training and awareness programs at various levels to achieve the training objectives (Table 2).

Table 2. Training programs completed by YBMK staff.

Training Module	Position(s)	Frequency	Training Delivery
Aerodrome Reporting Officer course	All Aerodrome Safety Officers (ASO) and nominated relief staff.	Every 24 months	External training course offered by accredited provider/or in-house training.
Firearm Safety Course	All licensed staff.	Every five years	External training course offered by accredited provider.
Firearm Refresher Training	All ASOs and nominated relief staff.	Every 24 months	External training course offered by accredited provider.
Wildlife Hazard Management Training	All ASOs and nominated relief staff.	Every 24 months	External training course offered by suitably qualified provider.
YBMK Bird Identification	All ASOs and nominated relief staff.	Part of inductions or as required	Internal training course or one on one delivery.
Wildlife Hazard Management Plan	Available to staff and stakeholders involved in the management of bird and wildlife hazards at YBMK.	Annually or as required	ASO briefing during team meetings.
Wildlife Species Action Plans	All ASOs and nominated relief staff.	Reviewed as required.	Field Manual available to staff for species identification.
Wildlife Info-cards	All ASOs and nominated relief staff.	Monthly	ASO briefing during team meetings.
Wildlife Hazard Management Committee	Stakeholders and YBMK Staff.	Meets biannually	Advisory committee.

3. Operations Profile

YBMK is a major regional airport for the city of Mackay and acts as a gateway to the Whitsunday Coast. It supports the increasing demands of tourism, passenger traffic, cargo transport, and mining operations. YBMK operates 15 hours and has one runway (Table 3). The aerodrome supports business and tourist travellers with regular flights to and from Brisbane, Rockhampton, Townsville, Cairns, and Hamilton Island. Airservices Australia provide Air Traffic Control (ACT) services and Australia's Aviation Rescue Fire Fighting Service (ARFFS) provide firefighting and emergency response.

3.1. YBMK Strike Risk

YBMK has an average strike rate of 1.56 confirmed on-airport and vicinity strikes per 10,000 movements. The wildlife strike risk is characterised by birds flying through operational airspace to and from adjacent habitats to forage and roost, as such, the morning and evening periods present the highest strike risk.

3.2. Facilities and Operation

Table 3 summaries the YBMK site profile and operational characteristics.

Table 3. YBMK site profile and operational characteristics.

<table>
<tr><th>Aerodrome</th><th>Description</th></tr>
<tr><td>Location</td><td>Mackay, Queensland, S 2110.3 E 14910.8</td></tr>
<tr><td>Aerodrome type</td><td>Certified, Regular Public Traffic (RPT) Helicopter and General Aviation (GA)</td></tr>
<tr><td>Aerodrome operator</td><td>Mackay Airport Pty Ltd</td></tr>
<tr><td>Airlines and aircraft types</td><td>
<table>
<tr><th>Operator</th><th>Aircraft Type</th><th>Maximum Passenger Numbers</th></tr>
<tr><td>Jetstar</td><td>A320</td><td>180-186</td></tr>
<tr><td>QantasLink</td><td>DH4</td><td>74</td></tr>
<tr><td>Virgin</td><td>B737-800</td><td>176</td></tr>
</table>
</td></tr>
<tr><td>Resident operators</td><td>Jetstar Airways
Pel-air
QantasLink
Virgin Australia
Virgin Australia (agent for Alliance Airlines)
Virgin Australia (agent for Sunstate Airlines)</td></tr>
<tr><td>2018 aircraft movements[2]</td><td>10,332 RPT and GA</td></tr>
<tr><td>Runways (RWY)</td><td>14/32</td></tr>
</table>

2 Source: BITRE 2019.

Aerodrome	Description
Taxiways (TWY)	Sealed TWY A to L
Helipads	Adjacent TWY C
Aprons	RPT Apron, Eastern GA Apron and Western GA Apron
Navigation and landing aids	VHF Omnidirectional Radar (VOR), Distance Measuring Equipment (DME), Non-directional Beacon (NDB), Precision Approach Path Indicator (PAPI)
Air Traffic Control	Monday – Friday: 2020-1020, Saturday – Sunday: 2020-0930 UTC Rescue and Firefighting Service on-site with hours of operation defined in NOTAM
Communication	Common Traffic Advisory Frequency (CTAF) 124.5MHz Aerodrome Frequency Response Unit (AFRU)

Further information is available in the YBMK Aerodrome Operations Manual and the En Route Supplement Australia (ERSA).

4. Environmental and Ecological Profile

YBMK has a propensity for wildlife strikes due to its high diurnal and nocturnal wildlife activity. Like most airports, YBMK attracts wildlife due to habitat and resource availability (i.e. grass to forage, airport infrastructure to perch, etc.).

Mackay has a humid sub-tropical climate with a typical hot wet summer season and dry sunny winter season. YBMK is bordered by coastal mangroves and beaches to the east, sugarcane and agriculture to the south and urban development and industry to the west and north.

Table 4 and 5 outlines YBMK's environmental and ecological characteristics and Table 6 presents species breeding activity. This information helps understand how environmental conditions can influence wildlife activity which allows YBMK to proactively manage upcoming wildlife hazards.

Table 4. YBMK environmental characteristics.

Environment	Description
Elevation	19ft above mean sea level (AMSL)
Area	169 ha
Geography	Sub-tropical and humid environment, subjected to inundation based on Riverine wetland flooding.
Habitat	Grasslands that provide habitat for birds to forage for seeds/insects or hunt for prey. Adjacent areas include mangroves, salt marshes, estuaries, sugarcane, agriculture, and urban development.
Habitat modification	Grass mowing: smaller areas are to be mowed at 200mm and larger areas mowed at 300mm. Reviewed grass heights adjacent to RWY14/32, adjacent TWY D.
Artificial modification	Fences, buildings and other infrastructure such as gable markers provide perches and nesting sites.
Climate	Refer to Table 5.

Table 5. YBMK environmental and ecological characteristics calendar[3].

	2018						2019					
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Total Rainfall mm (1950-2018 average)	1.4 (33)	4.6 (32)	23.2 (25)	30.4 (35)	7.4 (81)	371.2 (134)	221.2 (308)	204.2 (340)	228.2 (260)	204.8 (165)	3.8 (86)	34 (61)
Mean Temperature High ^{O}C (1950-2018 average)	27.4 (24)	29.6 (24)	33.9 (26)	32.7 (28)	39.7 (30)	35.8 (31)	31.5 (30)	34.0 (31)	31.9 (29)	29.3 (28)	18.1 (25)	25.2 (23)
Mean Temperature Low ^{O}C (1950-2018 average)	21.8 (11)	21.4 (12)	24.2 (15)	27 (18)	30.1 (21)	26.6 (22)	26.5 (23)	26.2 (23)	28 (22)	25.5 (20)	18.1 (16)	20 (13)
Mean Wind Speed km/h (1950-2010 average)	12 (12)	11 (13)	13 (15)	17 (17)	22 (17)	17 (16)	21 (17)	17 (16)	20 (18)	22 (16)	18 (14)	13 (13)
9am Mean Sea Level Pressure (hPa)	1021.4	1019.6	1019.5	1015.5	1014.5	1011.8	1010.5	1010.3	1011.7	1014.6	1019.8	1021.2

3 Bureau of Meteorology 2019, 'Climate statistics for Australian locations', [ONLINE], accessed http://www.bom.gov.au/climate/averages/tables/cw_033045.shtml

Table 6. YBMK hazardous wildlife breeding characteristics calendar.

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
2018/19 Peak Wildlife Risk[4] and Breeding Season												
Magpie Goose								B	B			B
Plumed Whistling-Duck				* [5]				B	B	B	B	
Australian White Ibis	B6	B	B	B	B	b[7]	b	b	b	b	b	b
Straw-necked Ibis		b	b	b	b	b	B	B	B	B		
Feral Pigeon		B		B	B	B	B	B	b	b	b*	b
Cattle Egret					B		B	B		*		
Australian Pelican	FR[8]	FR	FR	FR	FR	FR*	FR	FR	FR	FR	FR	FR
Masked Lapwing	B	B	B	B	B	B		B	B	B	B*	B*
Galah	B	b	b		b	b		B	B	B	B	B
Torresian Crow		b			B	B		B				
Black Kite	b*	B	B*	B*	B	b	b	b*	b	b	b*	b
Rainbow Lorikeet	B	B	B	B*	B	B	B					B
Pacific Black Duck	FR/AR[9]	FR/AR	FR/AR	FR/AR	FR/AR	FR/AR	FR/AR	FR/AR	FR/AR	FR/AR	FR/AR	FR/AR
Airside Grass and Ground Covers Species												
Gomphrena celosioides	f	f	f	f	F	F	F	F	F	F	f	f
Local Flora may increase regional wildlife risk												
Sugarcane Harvest												

4 Calculated from ARO Survey Data
5 * = Presence in 5-year strike average (2-13/14 – 2017/18
6 B = Breeding Season
7 b = Possible breeding
8 FR = Following Rainfall
9 AR = Abundant Resources
F = Flowering
f = unseasonal flowering

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Melaleuca quinquenervia	f	f	f	f	f	f	F	F	F	F	F	f
Eucalyptus robusta	f	f	f	f	f	f	F	F	F	F	F	f
Acacia leiocalyx	f	f	f	f	f	f	F	F	F	F	F	f
Insect Activity												
Mosquito	FR	FR	FR	FR	FR	FR	FR	FR	FR	FR	FR	FR
Beetles												
International Migratory Season												
Waders Present												

5. Wildlife Strikes Trends

Figure 2 presents YBMK 2014/15-2018/19 wildlife strike profile. In 2018/19 the strike rate was 7.28 confirmed strikes per 10,000 aircraft movements. Six of these strikes affecting planned flight resulting in an adverse effect strike rate of 15.61 per 100,000 movements; well above the international benchmark[10]. Mass struck per 10,000 movements in 2018/19 (3.17 kg per 10,000 aircraft movements) decreased since 2017/18 (4.28 kg per 10,000 aircraft movements). Bush Stone-curlew (647 g) (high risk) accounted for 27% of the mass struck in 2018/19. Despite the decrease, mass struck per 10,000 aircraft movements was above the 4-year average (2.38 kg per 10,000 movements, 2014/15-2017/18).

5.1. Strike Profile

This section presents an analysis of strike data. YBMK and Australian Transport Safety Bureau (ATSB) provided strike data and Airservices Australia provided aircraft movement data.

Key points:

- Confirmed, on-airport and vicinity strikes for 2018/19 are the highest for the reporting period (Figure 2) due to 7 Bush Stone-curlew strikes (4.529kg) compared to average of 2.5 strikes per year (2014/15-2017/18).
- Unidentified Bird was reported in 5 confirmed strikes (Figure 4). Species identification was not possible as a carcass could not be recovered and/or no biological remains could be located for forensic analysis.
- Strikes by time of day (Figure 5) follow the expected trend with a peak in the morning as birds transit through YBMK airspace to habitats adjacent to the airport.
- One strike caused damage (Table 5) which triggered a significant strike investigation.

10 The international benchmark for adverse effect strikes is 1.07 per 100,000 movements (Ref: Dolbeer and Begier 2012 Comparison of Wildlife Strike Data Among Airports to Improve Aviation Safety. International Bird Strike Conference. Stavanger, Norway.

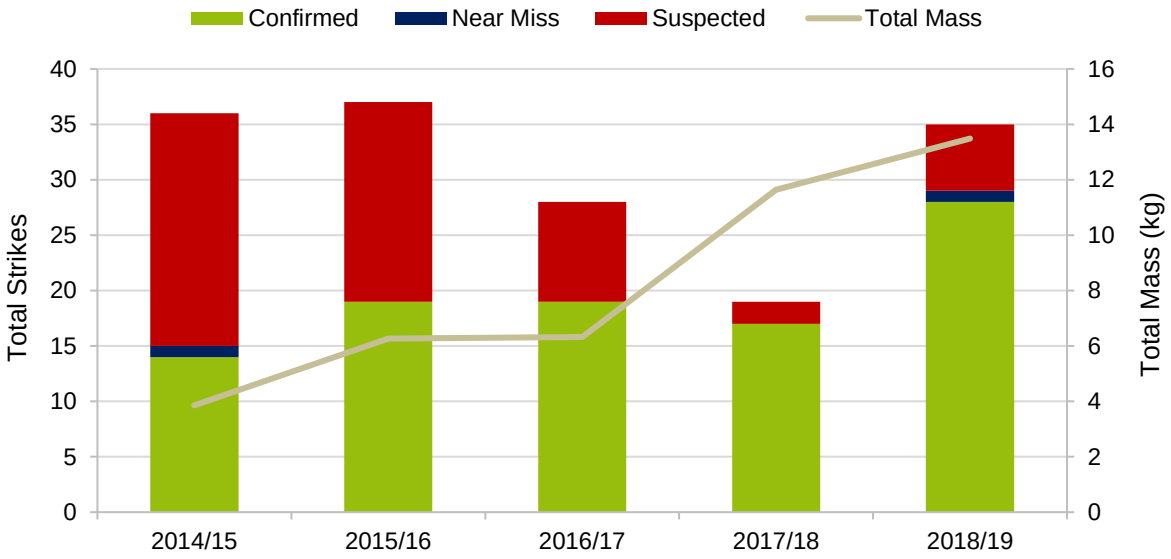

Figure 2. On-airport and vicinity wildlife strikes vs mass struck by year and strike type, YBMK 2014/15 – 2018/19.

