Melbourne Airport
M3R MDP

Chapters E1–E6

Volume 8

MELBOURNE AIRPORT

Chapter E1
Management Framework - Introduction

Overview

The preceding Parts A, B, C and D of this MDP describe the M3R project and the environmental, airspace, social, health and economic impacts of its construction and operation. Part E details the management framework and governance structures applicable to M3R, and summarises the findings of each of the impact assessments undertaken for this MDP. It includes the following chapters:

Chapter E2: Environmental Management Framework provides a practical outline of how land-based environmental issues will be managed for the construction and operation of M3R.

The Environmental Management Framework provides the basis for the Construction Environmental Management Plan (CEMP) which will be prepared to inform and regulate the management of environmental issues throughout the construction of M3R . This chapter also details the requirements of the environmental training, environmental monitoring, reporting, auditing and review processes for M3R construction activities

Chapter E3: Offset Management Strategy describes the strategy for securing the environmental offsets for M3R required under the Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy, and assesses the suitability of the proposed environmental offset arrangements.

Chapter E4: Draft Runway Operating Plan presents an indicative plan for the future runway operations that Melbourne Airport envisages will be adopted once M3R becomes operational (subject to the detailed airspace design that will be completed by Airservices prior to commencement of M3R operations).

Chapter E5: Risk Management provides the framework for assessing the Melbourne Airport corporate business risks, airport operational risks and project risks associated with M3R. This risk framework will provide the basis for future risk management as M3R progresses, with a transitioning focus from design to construction and into operations.

Chapter E6: Summary Commitments and Conclusion summarises the highest impacts and benefits of M3R as described in Parts A, B, C and D of the MDP. These impacts are related to both the construction and operation phases of M3R. The highest impacts are considered in the context of the whole-of-environment framework contained in the *Environment Protection and Biodiversity Conservation Act 1999 Significant impact guidelines 1.2 Actions on, or impacting upon Commonwealth land, and actions by Commonwealth agencies* . It also describes how cumulative and facilitated impacts are addressed and Melbourne Airport's commitment to mitigation and monitoring measures to minimise impacts.


ZMG 381
VICTORIA - THE PLACE TO BE
Dynapro AT M
1


Jet
Jetstar.com
rex
Regional

Chapter E2
Environmental Management Framework

Summary of key findings:

- Melbourne Airport must comply with Commonwealth and Victorian legislative requirements for managing environmental issues associated with the development of Melbourne Airport's Third Runway (M3R)
- Melbourne Airport has developed an Environmental Management Framework (EMF) that will guide environmental management during the design, planning and construction phases of M3R
- The main environmental issues considered include:
  - Asbestos contamination (**Chapter B3**)
  - PFAS contamination (**Chapter B3**)
  - Water quality and erosion (**Chapter B4**)
  - Ecology (**Chapter B5**)
  - Cultural heritage (**Chapter B6**)
  - European heritage (**Chapter B7**)
  - Surface transport (**Chapter B8**)
  - Ground-based noise and vibration (**Chapter B9**)
  - Air quality (**Chapter B10**)
  - Greenhouse gas emissions (**Chapter B11**)
  - Landscape and visual amenity (**Chapter B12**)
  - Climate risk and natural hazards (**Chapter B13**).
- Appropriate management strategies have been identified for each issue. They are provided in the above chapters in Part B (Airport) of the Major Development Plan (MDP) and will be further developed and refined during detailed design of M3R.


Vietnam Airlines

CHAPTER E2 CONTENTS

CHAPTER E2 FIGURES

CHAPTER E2 TABLES

E2.1 INTRODUCTION

Melbourne Airport actively responds to key environmental and sustainability challenges. The organisation is committed to responsible environmental management, and implementing practical strategies for continuously improving environmental performance and the ongoing sustainability of operations.

Melbourne Airport's Third Runway (M3R) will follow the overarching Melbourne Airport Environment Strategy, Environmental Management System (EMS) and Environment and Sustainability Policy. In addition to the environmental aspects addressed in these documents, key sustainability focus areas have been identified for the project (**Chapter A7: Sustainability Framework**) and detailed impact assessments undertaken to identify risks and opportunities in key issue areas.

E2.2 ENVIRONMENTAL MANAGEMENT FRAMEWORK (EMF)

E2.2.1 Purpose of the EMF

This EMF provides an overview of how environmental and sustainability issues will be managed through the construction and operation phases of M3R. The framework considers the design, enabling works, construction and all ancillary works associated with M3R for all activities likely to result in land-based impacts (MDP Part B: Airport).

The objective of the EMF is to ensure M3R minimises impacts to the 'whole of the environment' in a manner consistent with the applicable environmental approvals and regulatory context (**Figure E2.1**).

The EMF includes Melbourne Airport's responsibilities under relevant Commonwealth and Victorian legislation, policy and guidelines. This framework enables the project-specific risks identified by the MDP, and the environmental issues and key impacts outlined in **Section E2.5**, to be appropriately managed throughout the life of M3R.

E2.2.2 Construction Environmental Management Plan

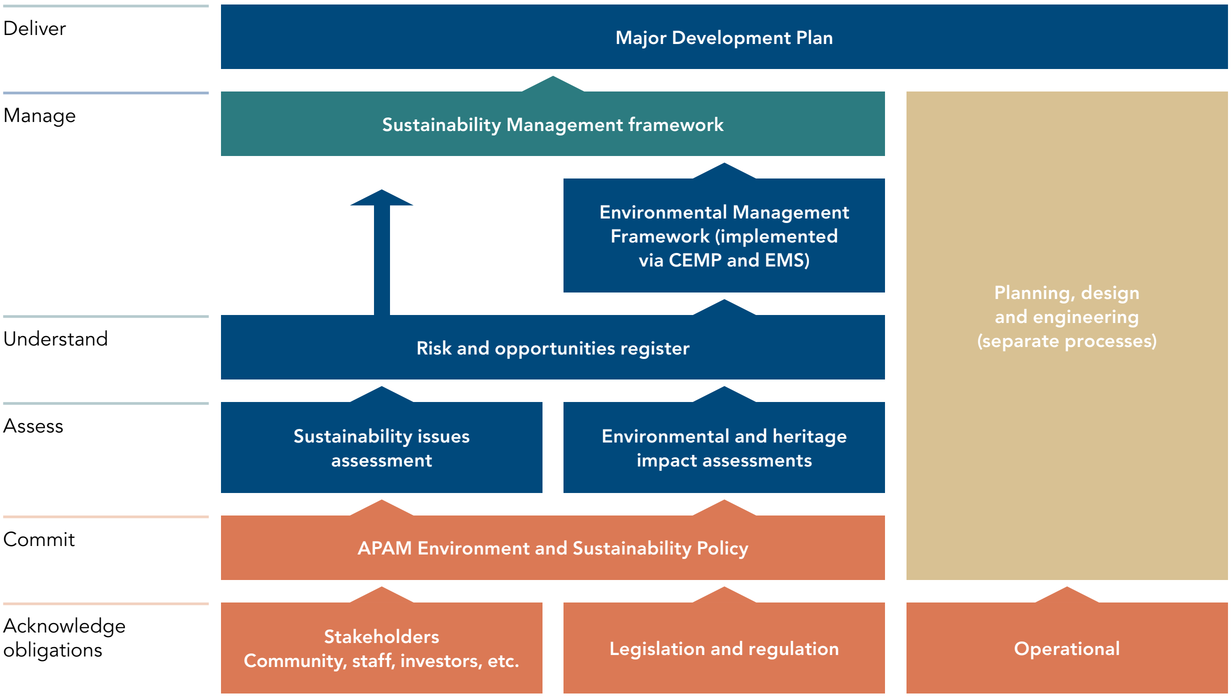
Before construction, the EMF will guide Melbourne Airport and contractor/s in the development of detailed designs, and a Construction Environmental Management Plan (CEMP) including a suite of environmental management sub-plans, as required.