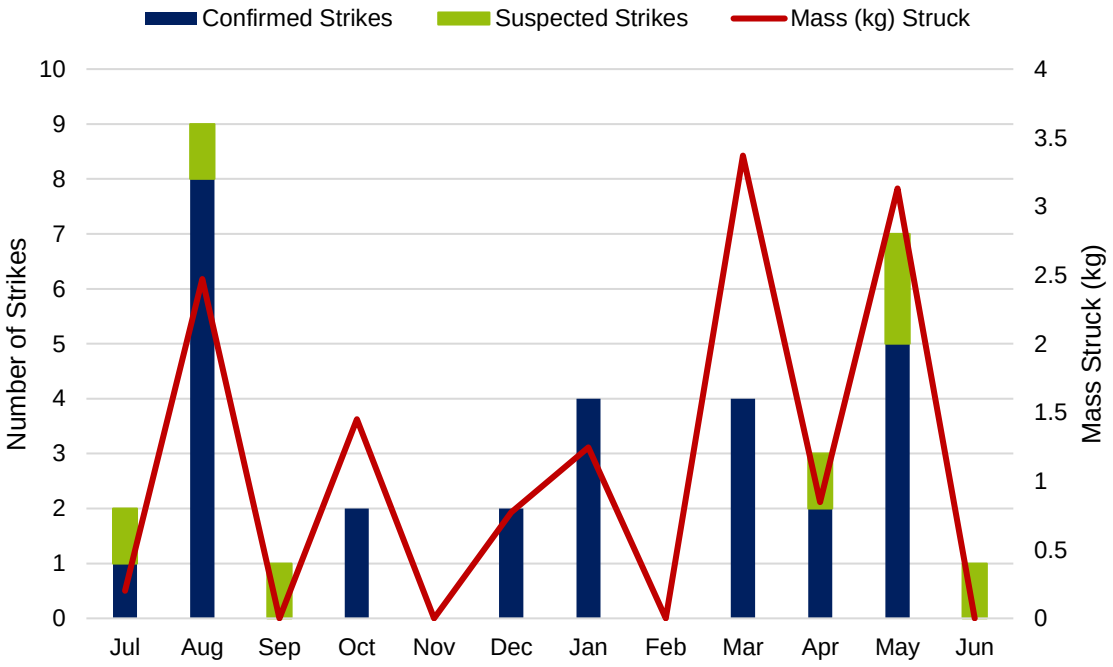

Figure 3. Confirmed and suspected on-airport and vicinity strikes vs mass (kg) struck by month, YBMK 2018/19.

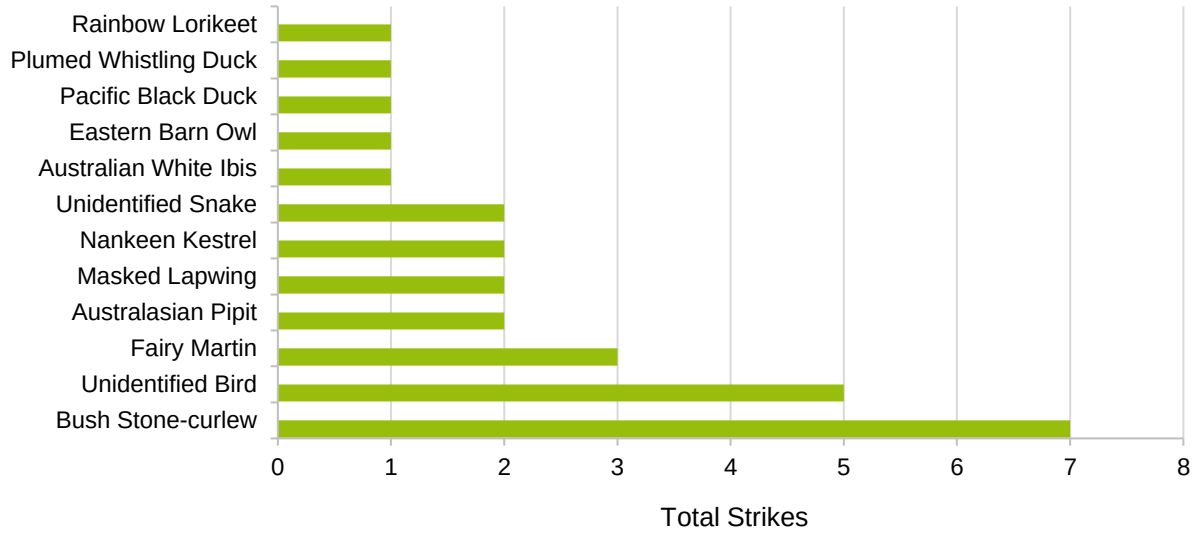

Figure 4. Confirmed, on-airport and vicinity species struck, YBMK 2018/19.

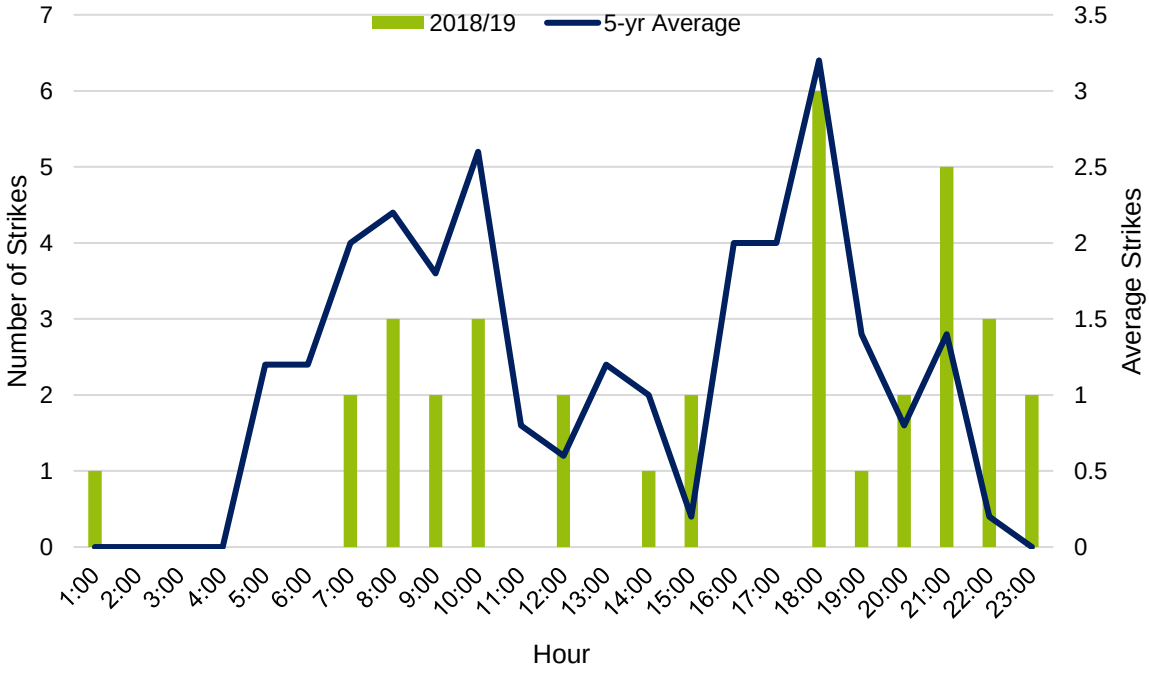

Figure 5. Total strikes[11] by time of day vs. 5-year average strikes (excludes 11 strikes where time was not reported), YBMK 2013/14 – 2018/19.

11 Includes confirmed, suspected, near miss and unknown on-airport, airport vicinity and unknown designation strikes.

5.2. Strikes Affecting Flight

Table 7 outlines the strikes that have had an adverse impact in the previous 5 years.

Table 7. Adverse effective strikes summary, YBMK, 2014/15-2018/19.

Date	Operator	Location	Species	No.	Strike Type	Effect Type
20/07/2014	Unknown	Unknown	Topknot Pigeon	5	Confirmed	Precautionary landing
02/09/2014	Pel-Air	Touchdown marker	Unidentified Bird	0	Suspected	Rejected take-off
14/12/2015	Qantaslink	Unknown	Unidentified Bird	1	Confirmed	Delay
09/08/2018	Unknown	RWY14	Masked Lapwing	1	Confirmed	Rejected take-off
30/12/2018	Unknown	On-airport	Rainbow Lorikeet	1	Confirmed	Delay
11/02/2019	Sunstate Airlines	South of TWY J	Nankeen Kestrel	1	Confirmed	Delay
08/03/2019	Virgin Australia	On-airport	Australian White Ibis	1	Confirmed	Delay
09/05/2019	Virgin Australia	Unknown	Black Flying-fox	2	Confirmed	Damage and delay
09/05/2019	Virgin Australia	Unknown	Eastern Barn Owl	1	Confirmed	Delay
10/05/2019	Jetstar	Unknown	Unidentified Bird	0	Suspected	Delay

6. Annual Wildlife Hazard Assessment

Annual Wildlife Hazard Assessments (WHA) evaluates program progress and analyses program data to help inform and implement the WHMP. Trigger events or risk changes (e.g. increased aircraft operations, significant changes in wildlife numbers, off-airport developments) may require more frequent assessments. Avisure completed a WHA of YBMK's wildlife management program which included:

- **Risk assessment** – based on strike history and airside wildlife surveys, including wildlife numbers, behaviour, and presence in critical areas of the aerodrome.
- **Hazard identification** – a broad assessment of the aerodrome's hazard profile that affect YBMK's wildlife strike risk profile including:
    - Airside wildlife attracting areas and facilities
    - Landside wildlife attracting areas and facilities
    - Off-airport wildlife attracting sites
    - Analysis of Avisure surveys.

6.1. Risk Assessment

Avisure assessed the risk using strike data from the **ATSB** and YBMK, and on-airport survey data collected during site visits (Table 8). Although diurnal surveys recorded more birds, nocturnal periods present the highest risk because of the type and body mass of species observed (Figure 8).

Refer to Appendix B for risk assessment methods, Appendix C for survey methods.

Table 8. Overall species risk rankings, high and moderate risk only, YBMK 2018/19.

Rank	Species	Overall Risk	Survey Risk		Strike Risk
			Diurnal	Nocturnal	
1	Little Black Cormorant	Very High	Very High	-	-
2	Australian White Ibis	High	High	-	Moderate
3	Unidentified Flying-fox	High	-	High	Moderate
4	Plumed Whistling-Duck	High	Moderate	High	-
5	Bush Stone-curlew	High	-	Moderate	High
6	Magpie Goose	High	High	-	-
7	Straw-necked Ibis	High	High	-	-
8	Unidentified Bird	High	-	-	High

Rank	Species	Overall Risk	Survey Risk		Strike Risk
			Diurnal	Nocturnal	
9	Pacific Black Duck	Moderate	Moderate	Moderate	Moderate
10	Masked Lapwing	Moderate	Moderate	Moderate	Moderate
11	Black Kite	Moderate	Moderate	-	Low
12	Rainbow Lorikeet	Moderate	Moderate	-	Low
13	Feral Pigeon	Moderate	Moderate	-	Low
14	Magpie Lark	Moderate	Moderate	-	Low
15	Red-tailed Black-Cockatoo	Moderate	Moderate	-	-
16	Radjah Shelduck	Moderate	Moderate	-	-
17	Cattle Egret	Moderate	Moderate	-	-
18	Torresian Crow	Moderate	Moderate	-	-
19	Pied Imperial-Pigeon	Moderate	Moderate	-	-
20	Galah	Moderate	Moderate	-	-
21	Australian Pelican	Moderate	-	-	Moderate
22	Wandering Whistling-Duck	Moderate	-	-	Moderate
23	Unidentified Raptor	Moderate	-	-	Moderate
24	Unidentified Snake	Moderate	-	-	Moderate
25	Black Flying-fox	Moderate	-	-	Moderate

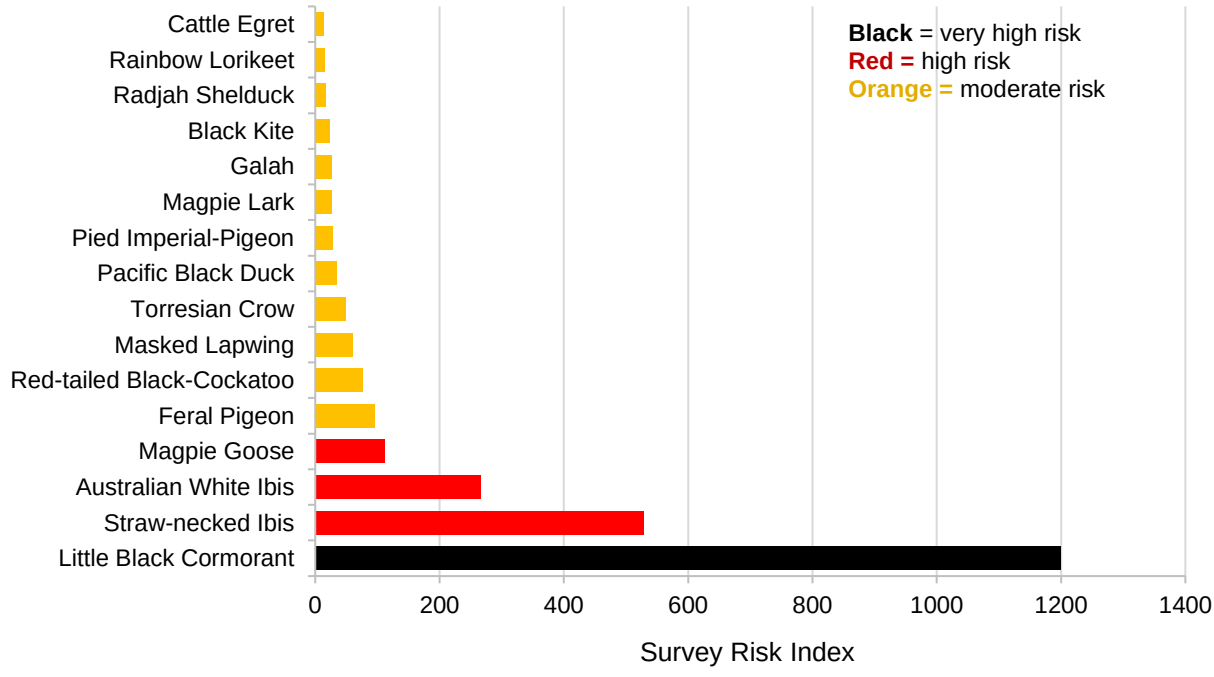

Figure 6. Average diurnal survey risk index, YBMK 2018/19.