The CEMP will be prepared to detail the environmental management requirements and approval conditions for the whole project and comply with any requirements of the Melbourne Airport Environmental Management Plan and relevant Commonwealth guidelines such as the Department of Climate Change, Energy, the Environment and Water's Environmental Management Plan guidelines. The CEMP will define impact avoidance and mitigation opportunities, and detail response strategies for environmental incidents and emergencies.

The CEMP will be updated if there is a significant change (such as the introduction of new legislative requirements during the construction program) to ensure it remains relevant to the regulatory context in force at the time of construction.

Melbourne Airport requires all contractors and sub-contractors to comply with the approved CEMP.

Figure E2.1
Environmental management framework within the context of the MDP



E2.2.3
Environmental Management during operation of M3R

As M3R becomes operational, the operational elements of this EMF (along with any updates as a result of approval conditions or updates to legislation) will be transitioned to, and incorporated in, Melbourne Airport's Environmental Management System (EMS).

Environmental Management Plans (EMPs) and/or Operational Environmental Management Plans (OEMPs) addressing M3R's operational aspects will address operational regulatory requirements.

E2.2.4
Melbourne Airport Environmental Management System (EMS)

Melbourne Airport's EMS (**Figure E2.2**) provides a framework for monitoring and addressing environmental impacts associated with Melbourne Airport's operation and construction activities. It comprises a series of policies, plans, procedures, registers and activities that collectively form a systematic approach to managing the environmental aspects of the airport and meeting compliance obligations.

The EMS applies to the environmental aspects that Melbourne Airport identifies as within its control and influence. Melbourne Airport also influences how third parties approach environmental management on the airport site. The EMS is certified to the international standard ISO 14001:2015.

E2.3
ROLES AND RESPONSIBILITIES

The Melbourne Airport Environment and Sustainability Team, and all parties involved in the design, construction and operation of M3R, are responsible for controlling the environmental management of the project. Achieving positive environmental outcomes requires a collaborative and integrated approach. This is coordinated by the Environment and Sustainability Team to drive performance and monitor success. Key responsibilities of roles regarding the EMF mirror those of Melbourne Airport's EMS and are outlined in **Figure E2.3**.

The role of Melbourne Airport's Environment and Sustainability Team includes:

- Providing advice and contributing to environmental approval submissions
- Reviewing and approving CEMP and all sub-plans and technical documents (e.g. soil classifications for import/re-use)
- Environmental monitoring and reporting
- Ensuring all personnel are aware of their environmental and sustainability responsibilities for the project
- Undertaking environmental risk reviews and audits to ensure continued compliance and environmental improvement
- Offering ongoing environmental and sustainability advice and support to the project.