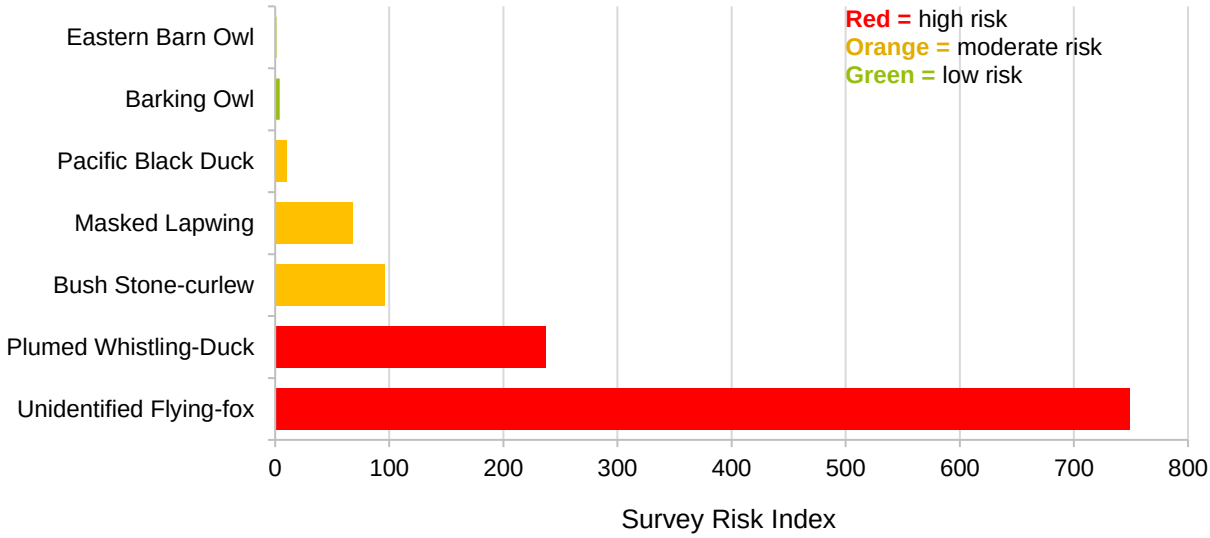

Figure 7. Average nocturnal survey risk index, YBMK 2018/19.

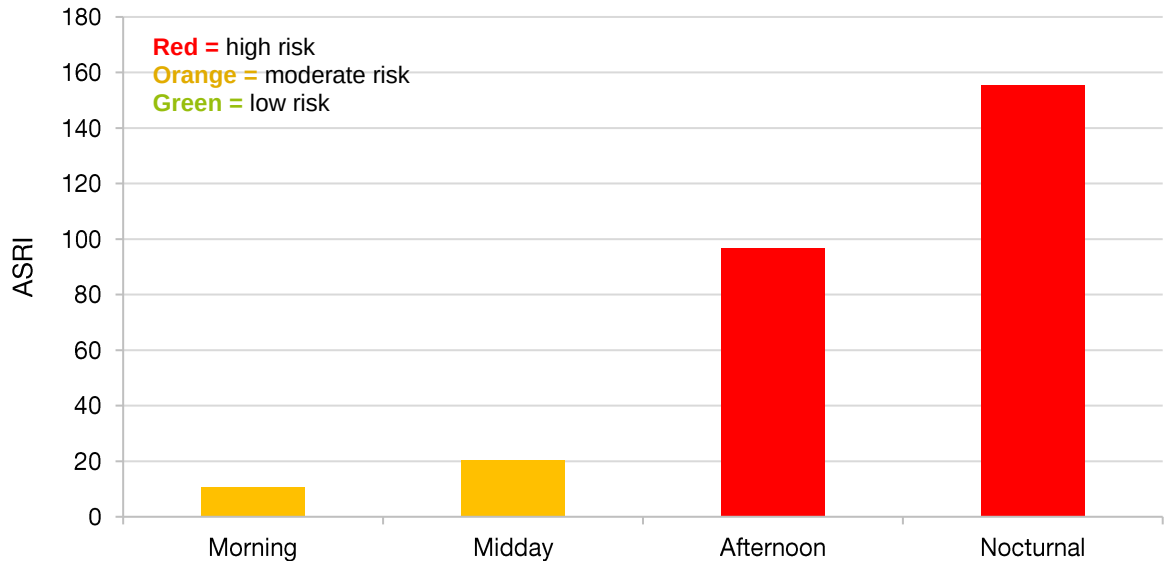

Figure 8. Airport Survey Risk Index (ASRI) by time of day, YBMK, 2018/19.

6.2. Wildlife Risk Trend Summary

Table 9 summarises the wildlife strike trend and risk species.

Table 9. YBMK wildlife strike and hazard summary 2014/15 to 2018/19.

Measure	2014/15	2015/16	2016/17	2017/18	2018/19
Confirmed[12] strikes	14	16	11	17	28
Suspected[12] strikes	21	18	8	2	6
Near Miss[12] strikes	1	0	0	0	1
Total strikes	38	38	29	22	35
Damaging strikes[12]	0	0	0	2	1
Total aircraft movements[13]	34,038	32,282	28,968	27,276	38,443[14]
No. strikes affecting planned flight[12]	1	1	0	0	6
Average mass struck (kg)[15]	0.28	0.35	0.36	0.68	0.48
Total mass struck (kg)[12]	3.86	6.23	6.32	11.64	13.487
Confirmed strikes per 10,000 aircraft movements[13]	4.11	5.89	6.56	6.23	7.28
No. very high-risk species	2	0	0	1	1
No. high risk species	5	7	6	3	7
No. moderate risk species	15	18	16	16	17
Airport Survey Risk Index	4381	1600	1195	2786	2625

6.3. On-Aerodrome Surveys and Hazards

Australian White Ibis (high risk) was the most observed species per on-airport survey in 2018/19 (Figure 9). Due to their flocking tendency and high body mass (1.95 kg), they pose a bird strike risk, particularly during and post rainfall events.

Australian White Ibis (high risk) and Little Black Cormorant (moderate risk) accounted for 33% of all species observed in the critical area of the airfield (Figures 10 and 11) where the risk of infringing an aircraft flight paths can occur. These species are primarily observed flying-over (Figure 14 and 15) to and from adjacent habitats and are generally not attracted to the airport itself.

Unidentified Flying-fox (high risk) was included in the risk assessment due to their transits through YBMK airspace during February's nocturnal survey. Due to their daily airport transits after last light, they pose a multiple strike risk for nocturnal operations. Refer to section 6.5.

12 On-airport and airport vicinity strikes only.
13 Provided by Airservices.
14 Provided by YBMK and includes movements inside ATC operation hours and landings outside of ATC hours, only.
15 Confirmed on-airport and airport vicinity strikes only.

Bush Stone-curlews (high risk) continue as the most observed nocturnal species airside. ASO inspected the RWY for curlews at night immediately prior to each aircraft movement.

Nocturnal activity continues to pose a risk to aircraft operations (Figure 12) with Bush Stone-curlews (high risk), Masked Lapwing (moderate risk) and Unidentified Flying-fox (high risk) utilising YBMK at this time. Airports provide the ideal foraging habitat for curlews and lapwings as they have open grassed areas with 360-degree views of their surroundings, free from predators. Their activity is expected to increase during their respective breeding seasons.

Peak wildlife activity occurs in the morning period (Figure 13) as temperatures are cooler and more suitable for foraging. This aligns with YBMK's peak aircraft movement schedule. Morning activity includes species foraging in airside grassed areas and transiting the airfield between roosting and foraging sites. Refer to section 6.4.

Australasian Pipit (low risk) and Masked Lapwing (moderate risk) foraging in the grass accounted for the high proportion of foraging behaviour and grass habitat observed during diurnal surveys (Figure 14 and 15). Airside mowing activities increased foraging opportunities for species such as Australasian Pipit (low risk), Australian Magpie (low risk), Torresian Crow (moderate risk) and Magpie Lark (moderate risk) as they forage in the short grass. Short grass provides ideal foraging conditions for granivorous and insectivorous species such as pipits and magpies.

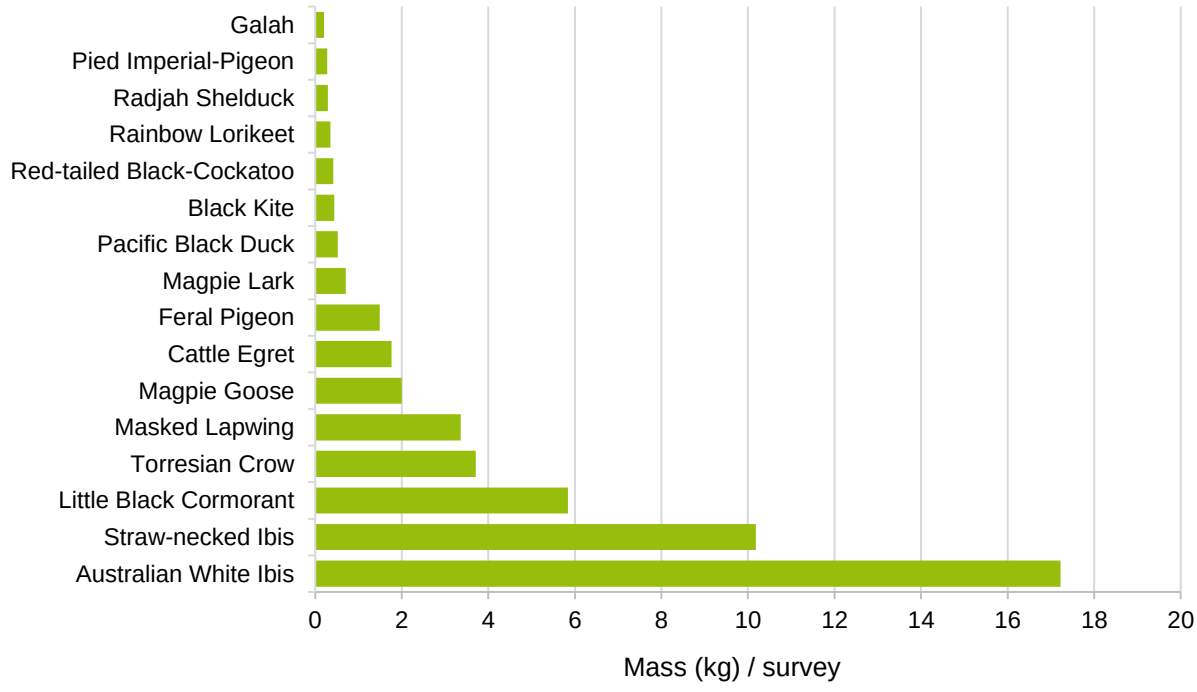

Figure 9. Average mass (kg) of high/moderate species per diurnal survey, YBMK 2018/19.

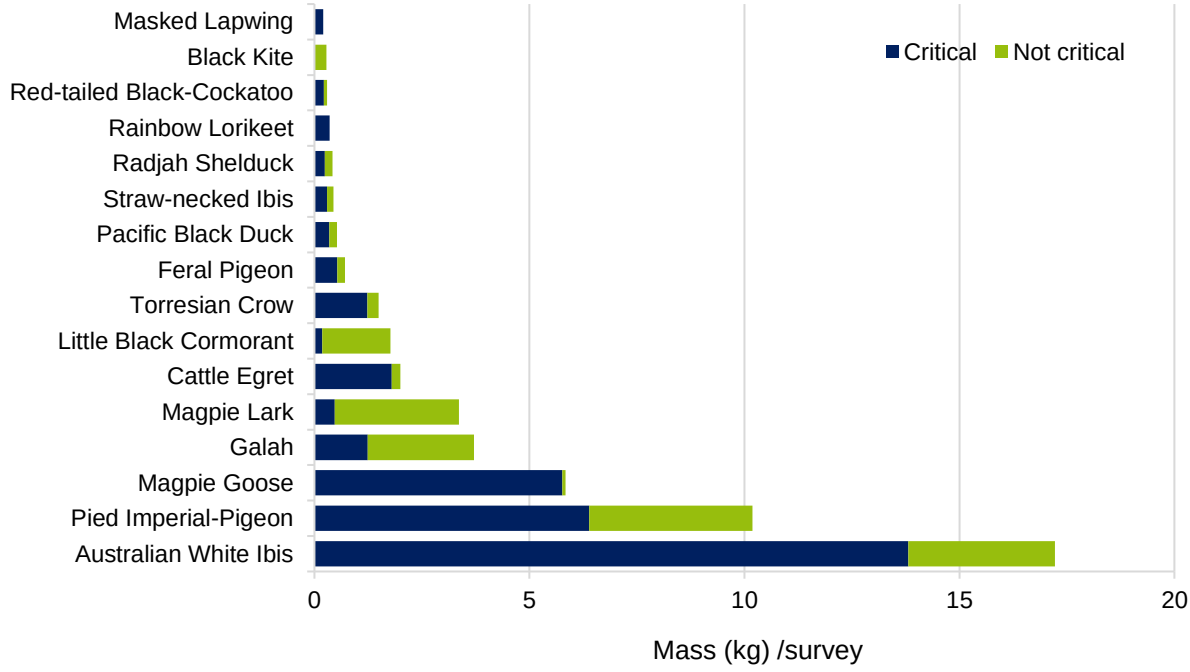

Figure 10. Average mass (kg) of high/moderate risk species per diurnal survey by critical location, YBMK 2018/19.

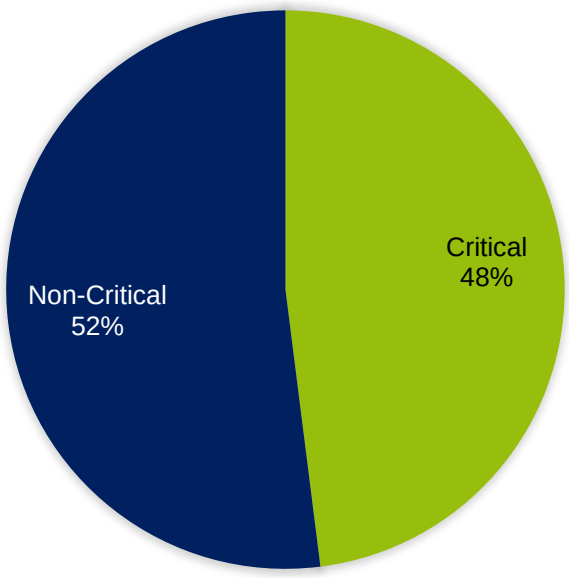

Figure 11. Proportion of diurnal species observed in the critical areas, YBMK 2018/19.