Figure E2.2
Overview of Melbourne Airport's Environmental Management System

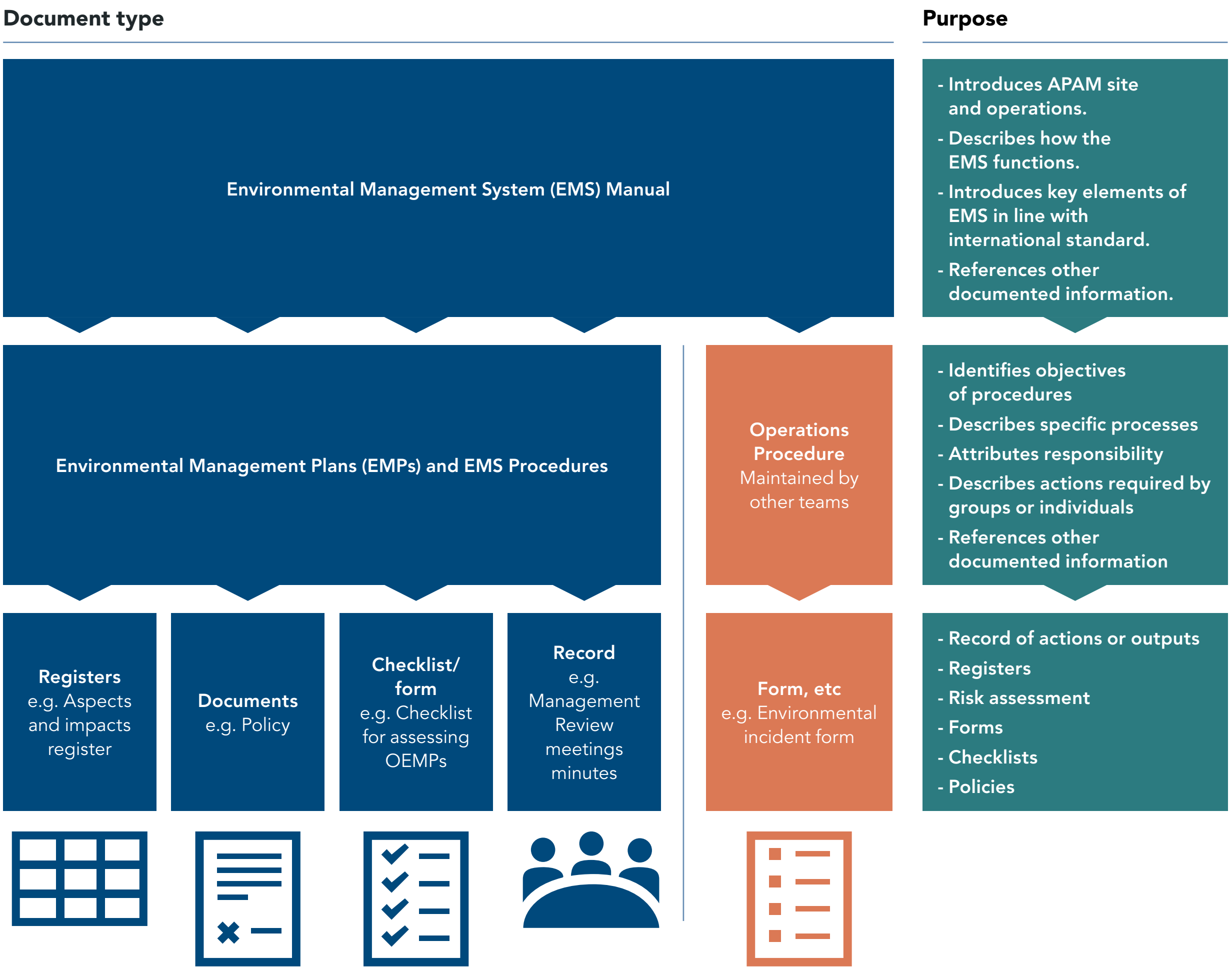
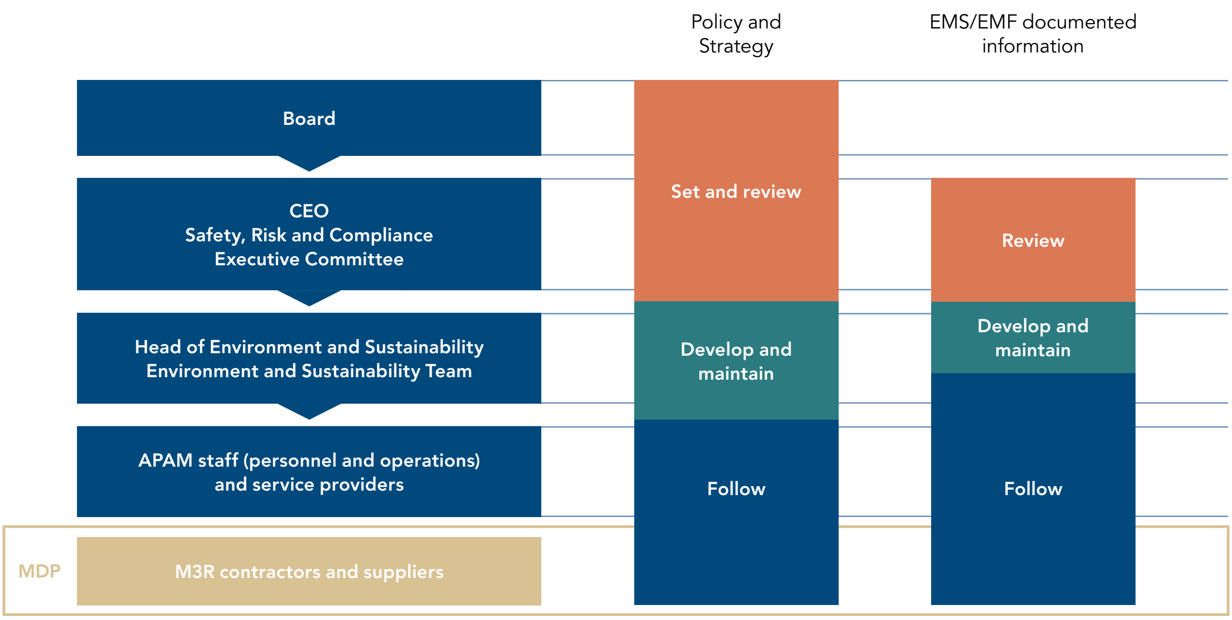


Figure E2.3
Roles and responsibilities for Melbourne Airport's Environmental Management System and Framework



E2.4
POLICY AND LEGISLATIVE REQUIREMENTS

Melbourne Airport is located on Commonwealth land, therefore Commonwealth legislation and regulations have primary relevance. Some elements of Victorian legislation and regulations at the interface with the boundary of the airport site are also relevant but are generally secondary to Commonwealth legislation and regulation.

The key oversight and regulatory obligations to be addressed at different stages of M3R are contained in:

- M3R Major Development Plan (MDP)
- Melbourne Airport Master Plan 2022
- Permit approval conditions
- Legislative requirements
- Applicable Melbourne Airport standards and guidelines.

A list of the legislative requirements and guidelines expected for the project can be found in **Appendix E2.A**.

E2.5
ENVIRONMENTAL ISSUES, MANAGEMENT AND MITIGATION

Key environmental issues relating to M3R have been identified through processes outlined in the sustainability management framework (**Chapter A7: Sustainability Framework**) and through an impact assessment (**Chapter A8: Assessment and Approvals Process**). Part B (Airport) of this MDP provides an assessment of the key impacts and ongoing management for each key environmental issue identified.

Table E2.1 provides a summary of the key impacts for each environmental issue assessed as part of this MDP. These impacts will be managed by Melbourne Airport throughout the life of the project in accordance with Commonwealth and Victorian legislative requirements and accompanying guidelines. During construction, the CEMP (**Section E2.2.2**) will be the key process for managing environmental issues. Once M3R is operational, environmental issues will be managed by Melbourne Airport's Environment and Sustainability Team and airfield personnel through the existing environmental management system.

Table E2.1
Key impacts identified for each environmental issue related to M3R

Environmental Issue	Key Impacts
Contamination – Asbestos (Chapter B3)	• Potential environmental impact – soil contamination • Potential health impact for construction workers interfacing with impacted soil
Contamination – PFAS (Chapter B3)	• PFAS contamination within soils, sediments and groundwater may impact surface water ecosystems
Water quality (Chapter B4)	• Increased run-off and pollutant load from the construction site (due to increased impervious areas)
Erosion (Chapter B4)	• Loss of soils from exposed surfaces or stockpiles • Access issues if significant rills or gullies are formed (due to wind or water) • Potential construction delays if sub-grade materials or working platforms and batter slopes are eroded • Off-site water quality and environmental impacts
Ecology (Chapter B5)	• Removal of habitat for EPBC Act listed Growling Grass Frog, Swift Parrot and Golden Sun Moth and removal of EPBC Act listed communities Natural Temperate Grassland of the Victorian Volcanic Plain and Grey Box Grassy Woodlands and Derived Native Grasslands of South Eastern Australia • Removal and modification of native vegetation and fauna habitat • Reduction in connectivity of habitat and populations (fragmentation) • Increased risk of weed invasion and disease • Effects of additional aircraft noise and disturbance on listed species of fauna • Increased sediment load during construction.