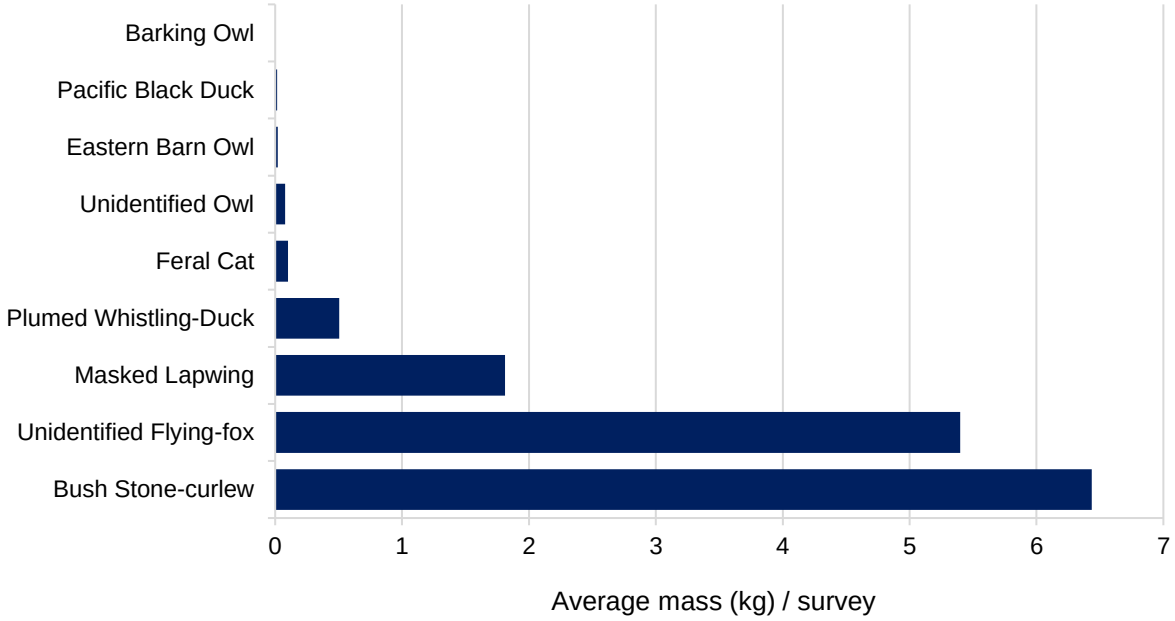

Figure 12. Average mass (kg) of species per nocturnal survey, YBMK 2018/19.

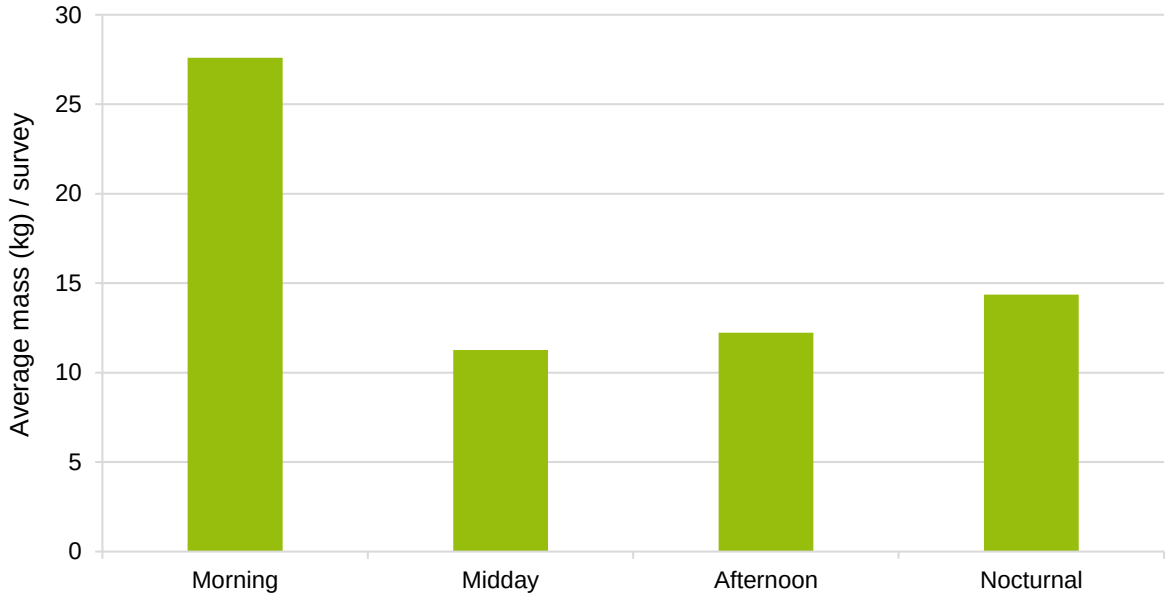

Figure 13. Average mass (kg) surveyed by time of day, YBMK 2018/19.

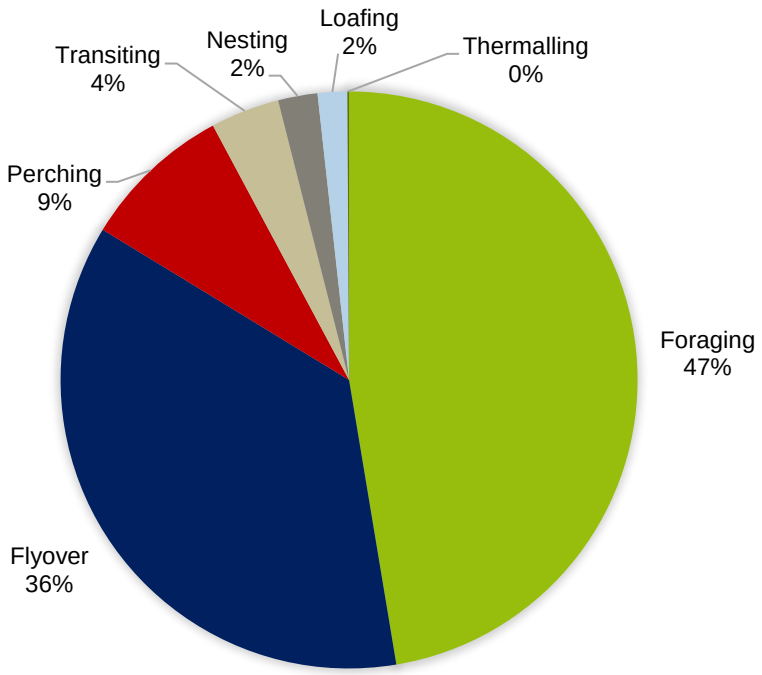

Figure 14. Proportion of species behaviour observed, YBMK 2018/19.

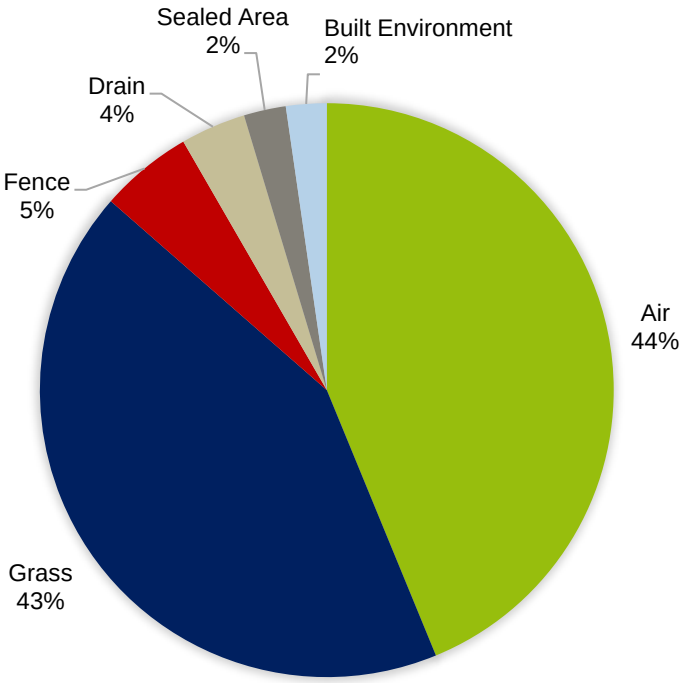

Figure 15. Proportion of habitat used, YBMK 2018/19.

6.4. Off-Aerodrome Surveys and Hazards

Off-aerodrome wildlife populations can contribute significantly to the strike risk. Their movements may intersect aircraft flight paths either over YBMK, in the approaches, or in areas used for low-level circuit operations. In addition, regional and local wildlife populations may fluctuate in response to seasonal, climatic or other environmental variables, increasing the strike hazard.

Avisure monitored seven off-airport sites within 3 km of YBMK, five within 8 km and one within 13 km (Figure 17). These sites attract, or have the potential to attract, wildlife, in adherence to the ICAO guidelines relating to radial distances from airports. An additional 15 sites are included as potential hazards and should be included in future surveys (Table 10 and Figure 17).

The National Airports Safeguarding Framework (NASF) (Appendix C) Wildlife Attraction Risk is based on the NASF risk category allocation where incompatible land uses are ranked from very low to high.

The potential risk posed to YBMK is based on each sites proximity to YBMK, the land use, the site's attractiveness to high and moderate risk species and the number observed in 2018/19. Quarterly and annual off-airport surveys help understand the high and moderate risk species that use these sites.

Stock feed at Farm 63 Farrelly's Road and Manzelmann's attracts hazardous species including Australian White Ibis (high risk), Straw-necked Ibis (high risk) and Cattle Egret (moderate risk). Due to all species' tendency to flock and their low aircraft avoidance, they pose a strike risk to YBMK.

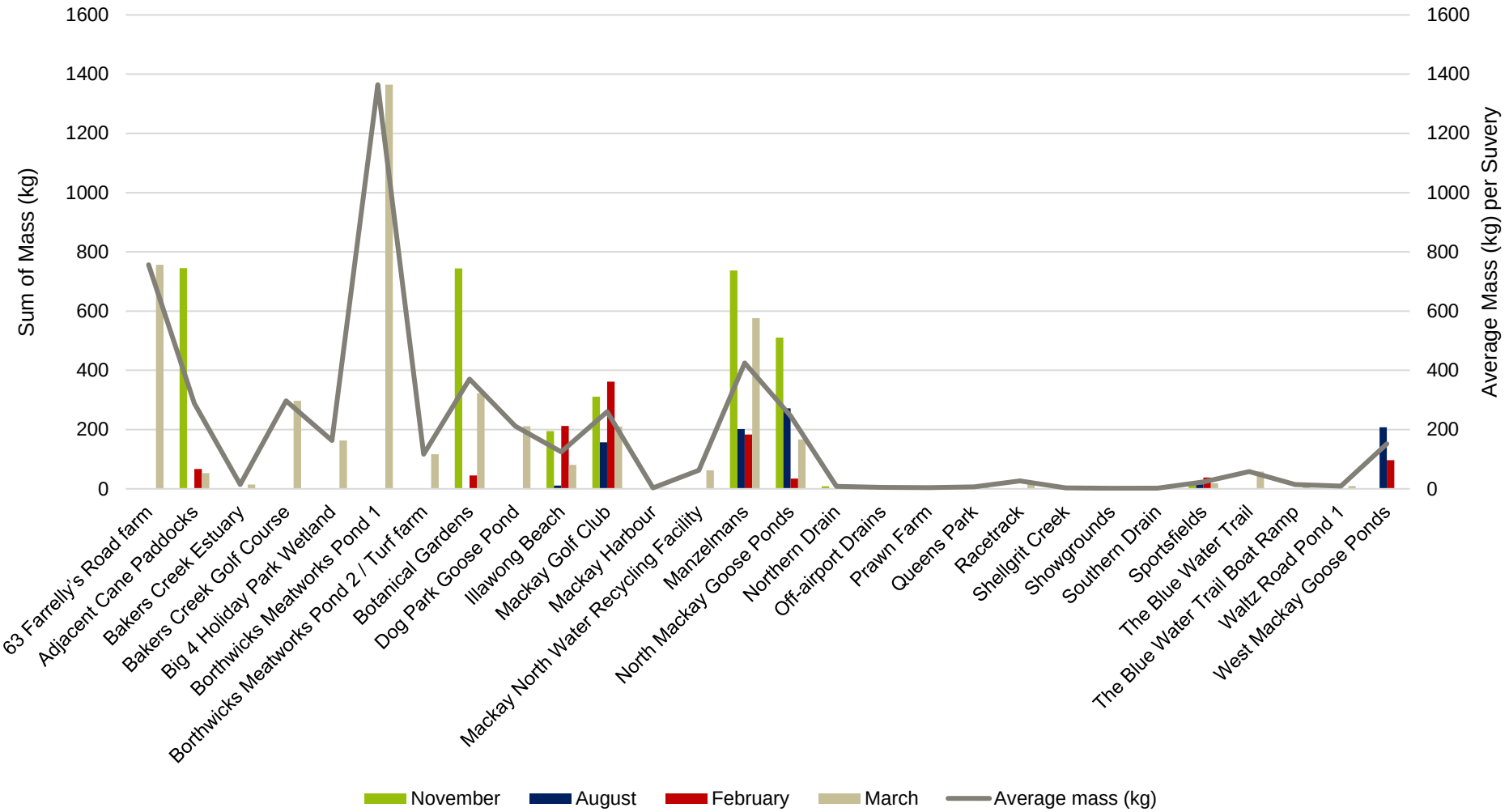

Figure 16. Mass per survey (kg) at off-aerodrome locations, YBMK 2018/19.

Table 10. Off-aerodrome habitats and total number of risk species, YBMK 2018/19.

Location	Distance from YBMK (km)	Average V-High Risk Species	Average High Risk Species	Average Moderate Risk Species
Adjacent Cane Paddocks	0.82	1	91.25	18.25
Off-airport Drains	0.89	0	1	2
Manzelmann's	1.1	0	230	42.75
Shellgrit Creek	1.22	0	0	6
Sportsfields	0.37	0	5.75	59.25
Illawong Beach	1.66	0	1	1.5
Botanical Gardens	2.66	1	107.5	11
Milton Street Oval Showgrounds	3.09	0	0	3
Thomas Borthwick and Sons	5.48	0	15.25	34.5
West Mackay Goose Ponds	5.52	1	48.5	32.25
North Mackay Goose Ponds	5.81	1	45.75	89.75
Dog Park Goose Pond	5.82	0	117.25	6.25
Wakeboard Park	5.98	0	0	0
Mackay Golf Club	9.5	1	136.25	50.5
Farm 63 Farrellys Road	1.95	0	109	11.25
Paget Waste Management Centre	2.83	0	0	0
Racetrack	3.08	0	2	9
Sandfly Creek Estuary	3.52	0	0	0
Gordan Street East Wetland	3.97	0	0	0
Blue Water Lagoon	4.1	0	0	0
Bruce Highway Bridge	4.47	0	0	0
Walz Road Pond 2	5.22	0	0	0
Bakers Creek Golf Course	5.55	0	73.25	2.75
Walz Road Pond 1	5.65	0	0	1.75
Queens Park	6.1	0	0.5	2.25
Quarry	6.81	0	0	0
Blue Water Trail	7.1	0	0	2.25
Mackay Marine Tourist Park	7.45	0	0	0
Mackay Harbour	8.22	0	0	0
Big 4 Holiday Park	10.1	0	5.25	2
Bucasia Wetland	14.72	0	0	0
Mackay North Water Recycling Facility	16.18	0	45.75	3.75

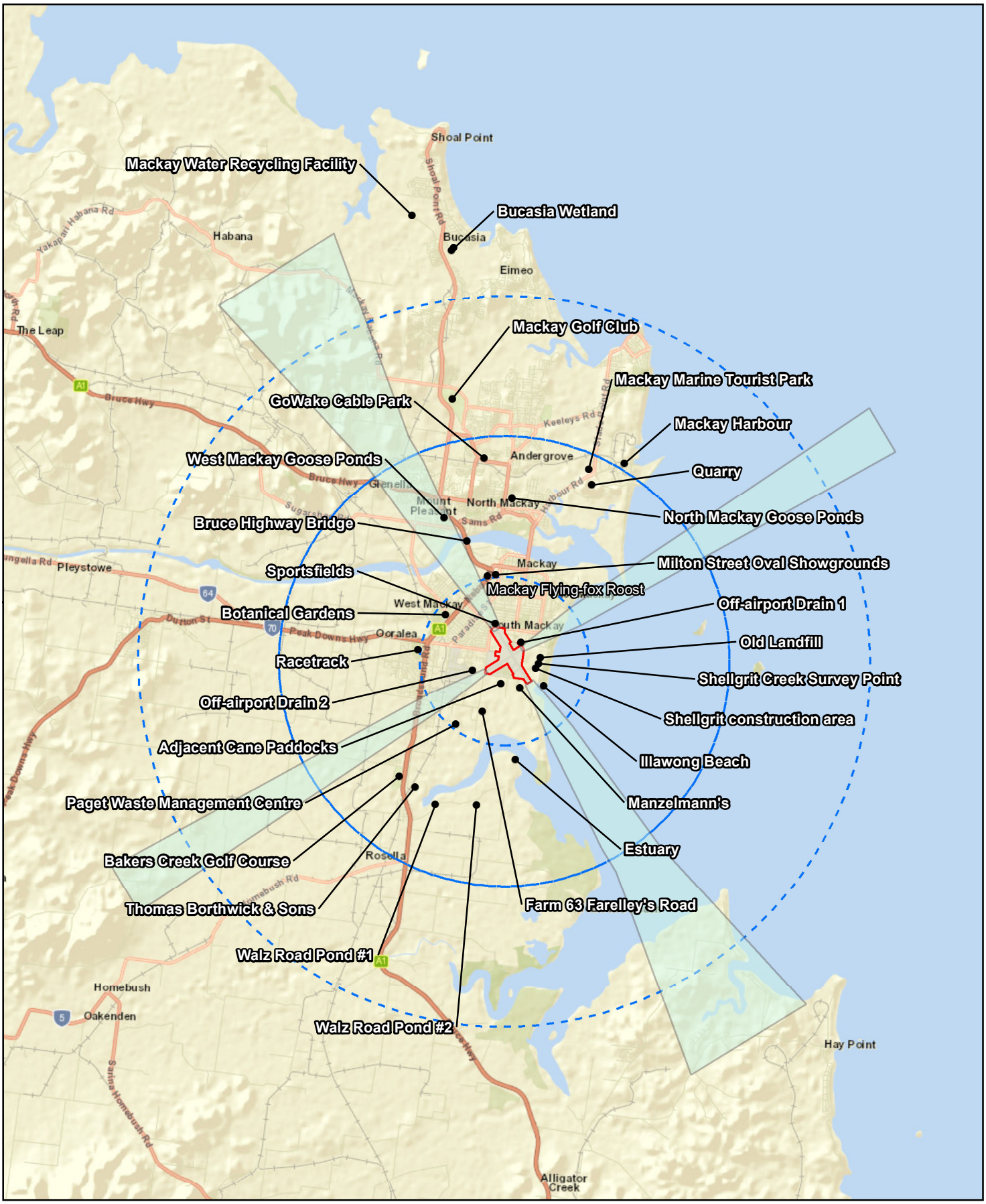

Figure 17 Off-airport assessment locations, YBMK, 2018/19.

Mackay Regional Council

Mackay Airport Bird Management Program 2018/19

- Mackay Flying-fox Roost
- Approach & Departure Paths
- Airport Perimeter
- Distance from ARP (3, 8 and 13 km)

AVISURE safety | aviation | wildlife

Job number: PR3416
Revision: 4
Author: ALM, DB, KF, AJS
Date: 15/07/2019

0 0.5 1 2 3 4 5 6 Kilometers

GDA 1994 MGA Zone 55
Projection: Transverse Mercator
Datum: GDA 1994
Units: Meter

Data Sources: © Avisure Pty Ltd 2019
Image Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, © OpenStreetMap contributors, and the GIS User Community. AVISURE does not warrant the accuracy or completeness of information displayed in this map and any person using it does so at their own risk. AVISURE shall bear no responsibility or liability for any errors, faults, defects, or omissions in the information.

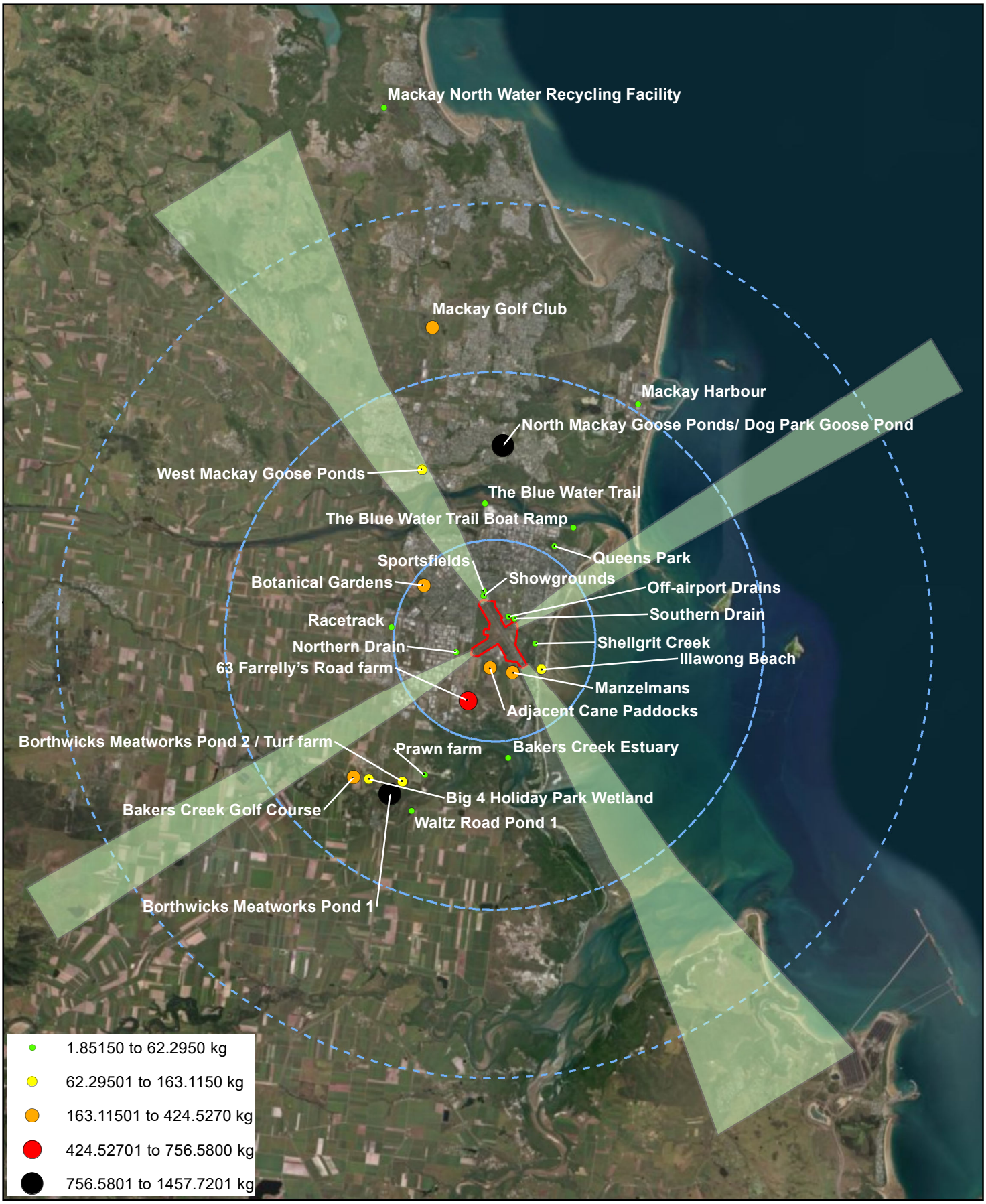

Figure 18. Off-airport density map, YBMK, 2018/19.

Mackay Regional Council

Mackay Airport Bird Management Program 2018/19

Approach & Departure Paths

Airport perimeter

Distance from ARP (3, 8 and 13 km)

AVISURE safety | aviation | wildlife

Job number: PR3416
Revision: 1
Author: AJS
Date: 15/07/2019

0 1 2 4 6 8 Kilometers

GDA 1994 MGA Zone 55
Projection: Transverse Mercator
Datum: GDA 1994
Units: Meter

Data Sources: © Avisure Pty Ltd 2019
Image Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community. AVISURE does not warrant the accuracy or completeness of information displayed in this map and any person using it does so at their own risk. AVISURE shall bear no responsibility or liability for any errors, faults, defects, or omissions in the information.

PR3416_MPX_WHMP_Offairport_Density
A4

6.5. Flying-foxes

Flying-foxes contribute to the strike risk as they transit to and from their camps, which are used permanently or seasonally. Mackay Regional Council and the Department of Environment and Science (DES) monitor Mackay's flying-fox camps (Figure 20).

In November 2018, Avisure identified a Black Flying-fox camp at Mackay Cemetery which is located approximately 3 km from YBMK. Avisure commenced quarterly monitoring of this camp and DES also monitors this site as part of the National Flying-fox Monitoring Program. Table 11 details this camp's fly-out times and direction for 2018/19.

Table 11. Mackay Cemetery flying-fox camp fly-out, YBMK, 2018/19.

Date	Fly-out Start	Fly-out Finish	Number	Direction
15/11/2018	18:40	19:05	3,500	East
			2000	Southeast
19/02/2018	18:46	17:08	2,200	East
			900	Southwest
			700	Southwest
18/05/2019	18:10	18:35	310	South-southeast

Figure 19. Flying-fox fly out map, YBMK, 2018/19.

Mackay Regional Council
Mackay Airport Bird Management Program 2018/19

Flying-fox Roosts
Runway Centre Lines
Approach & Departure Paths
Airport perimeter
Distance from ARP (3, 8 and 13 km)

AVISURE
safety | aviation | wildlife

Job number: PR3416
Revision: 3
Author: AJS
Date: 15/07/2019

0 1 2 4 6 8
Kilometers

GDA 1994 MGA Zone 55
Projection: Transverse Mercator
Datum: GDA 1994
Units: Meter

Data Sources: © Avisure Pty Ltd 2019
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P3416_MPX_Flying-fox_FlyOut&_Roosts
A4

7. Management

The section outlines the tactical framework for wildlife hazard management at YBMK, comprising of:

- Hazard Detection
- Hazard Monitoring
- Hazard Communication
- Wildlife Strike Reporting
- Data Management
- Hazard Mitigation.

Each element is detailed below.

7.1. Hazard Detection

Assessing the actual or potential wildlife hazard prior to aircraft movements advises aircrew of potential strike risks and informs decision-making to mitigate the risk. Routine hazard detection is achieved during serviceability inspections, perimeter fence inspections and runway and flight strip inspections (Table 12). This ensures early detection of wildlife hazards in airside areas, particularly inside critical aircraft movement areas.

Table 12. YBMK hazard detection methods.

Task	Description	Frequency	Responsible	Procedure/Reference
Flight strip inspections	Check aircraft movement areas for wildlife.	2/day	ASO	SOP: Serviceability Inspections and Wildlife Patrols
Serviceability inspections	Inspect for wildlife as part of mandatory serviceability inspections.	2/day	ASO	SOP: Serviceability Inspections and Wildlife Patrols
Perimeter fence inspections	Check for breaches that could allow airside access to terrestrial animals.	2/day	ASO	SOP: Perimeter Fence Inspections
Wildlife patrols (routine)	Check airside areas for wildlife.	Daily	ASO	SOP: Serviceability Inspections and Wildlife Patrols
Wildlife patrols (post-strike)	Check airside areas for evidence of wildlife and associated hazards following a strike event.	As required	ASO	SOP: Serviceability Inspections and Wildlife Patrols
ATC Hazard detection	N/A	As required	ATC	Manual of Air Traffic Services 2017 – 12.2.2.1.1

7.2. Hazard Monitoring

Hazard monitoring collects essential information to identify changes in hazards and risks. It also provides evidence of regulatory conformance and enables efficacy assessments of the WHMP. Table 13 outlines YBMK's hazard monitoring.

ASOs conduct standardised airside and off-airport bird counts which are used to monitor trends in bird numbers and hazards. The data is entered into the Bird Count Database for analysis. Monitoring frequency, in addition to the activities detailed in Table 13, is a matter of professional judgement and depends on wildlife numbers, species composition, and weather and aircraft activity.

Avisure assesses wildlife monitoring data to update species risk profiles and to assess the effectiveness of management actions.

A Memorandum of Understanding (MOU) has been developed between YBMK and Manzelmann's regarding wildlife hazard management.

Table 13. YBMK identifying and monitoring wildlife hazards.

Task	Description	Frequency	Responsible	Procedure/Reference
Airside wildlife counts	Regularly complete standardised wildlife counts.	Daily	ASO	SOP: Airside Wildlife Counts
Off-aerodrome wildlife counts	Regularly complete standardised wildlife counts.	Monthly	ASO	SOP: Off-airport Wildlife Counts
Flying-fox counts	Regularly complete standardised flying-fox transit counts.	Nightly	ASO	SOP: Flying-fox Counts
Consultant wildlife surveys and risk assessment	Regularly complete standardised wildlife surveys and risk assessment.	Quarterly	Consultant	Appendix C

Non-routine hazard monitoring is achieved through a review of on- and off-aerodrome development proposals and land-use changes. This monitoring helps to assess if wildlife hazards will be created, or enhanced, and how it will contribute to the YBMK strike risk.