Cultural heritage (Chapter B6)	• Large portions of cultural heritage places within the development footprint will be removed by construction of compounds, haul roads or proposed infrastructure. Threats to cultural heritage within the development footprint include:
	  ○ Removal and/or modification of topsoils, impacting surface artefacts and shallow archaeological deposits on the volcanic plains
	  ○ Removal and/or modification of subsoils with archaeological deposits, impacting archaeological deposits on alluvial terraces

European heritage (Chapter B7)	• Removal and/or modification of topsoils and subsoils, impacting surface artefacts, features and archaeological deposits

Environmental Issue (cont.)	Key Impacts (cont.)
Surface transport (Chapter B8)	• The construction vehicles expected to use public roads will include truck and trailer tippers, concrete trucks, trucks delivering materials and low loaders delivering equipment. Based on the estimated quantities of materials it is expected that the construction activity will have some adverse impact on traffic conditions on the approaches to the M3R site
Ground-based noise and vibration (Chapter B9)	• Many activities during construction and operation will produce noise of similar levels to existing airport noise during operational hours. At certain stages of the construction schedule, and principally during the night-time period, construction noise is expected to result in a minor to moderate adverse effect at one location
Air Quality (Chapter B10)	• The air quality impacts from construction of the M3R are assessed as having an impact risk of medium. The expectation is additional dust mitigation measures (i.e. not included in the modelling) and the avoidance of worst-case conditions for off-site impacts will confine significant air quality impacts to within the airport boundaries
Greenhouse gas (Chapter 11)	• During construction, emissions are dominated by emissions associated with the manufacture and supply of concrete, steel, aggregate and asphalt – the major construction materials used in the M3R, fuel use in construction equipment, as well as emissions from land clearing • The biggest source of emissions during operation of M3R is from aircraft during the landing and take-off cycle. Melbourne Airport has limited ability to implement measures to reduce these emissions but will continue to work with the airlines to reduce greenhouse gas emissions wherever possible
Landscape and visual amenity (Chapter 12)	Changes to the environmental landscape are associated with M3R. Temporary (construction phase) and permanent (operational phase) impacts include: • Removal of vegetation within the footprint of M3R • Major earthworks and construction of the runway platform • Concrete and asphalt batching plant operations • Changed and increased appearance of aircraft in the sky - particularly during approach and departure procedures in the vicinity of the airport.
Climate change and natural hazards (Chapter 13)	Ongoing climate and natural hazards that may impact M3R are most significant during the construction phase, they include: • Localised surface water flooding • Surface water flooding leading to mobilising of contaminants from construction area affecting flora and fauna • Bushfires resulting in smoke and diminishing air quality for workers

E2.6 CONCLUSION

Melbourne Airport has provided a management framework for identifying and managing environmental impacts created by M3R during construction and operation. This document outlines the Commonwealth and Victorian legislation and guidelines that determine how environmental issues need to be managed. An overview of the environmental management governance process, including roles and responsibilities, has also been provided. Following detailed design of M3R, additional mitigation measures will be identified and the EMF updated to reflect this and subsequent approval conditions.