7.2.1. Department of Environment and Science Flying-fox Surveys

The Department of Environment and Science monitor the following flying-fox camps as part of the National Flying-fox Monitoring Program:

- Mackay Cemetery Flying-fox Camp
- Walkerston Flying-fox Camp

- Baker's Creek Island Flying-fox Camp
- Wines Creek Flying-fox Camp
- Eimeo Mangroes Flying-fox Camp

7.2.2. Avisure Flying-fox Surveys

Avisure monitors of the following flying-fox camps every quarter to evaluate the risk flying-foxes pose to nocturnal operations at YBMK.

- Mackay Cemetery

7.3. Hazard Communication

Communicating wildlife hazards to aircrew increases their awareness, which subsequently informs decision-making that can avoid a strike. Conversely, communicating wildlife hazards to aerodrome operators helps inform their awareness, contributing to improved wildlife management practices and a safer environment for aircraft operations.

Effective hazard communication requires two things:

1. Clear channels of communication via processes that are efficient, timely and easy to access/receive.

2. Providing notifications that are well-informed, up-to-date, unambiguous, and provide useful information to the intended recipient (i.e. notifications must provide the recipient with sufficient information to understand the hazards and make decisions. Notifications that simply state that a bird hazard exists do not provide sufficient detail about the hazard to avoid a strike).

Table 14. YBMK's hazard communication methods.

Task	Description	Frequency	Responsible	Procedure/Reference
Wildlife hazard notifications	Communicating the wildlife hazard to aircrew and airlines to inform pilots of changed risk levels through direct ATC-pilot communication, NOTAM and ERSA.	As required	ASO	SOP: Wildlife Hazard Notification
NOTAMs	Communicating the wildlife hazard to aircrew and airlines to inform pilots of changed risk levels through direct ATC-pilot communication, NOTAM and ERSA.	As required	ASO	SOP: Wildlife Hazard Notification

Task	Description	Frequency	Responsible	Procedure/Reference
Updating ATIS	Communicating the wildlife hazard to aircrew and airlines to inform pilots of changed risk levels through direct ATC-pilot communication, NOTAM and ERSA.	As required	ASO	SOP: Wildlife Hazard Notification
Wildlife quarterly reports	Providing stakeholders with an update of the wildlife strike trends and current wildlife hazard species.	Quarterly	Consultants	WHMP Quarterly Reports
Wildlife Info-cards	Providing stakeholders with an update of the wildlife strike trends and current wildlife hazard species.	Monthly	Consultants	Wildlife Monthly Info-cards
WHA reports	Providing stakeholders with an update of the wildlife strike trends and current wildlife hazard species.	5-yearly	Consultants	WHA Report., December 2017
WHMP update	Providing stakeholders with an update of the wildlife strike trends and current wildlife hazard species.	Annually	Consultants	SOP: WHMP Review Section 6.1.2. Annual Reviews

7.3.1. Meetings

Input from various on- and off-aerodrome stakeholders helps YBMK to achieve an effective and integrated approach to wildlife hazard management. Wildlife hazard management is a standing agenda item for the meetings outlined in Table 15.

Table 15. Meetings.

Meeting	Wildlife Agenda Description	Frequency	Responsible
Wildlife Hazard Management Committee	WHMP review against Key Performance Indicators, annual report and issues.	Biannually	SAS

7.4. Wildlife Strike Reporting

YBMK ASOs record wildlife strikes regardless of type (e.g. strike, near strike) or location (e.g. on-aerodrome, off-aerodrome, remote from the aerodrome). YBMK enters all strikes into a database and sends reports to the ATSB.

Efforts are made to identify the species involved in strikes. Carcasses are stored in a freezer for identification by an ornithological consultant. Stomach contents may be examined for indicators of food attractants on airport. Where only remnants of strike victims are available, material is collected for DNA analysis or feather identification. In cases when the collection of biological remains is required, staff strictly adhere to health and safety requirements.

YBMK investigate all significant strike incidents.

Table 16. YBMK's wildlife reporting methods.

Task	Description	Frequency	Who	Procedure/Reference
Report and investigate strikes	Report all strikes, regardless of type or location.	As required	ASO	SOP: Identifying and Handling Wildlife Remains
Identify all strikes, process and handle strike remains	Collect struck remains when possible.	As required	ASO	SOP: Identifying and Handling Wildlife Remains
Store strike remains that require further analysis	Store strike remains in a designated freezer where further analysis of the remains is required (e.g. carcass evaluation, DNA analysis).	As required	ASO	SOP: Wildlife Strike Reporting WHMP Section 6 – Wildlife Hazard Assessment

7.5. Data Management

Wildlife strike and survey data are maintained electronically to easily identify trends in strikes and in wildlife activity. Strike and survey data are used to complete risk assessments to identify high and moderate risk species. This data is used in routine reporting which ensures all staff and managers are equipped with the information needed to adapt hazard management activities and the WHMP when required.

Table 17. YBMK's data management methods.

Task	Description	Frequency	Who	Procedure/Reference
Reporting	Report on wildlife strike and airside activity.	Monthly, Quarterly and Annually	Consultants	Monthly wildlife info-cards, quarterly wildlife risk reports and annual WHMP.
Data management	Electronically store wildlife data (e.g. surveys, strikes, dispersal) to monitor program progress and identify trends.	Weekly and Monthly	YBMK and Consultants	Relevant internal databases and data sharing with consultant.
Review data and program trends	Review the data to analyse trends.	Annually	YBMK and Consultants	SOP: Data Review SOP: WHMP Review WHMP Section 6 – Wildlife Hazard Assessment

7.6. Hazard Mitigation

Strategies for managing wildlife hazards typically focus on managing populations on and surrounding the aerodrome. Management actions are classified as either:

a. Active management – directly removing or reducing the numbers of wildlife; and

b. Passive management – modifying habitats or other aspects of the environment to indirectly remove or reduce the number of wildlife.

7.6.1. Active management

Active management methods employed at YBMK include wildlife dispersal and lethal control. Lethal control of wildlife may be necessary, but in general, animals are not destroyed unless there is an immediate danger to essential facilities or to the safety of an aircraft. All care is taken to ensure that the lethal control of wildlife is a last resort and this option is only used after all other non-lethal harassment measures have been taken.

Wildlife hazard levels and aircraft movements determine the frequency and intensity of active management. The overall objective is to separate aircraft and wildlife which is achieved by influencing wildlife or aircraft to minimise the likelihood of occupying the same airspace at the same time. Refer to Table 18 for the methods used.

Hazard removal actions and their outcomes are important sources of information. The ASO records all dispersal and lethal control actions and their outcomes in the Aerodrome Logbook, as required by the AOM. This provides a historical record for comparison and analysis and may provide evidence of adequate wildlife hazard management in the event of litigation.

Table 18. Active Management Methods.

Task	Description	Frequency	Responsible	Procedure/Reference
Wildlife dispersal	Using tools and techniques to harass birds from the airside area, prioritising the critical aircraft movement areas.	In response to hazards	ASO	SOP: Wildlife Dispersal SOP: Wildlife Dispersal Training
Wildlife lethal control	Using lethal control (under permit) to manage immediate and significant strike risks.	In response to hazards	ASO	SOP: Wildlife Culling SOP: Firearm Safety and Use SOP: Firearm Licensing and Authorisation SOP: Using Ammunition and Firearms SOP: Cleaning Firearms
Wildlife egg and nest removal	Under permit, destroy/relocate nests and use lethal control to manage immediate and significant risks.	As required	ASO	SOP: Wildlife Culling
Handling wildlife carcasses and other remains	Safe handling practices to manage wildlife remains, and how to process for forensic analysis.	As required	ASO	SOP: Identifying and Handling Wildlife Remains
Wildlife relocation	Safe handling practices to capture wildlife airside and relocating them off-airport.	As required	ASO	SOP: Wildlife Culling
Airside vertebrate pest control	Trapping, shooting, baiting and den-fumigation of vertebrate pests.	As required	ASO	SOP: Wildlife Culling
Safe use of firearms	Use and maintenance of firearms for dispersal and lethal control.	As required	ASO	SOP: Firearm Safety and Use SOP: Firearm Licensing and Authorisation SOP: Using Ammunition and Firearms SOP: Cleaning Firearms

7.6.2. Passive management

Passive management aims to manage wildlife hazards by preventing access to food and other resources. YBMK uses a rage of methods to passively manage risks, there is a full security fence preventing access from terrestrial threats such as wallabies. YBMK manipulates grass height and overall landscaping to reduce the availability of food and shelter, reducing the wildlife attraction.

Table 19. YBMK's passive management methods.

Task	Description	Frequency	Responsible	Procedure
Mow grass		As required	Grounds Maintenance	YBMK Mowing Plan Map SOP: Habitat and Land Management
Inspect airside gates		As required	ASO	YBMK Gate Map SOP: Perimeter Fence Inspections
Landscaping	Landscaped areas (e.g. gardens, trees, etc.) are managed to reduce the attraction to hazardous species.	As required	MAPL	Landscaping Guidelines 2008 SOP: Habitat and Land Management
Manage vegetation	Vegetated areas are managed to reduce the attraction to hazardous species.	As required	YBMK	SOP: Habitat and Land Management

7.6.3. Species Action Plans

Species Action Plans (SAP) support the WHMP and provide the actions required by YBMK to manage the following high and moderate risk species. SAPs for the following species are provided in a separate document:

1. Little Black Cormorant
2. Australian White Ibis
3. Unidentified Flying-fox
4. Plumed Whistling-Duck
5. Bush Stone-curlew
6. Magpie Goose
7. Straw-necked Ibis
8. Pacific Black Duck
9. Masked Lapwing
10. Black Kite
11. Rainbow Lorikeet
12. Feral Pigeon
13. Magpie Lark
14. Red-tailed Black-Cockatoo
15. Radjah Shelduck
16. Cattle Egret
17. Torresian Crow
18. Pied Imperial-Pigeon
19. Galah
20. Australian Pelican
21. Wandering Whistling-Duck
22. Unidentified Raptor
23. Unidentified Snake
24. Black Flying-fox

8. Safety and Quality Assurance

The MAO is responsible for ensuring successful WHMP implementation. This is achieved by managing change, continually improving the WHMP, and regularly assessing progress against the objectives to ensure it remains suitable and effective.

8.1. Reviews

YBMK complete the following WHMP reviews to ensure it is current and relevant, and to identify options for continual improvement.

8.1.1. Major Review

Completed every five years, major reviews rewrite and reissue the WHMP. The MAO is responsible for the review, who may be assisted by an aviation ecologist. Major reviews take the place of annual reviews in the years they occur.

8.1.2. Annual Reviews

In accordance with the CASA MOS Part 139, the WHMP is reviewed every year as part of each technical inspection. Completed with the support of an aviation ecologist, annual reviews:

- are based on performance indicators and audit findings
- recommend management actions to further reduce the risk of bird and wildlife strike
- ensure compliance with all current legislation
- update the risk assessment using strike and monitoring data and observations
- ensure all procedures, roles and responsibilities are current and relevant
- ensure the WHMP includes all management actions undertaken to manage wildlife hazards.

Review results are documented in an Annual Report and any non-compliances or other concerns are reported in the YBMK SMS.

8.1.3. Triggered Reviews

Reviews may be triggered in response to regulatory changes, operational changes, or significant changes to the wildlife strike risk. Triggered reviews may also be at the discretion of CASA or the MAO.

8.2. Audits

8.2.1. Internal Audits

Internal audits form part of the YBMK audit program, and the YBMK. These audits aim to evaluate and check all data, equipment and procedures to ensure regulatory compliance and to identify any program gaps.

Based on the *CASA AC 139-26 (0) Wildlife Hazard Management at Aerodromes*, audits focus on:

- evaluating the accuracy of identifying and monitoring of the wildlife hazard
- reviewing the hazard and rank of wildlife species risks
- evaluating the effectiveness of passive and active control measures
- reviewing the implementation of the WHMP and monitoring its effectiveness
- assessing the efficacy of the Standard Operating Procedures
- cross-checking program performance against benchmarks, objects and targets
- reviewing the adequacy of training provided to wildlife management personnel.

Findings of these audits are used to modify practices and procedures to improve any deficiencies identified and incorporated into future WHMP reviews.

8.2.2. External Audits

Airlines, CASA, and/or aviation consultants may complete external audits. Audit findings help guide the wildlife management program.

8.2.3. Damage Mitigation Permit: Audit Reports

DES require YBMK to have a DMP for lethal control in accordance with the Nature Conservation Regulation 2006. As part of this permit YBMK must submit reports to DES every three (3) months citing the number, species and reason or taking animals under this permit.

9. Procedures

Standard Operating Procedures (SOPs) detail the correct and safe implementation of WHMP tasks and responsibilities. The following procedures are provided in a separate document:

Wildlife Management SOPs:

- Serviceability Inspections and Wildlife Patrols
- Airside Wildlife Counts
- Off-airport Wildlife Counts
- Wildlife Hazard Notification
- Identifying and Handling Wildlife Remains
- Wildlife Dispersal
- Wildlife Culling
- Data Review
- Perimeter Fence Inspections
- Wildlife Strike Reporting
- Habitat and Land Management
- WHMP Review
- Wildlife Dispersal Training
- Flying-fox Count

Firearm SOPs:

- Safety and Use
- Licensing and Authorisation
- Using Ammunition and Firearms
- Cleaning Firearms

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Appendices

Appendix A: Roles and Responsibilities

Appendix B: Risk Assessment Methods

Appendix C: Avisure On-aerodrome Survey Methods

Appendix D: Legal and other requirements

Appendix A: Roles and Responsibilities

Table A1. WHMP roles and responsibilities, YBMK.

Position	Responsibilities	Frequency
Manager Aviation Operations (MAO)	Endorse the final WHMP.	August 2019
	Provide resources for implementing the WHMP.	August 2019
	Attend the annual WHMC meetings or delegate a representative.	Biannually (summer and winter)
	Oversee the implementation and review of the WHMP.	As required
	Ensure ASOs are trained and competent in the functions required for wildlife hazard management, including inspections, wildlife counts, wildlife identification, wildlife harassment and reporting techniques.	As required
	Issue the WHMP and procedures to relevant staff and ensure implementation.	August 2019
	Ensure ASOs and other relevant YBMK staff adhere to the procedures and actions detailed in the WHMP.	As required
	Liaise with aircraft operators, local government and other stakeholders to assist in identifying and managing wildlife issues. Invite relevant external stakeholders to WHMC meetings to assist with wildlife management at off-airport sites.	As required
	Ensure the YBMK Aerodrome Manual includes references to relevant sections of the WHMP.	August 2019
	Provide information regarding wildlife hazards and their management at YBMK to regulatory authorities and operational publications as required.	As required
	Coordinate interactions with WHMC stakeholders for the management of land use surrounding the airport.	As required

Position	Responsibilities	Frequency
Supervisor Airside Safety (SAS)	Ensure that all SOPs contained in the WHMP involving ASOs are implemented.	As required
	Review of the WHMP at least annually, particularly the SOPs. Forward any recommended modifications to the MAO.	Annually
	Ensure ASOs monitor, inspect, assess, record and report as described in the WHMP.	Daily
	Ensure that the ASOs are trained and competent in the functions required for wildlife hazard management, including wildlife surveys, wildlife identification, and wildlife dispersal and reporting techniques.	As required
	Provide technical presentations and advice to WHMC meetings.	As required, at least biannually (summer and winter)
	Coordinate training for personnel assigned to conduct wildlife harassment with appropriate firearms certification.	As required
	Maintain the Damage Mitigation Permit.	Yearly (renewal) Quarterly (Return of Operations)
	Attend WHMC meetings or delegate a representative.	Biannually (summer and winter)
Aerodrome Safety Officers (ASO)	Provide live wildlife hazard notifications.	As required
	Inspect, assess, record and report as described in the relevant sections of the WHMP and any SOPs.	As required
	Manage wildlife and their habitats as described in the relevant sections in the WHMP and adhere to SOPs.	As required
	Attend wildlife hazard management training as required.	As required

Position	Responsibilities	Frequency
	Use, store and maintain firearms and ammunition as required by YBMK's firearms policy and procedures.	Daily
	Record management actions as per SOPs.	Daily
	Report bird strikes.	As required
	Maintain the database detailing species and number of wildlife culled.	At least monthly
	Collect and maintain dispersal data, including ammunition use.	Daily
	Coordinate with aircrews and ground support personnel the collection of all strike remains and assist with species identification.	As required
	Collect and store wildlife carcasses from strikes for identification and arrange carcass disposal.	As required
	Provide input in the revision of the WHMP and SOPs.	Annually
	Attend the WHMC meetings.	Biannually (summer and winter)
Grounds Maintenance	Ensure that all mowing practices align with the WHMP.	August 2019
	Ensure all vegetated areas, drainage systems and any bird deterrent measures are maintained, identify and maintain all perimeter fences and gates.	As required
Environment Manager	Provide advice regarding environmental matters.	As required
	Prepare wildlife strike data and depredation data and monitor species risk and hazards.	As required
	Ensure that the WHMP's principles are consistent with the YBMK's Environmental Management System.	Annually review
	Ensure compliance with permit conditions.	As required

Position	Responsibilities	Frequency
	Where necessary, assist with the management and control of birds and other wildlife in occupied buildings and hangars.	As required
	Regularly review waste management practices at the airport to secure food and waste attractants away from wildlife.	Annually
Aircraft Operators	Require air and ground crews to promptly inform ASOs of all wildlife strikes or hazardous conditions.	As required
	Require ground staff to relay evidence of strikes including damage, carcasses, feathers, or other material to ASOs for collection.	As required
	Provide details of strikes to SAS.	As required
	Maintain awareness of the WHMP and forward recommendations to MAO.	Annually
	Where appropriate, consider changing operations to avoid hazardous times and locations.	As required
	Attend WHMC meetings.	Biannually (summer and winter)
Airport Tenants	Ensure waste is disposed of appropriately and bins and other waste storage facilities are maintained with closed lids or other suitable covering wherever practicable.	Daily
	Report observations of bird nesting in any infrastructure to SAS.	As required
	Attend WHMC meetings.	Biannually (summer and winter)
Wildlife Hazard Management Committee (WHMC)	Meet biannually.	Biannually (summer and winter)
	Share information, identify risks and ensure stakeholders are engaged in collaborative management of these risks.	As required
	Discuss relevant wildlife issues and management practices.	As required
	Review and approve the WHMP.	August 2019

Position	Responsibilities	Frequency
	Review bird strike reports, cull reports, bird count reports, and overall strike statistics and discuss strategies for improvement as required.	Biannually (summer and winter)
	Review performance against KPIs.	Biannually (summer and winter)
	Discuss on- and off-airport strategies to manage wildlife hazard.	Biannually (summer and winter)

Appendix B: Risk Assessment Methods

Definitions

(Source: AS/NZS 4360:1990 Risk Management)

Hazard	A source of potential harm or a situation with a potential to cause loss.
Risk	The chance of something happening that will have an impact (either positive or adverse) on objectives and is measured in terms of the probability (or likelihood) of an event and its consequences.
Likelihood	A qualitative description of probability or frequency.
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.

Wildlife hazard management at aerodromes requires an understanding of wildlife populations, their behaviour, and the risk management process. This assessment followed the process outlined in Australian and New Zealand Standard 31000:2009 Risk Management, Figure B1.

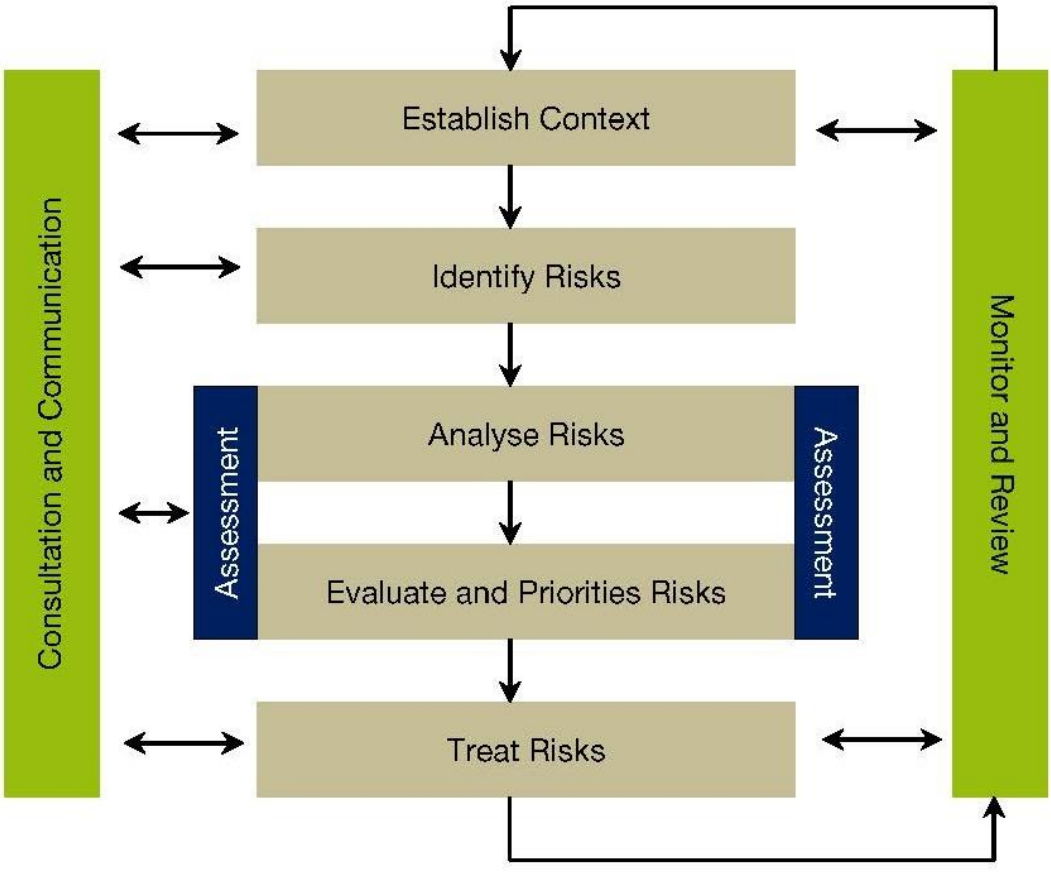

Figure B1. The risk management process (Source: AS/NZS 31000:2009 Risk Management).

Previous efforts to rank species according to risk level have involved one of the following:

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

Strike Risk Assessment (Allan, 2006)

The assessment phase of the risk management process involves categorising risks. To do this, a hazard needs to be measured in terms of its probability of occurring and the consequence should it occur. This allows it to be placed into a risk matrix as outlined below:

		Probability of Strikes (5yr average)				
		Very Low	Low	Moderate	High	Very High
Probability of damage	Very Low					
	Low		Species A			
	Moderate					
	High	Species B			Species C	
	Very High					

Figure B2. Strike risk assessment matrix (Allan 2006).

Risks which fall into the green section are 'low' and require no further action beyond current management; yellow is 'moderate' and requires a review of current management practices and options for additional action, and; red is 'high' and requires immediate action to reduce the current risk.

Risk assessment procedures based on historical strike data are limited, as they cannot easily accommodate real time changes in bird species composition or distribution.

Survey Risk Assessment (Shaw, 2004)

Avisure has developed a model for determining risk categories using professional bird survey data. The survey data is used to derive probability factors (population size, position on aerodrome, time spent in air and the species ability to avoid) and consequence factors (bird mass and flock size) for all species recorded. The combination of these probability and consequence factors give a numerical risk index, the 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.

The following tables outline the risk rating for wildlife species according to calculated SRI, and the risk ranking of an aerodrome.

Table B1. Species Risk Index and Aerodrome Survey Risk Index for determining risk categories based on survey data.

SRI ranges used to rate risk for each species		ASRI ranges used to rate risk of an Aerodrome	
SRI	Risk rating	ASRI	Risk rating
>1000	Very high	>10000	Very high
100 to 999.9	High	1000 to 9999.9	High
10 to 99.9	Moderate	100 to 999.9	Moderate
1 to 9.9	Low	10 to 99.9	Low
< 1	Very low	< 10	Very low

The process intends to provide a transparent, logical and systematic approach to the identification and treatment of wildlife related risks at the aerodrome.

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Appendix C: Avisure On-aerodrome Survey Methods

Avisure complete surveys across four periods; early morning, middle of the day, late afternoon, and post-dusk. Each survey consists of eight sectors that cover the area inside the fence at YBMK. Each survey sector has an assigned observation point that overlooks the entire sector (Figure C1).

Diurnal Surveys

The observer travels from one observation point to the next following a set route through each sector making observations while en-route. The observer spends five minutes at each observation point, recording all wildlife observed within the sector during this time. Birds observed in transit or thermalling within the aerodrome boundary or on aircraft flight paths are recorded regardless of whether they are in the current sector or not. Binoculars are used to assist with identification of wildlife. Data recorded includes time, species, number sighted, position, estimated height above ground level, heading, activity (e.g. foraging, perching, transiting) and habitat used (e.g. grass, drain, fence). Survey records also include ambient conditions (e.g. rainfall, temperature, wind speed).

Nocturnal Survey

The observer travels from one observation point to the next in a continuous motion, stopping when necessary to identify species. A spotlight and vehicle high-beams are used to illuminate as much of the airside habitat as possible. The vehicle is driven at or less than 15 kph to allow the observer to scan with the spotlight. Binoculars are used to assist with identification of wildlife. Data recorded includes time, species, number sighted, position, estimated height above ground level, heading, activity (e.g. foraging, perching, transiting) and habitat used (e.g. grass, drain, fence). Survey records also include ambient conditions (e.g. rainfall, temperature, wind speed).

Limitations:

- Sampling is not always from independent replicates: wildlife can be counted twice if they move between sectors with common boundaries, although this is avoided where possible.
- Visibility in areas such as drainage channels and reed beds is lower, so wildlife in these areas may be under-represented in the data.
- Nocturnal visibility is limited to the focus of the spotlight and/or high beam lights.
- Observations of transiting and thermalling birds regardless of whether they are inside the sector may increase the representation of some bird species which tend to transit or thermal. In some circumstances, transiting birds may be missed due to the position of the observer.
- The cryptic nature of some bird species may result in the under-representation of these species in the data.
- Ideally, simultaneous all-sector counts are required to get a true representation of species and numbers.

Despite its limitations, this method is satisfactory for good trend analysis so long as it is applied consistently.

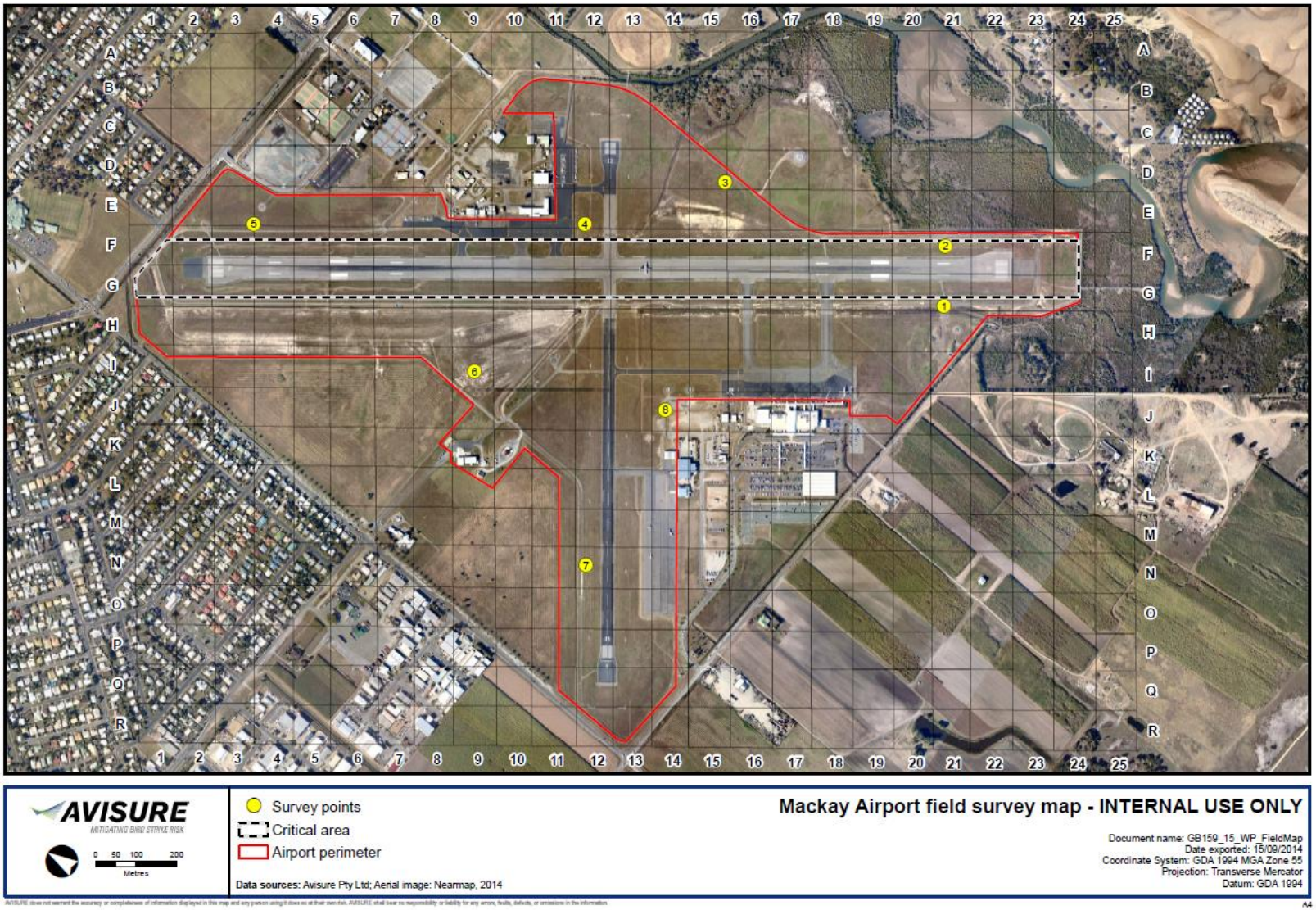

Figure C1. Avisure diurnal on-airport survey points.

Appendix D: Legal and other requirements

Australian Context

Australia's Civil Aviation Safety Authority (CASA) enacts and enforces the Civil Aviation Safety Regulations 1998. Managing wildlife on and around airports must consider a suite of legislative and regulatory requirements. The following tables summarises these requirements.

Table D1. Australian aviation legislation and standards.

Instrument	Body/Department	Description	Link
Civil Aviation Act 1998	CASA	Establishes CASA functions in relation to civil aviation, with a particular emphasis on safety.	http://casa.gov.au/scripts/nc.dll?WCMS:STANDARD:485652781:pc=PC_90902
Civil Aviation Safety Regulations 1998	CASA	Details Commonwealth legislation regarding all aspects of civil aviation safety and establishes the regulatory framework. Part 139 (Aerodromes) contains specific requirements for wildlife hazard management.	
Manual of Standards (MOS) Part 139 Aerodromes	CASA	Part 139 prescribes the aerodrome requirements. Sections relevant to wildlife hazard management focus on: bird hazard information for the Aeronautical Information Package (AIP) (5.1.3.24); drainage and drains in the runway strip (6.2.23.2); requirements for serviceability inspections (10.2.2.1, 10.2.7, 10.2.10.1, 12.1.3.2); Notice to Airman (NOTAM) requirements for bird hazards (10.3.2.2, 10.3.6.1); Reporting Officer responsibilities (10.6.3.1, 10.6.4.1), animal hazard management requirements (10.14); and standing water on paved surfaces (10.15.4.2).	https://www.comlaw.gov.au/Details/F2014C01301
Advisory Circular (AC) 139-26(0) Wildlife Hazard Management at Aerodromes	CASA	The AC is intended to provide recommendations and guidance for Part 139 compliance, by providing interpretative and explanatory material to assist aerodromes.	http://www.casa.gov.au/wcmswr/_assets/main/rules/1998casr/139/139c26.pdf

Instrument	Body/Department	Description	Link
Transport Safety Investigation Act 2003	ATSB	Bird strikes are defined as reportable matters, of which written reports must be submitted within 72hrs.	https://www.comlaw.gov.au/Series/C2004A01102
National Airports Safeguarding Framework Guideline C	Department of Infrastructure and Regional Development[16]	Aims to develop informed land use planning decisions to safeguard airports and their adjacent communities from wildlife hazards based on the international and national regulatory framework. The NASF allocates risk categories to incompatible land uses (very low to high), adhering to ICAO guidelines relative to radial distances from aerodromes, and recommends actions (incompatible, mitigate, monitor, no action) for both existing and proposed developments.	https://infrastructure.gov.au/aviation/environmental/airport_safeguarding/nasf/nasf_principles_guidelines.aspx .

16 Formerly the Department of Infrastructure and Transport.

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

Figure D1. NASF Guideline.

Table D2. Australian legislation and standards.

Instrument	Body/Department	Description	Link
Environment Protection and Biodiversity (EPBC) Act 1999	Commonwealth Department of Environment	The EPBC Act provides the framework for the protection of the Australian natural environment and its biodiversity and establishes processes that help to protect threatened species and ecological communities, and as well as promoting their recovery. Within the context of wildlife hazard management on airports, of principal consideration is the effect management actions, such as dispersal and lethal control, may have on threatened species. The management of species listed as either Critically Endangered, Endangered, Vulnerable or Conservation Dependent under the Act, may require Departmental approval and Airports may need to consult the Department for clarification. Whether an action is likely to impact upon animal species that are rare, endemic or otherwise valuable, such as listed threatened species and listed migratory species, either directly or on their feeding, nesting, breeding areas is of particular importance. Direct mortality of these species or removal of their habitat to remove or minimise hazards is undesirable but may be necessary where the risk to safety is deemed too significant. Each situation requires specific evaluation (see EPBC Referral Guidelines). The EPBC Act also identifies species protected under the various international migratory bird treaties (detailed next).	http://www.environment.gov.au/epbc
Japan-Australia Migratory Bird Agreement (JAMBA)	Commonwealth Department of Environment	Agreement between Australia and Japan to conserve migratory birds and their habitats. Wildlife species listed under international agreements afford them legislative protection in order to maintain populations and individuals.	http://www.austlii.edu.au/au/other/dfat/treaties/1981/6.html
China-Australia Migratory Bird Agreement (CAMBA)	Commonwealth Department of Environment	Agreement between Australia and China to conserve migratory birds and their habitats. Wildlife species listed under international agreements afford them legislative protection in order to maintain populations and individuals.	http://www.austlii.edu.au/au/other/dfat/treaties/1988/22.html
Korea-Australia Migratory Bird Agreement (ROKAMBA)	Commonwealth Department of Environment	Agreement between Australia and the Republic of Korea to conserve migratory birds and their habitats. Wildlife species listed under international agreements afford them legislative protection in order to maintain populations and individuals.	http://www.austlii.edu.au/au/other/dfat/treaties/2007/24.html

Instrument	Body/Department	Description	Link
Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention)	Commonwealth Department of Environment	Wildlife species listed under international conventions afford them legislative protection in order to maintain populations and individuals.	https://www.cms.int/
The Commonwealth Work Health and Safety Act 2011	Commonwealth Department of Health	Identifies work health safety legislation and codes of practice relevant to wildlife hazard management, including in off-base locations. Depending on the nature and location of the wildlife hazard and the proposed response, the following may be relevant: • Work Health and Safety Act 2011 • Work Health and Safety Regulations 2011 • AS/NZS 4360 series (Risk Management) • AS/NZS 4801 series (Occupational Health and Safety Management) • SafetyMan series.	https://www.legislation.gov.au/Details/C2017C00305
Australian Animal Welfare Strategy (AAWS)		Developed to ensure the humane treatment of all animals in Australia. The Strategy: • Provides an assessment of the relative humaneness of pest-animal control methods. • Provides SOPs that detail animal welfare impacts for target and non-target species and describe techniques and their application, as well as considering health and safety. • A model SOP for each of the key pest animal species provides general information on best practice management, control strategies, species biology and impact, and the humaneness of current control methods.	http://www.agriculture.gov.au/animal/welfare/aaws

Table D3. Relevant Codes of Practice.

State	Code Name	Authority	Link
Commonwealth	National Codes of Practices (Commercial and Non-Commercial) for the Human Shooting of Kangaroos and Wallabies	Department of the Environment	http://www.environment.gov.au/biodiversity/wildlife-trade/publications/national-code-practice-humane-shooting-kangASOos-and-wallabies-commercial
	Model Codes of Practice and Standard Operating Procedures for the humane capture, handling or destruction of feral animals in Australia	Department of the Environment	http://www.environment.gov.au/biodiversity/invasive-species/publications/model-codes-practice-feral-animals

Off-airport Hazards

Table D4. Summary of Australian regulatory and legislative requirements and recommendations for managing off-airport wildlife hazards.

Regulation / Standard	Requirement
CASA MOS Part 139. Section 10.6.4 Monitoring Activities Outside Aerodrome	The reporting function must also include monitoring activities outside but in the vicinity of the aerodrome which may result in hazards to aircraft operations. This includes land planning and use which may attract birds.
CASA AC 139:26 2011. Section 9.4.1	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.
CASA AC 139:26 2011. Section 6.1.1	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: • advise the relevant land owner(s) or controlling authority of both the nature of the wildlife hazard and the resultant impact on the aerodrome • work with the relevant land owner(s) or controlling authority to manage the wildlife hazard.

International Context

Australia has international obligations as a contracting state to the International Civil Aviation Organisation (ICAO). As a signatory of the Convention on International Civil Aviation, Australia is required to maintain aviation rules that align with the requirements of the Convention. This includes standards for wildlife hazard management at civilian airports in accordance with Annex 14, Volume 1 (Aerodrome Design and Operation), which establishes requirements for the management of collisions between wildlife and aircraft and requires authorities to take actions to reduce the prevalence of wildlife attracting sites in the vicinity of airports. ICAO's regulations and standards inform CASA regulations and recommendations for wildlife management at airports and are therefore relevant to the airport bird and bat strike risk assessment.

Table D5. International regulations and standards.

Instrument	Body/Department	Description	Link
ICAO Annex 14, Volume 1 (Aerodrome Design and Operation)	ICAO	Establishes requirements for the management of collisions between wildlife and aircraft and requires authorities to take actions to reduce the prevalence of wildlife attracting sites in the vicinity of airports.	Not available
ICAO Airport Services Manual Doc. 9184: Part 2 Land Use and Environmental Control	ICAO	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".	Not available

Instrument	Body/Department	Description	Link
ICAO Doc 9137 - Airport Services Manual Part 3, Wildlife Control and Reduction, (2012)	ICAO	Elaborates on the wildlife management responsibilities of airports, providing guidance on the development and implementation of effective airport wildlife management programs. It includes recommendations on hazard review and habitat management and identifies a recommended boundary for monitoring off-airport wildlife hazards and land uses.	http://www.birdstrike.org/wp-content/uploads/2014/10/ICAO-AirportServicesManual-Part3-FourthEdition-2012.pdf
Bird Strike Guidelines	International Air Transport Association	Recommend the correct way to handle animal remains.	https://www.iata.org/whatwedo/safety/health/Documents/health-guidelines-bird-strike-2011.pdf
International Best Practice Standards for Airport Bird Control	World Birdstrike Association (previously the International Bird Strike Committee)	Provides a series of standards relevant to all aspects of integrated wildlife hazard management programs on- and off- airports.	http://worldbirdstrike.com/index.php/resources/publications/ibsc-best-practices-manual

ICAO and Off-airport Hazards

Within the context of wildlife hazards, ICAO defines the airport vicinity into two radial distances from the Airport Reference Point (ARP); Area A being 3 km, and Area B being 8 km. These distances have been based in the known activity of birds, in general, aligned with standard aircraft flight paths around airports. Within these distances, ICAO provides land-use guidelines for acceptable and unacceptable land uses). ICAO also indicate that the placement of food waste landfills within 13km of and aerodrome is of concern.

Furthermore, the International Bird Strike Committee's Best Practice Standards (2006) recommend the establishment of a 13km circle from the ARP, within which an inventory of wildlife hazards should be established, and risk assessments completed to determine the level of contribution to the strike risk.

Table D6. ICAO Land Use Guidelines for the Avoidance of Bird Hazards (Source: ICAO Doc 9184, Appendix 2).

Land Use	Area A	Area B	Land Use	Area A	Area B
Agriculture			*Commercial**		
Landscape nurseries*	YES	YES	Offices	YES	YES
Tree farming*	YES	YES	Retail sales	YES	YES
Stock farming*	YES	YES	Hotels and motels	YES	YES
Dairy farming*	YES	YES	Restaurants	YES	YES
Sod farming	NO	YES	Parking lots	YES	YES
piggeries	NO	YES	Indoor theatres	YES	YES
Fruit tree farming	NO	YES	Warehouses	YES	YES
			Shopping centres	YES	YES
Wildlife Sanctuaries			Service stations	YES	YES
Bird sanctuaries	NO	NO	Cemeteries	YES	YES
Game reserves	NO	NO	Drive-in restaurants	NO	YES
			Food-processing plants	NO	YES
Recreational					
Golf courses*	YES	YES	*Municipal Utilities*		
Parks*	YES	YES	Water treatment	YES	YES
Playgrounds*	YES	YES	Non-food garbage landfill	YES	YES
Athletic fields*	YES	YES	Food garbage disposal	NO	NO
Riding fields*	YES	YES	Source: ICAO Doc 9184 (originally sources from Transport Canada Land use in the Vicinity of Airport		
Tennis, lawn bowling*	YES	YES			
Picnic and campgrounds	YES	YES	*These are general guidelines for planning and land-use zoning only. The avoidance of bird hazards during airport operations is another subject that can involve special controls to keep land free from food and shelter for birds		
Riding academies	NO	YES			
Racetracks	NO	YES			
Fair grounds	NO	YES			

Revision History

Rev. No.	Rev. Date	Details	Prepared by	Reviewed by	Approved by
00	12/07/2019	Wildlife Hazard Management Plan – Draft	Alexandra Stone Wildlife Biologist Erin Marsh Graduate Wildlife Biologist	Kylie Patrick Principal Consultant	Kylie Patrick Principal Consultant
01	21/01/2020	Wildlife Hazard Management Plan – Final	Alexandra Stone Wildlife Biologist	Will Jamieson Regional Manager	Will Jamieson Regional Manager
02	31/01/2020	Wildlife Hazard Management Plan – Final R1	Alexandra Stone Wildlife Biologist	Will Jamieson Regional Manager	Will Jamieson Regional Manager
03	06/02/2020	Wildlife Hazard Management Plan – Final R2	Alexandra Stone Wildlife Biologist	Will Jamieson Regional Manager	Will Jamieson Regional Manager

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