REFERENCES

Department of Environment (DoE), Environmental Management Plan Guidelines, Commonwealth of Australia 2014

APPENDIX E2.A
LIST OF LEGISLATION REQUIREMENTS AND GUIDELINES FOR ENVIRONMENTAL MANAGEMENT

Aspect of M3R	Legislative and other requirements
Airport development	**Commonwealth:** • Airports Act 1996 • Airports (Environment Protection) Regulations 1997 • Airports (Building Control) Regulations 1996 • Airports (Building Control) Amendment Regulations (No 1) 1999 • Environment Protection and Biodiversity Conservation Act 1999 • Environment Protection and Biodiversity Conservation Regulations 2000 **State (Victoria):** • Environment Protection Act 2017 • Environment Protection Regulations 2021 • Planning and Environment Act 1987 **Other:** • EPA Victoria Publication 1834 Civil Construction, Building and Demolition • Melbourne Airport Master Plan 2022 • Melbourne Airport Environmental Management System • Melbourne Airport Guideline for Submitting a Contractor Environmental Management Plan
Ecologically sustainable development	**Commonwealth:** • Environment Protection and Biodiversity Conservation Act 1999 **Other:** • National Strategy for Ecologically Sustainable Development. Prepared by the Ecologically Sustainable Development Steering Committee, endorsed by the Council of Australian Governments, December, 1992
Surface water	**Commonwealth:** Airports (Environment Protection) Regulations 1997: • National Environment Protection (Assessment of Site Contamination) Measure 1999 as amended and in force on 16 May 2013 • National Environment Protection (National Pollutant Inventory) Measure 1998 as varied in 2008 **State (Victoria):** • Environment Protection Act 2017 • Environment Protection Regulations 2021 • Water Act 1989 • Catchment and Land Protection Act 1994 • Pollution of Waters by Oils and Noxious Substances Act 1986 • Victoria Planning Provisions • EPA Victoria Publication 275 – Construction Techniques for Sediment Pollution Control May 1991 • EPA Victoria Publication 701 – Sampling and Analysis of Waters, Wastewaters, Soils and Wastes June 2009 • EPA Publication 1834 Civil construction building and demolition guide 2020 • EPA Victoria Publication 1893: Erosion, sediment and dust: treatment train • EPA Victoria Publication 1894: Managing soil disturbance • EPA Victoria Publication 1895: Managing stockpiles • EPA Victoria Publication 1896: Working within or adjacent to waterways • EPA Victoria Publication 1897: Managing truck and other vehicle movement **Other:** • Melbourne Water Healthy Waterways Strategy 2018 • Melbourne Water Stormwater Strategy 2013 • CSIRO Urban Stormwater Best Practice Environmental Management Guidelines 2006 • Melbourne Airport Stormwater Management Plan 2008 • Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2018 (Environment Australia)
Noise and vibration	**Commonwealth:** • Airports (Environment Protection) Regulations 1997 **State (Victoria):** • Environment Protection Act 2017 • Environment Protection Regulations 2021 • Occupational Health and Safety Act 2004 • Occupational Health and Safety Regulations 2017 **Other:** • EPA Victoria Publication Noise Control Guidelines 1254 October 2008 • EPA Publication 1834 Civil construction building and demolition guide 2020 • Australian Standard 2021-2000 Acoustics – Aircraft noise Intrusion – Building siting and construction

Aspect of M3R (cont.)	Legislative and other requirements (cont.)
Air quality and greenhouse gas	**Commonwealth:** • Airports (Environment Protection) Regulations 1997 • National Greenhouse and Energy Reporting Act 2007 • National Greenhouse and Energy Reporting Regulations 2008 **State (Victoria):** • Environment Protection Act 2017 • Environment Protection Regulations 2021 • Climate Change Act 2017
Soil and groundwater	**Commonwealth:** • National Environmental Protection (Assessment of Site Contamination) Measure 1999 • Airports (Environment Protection) Regulations 1997 • Work Health and Safety Act 2011 No 137 • Work Health and Safety Regulations 2011 No 262 • PFAS National Environmental Management Plan 2020 • Environment Protection and Biodiversity Conservation Act 1999 **State (Victoria):** • Environment Protection Act 2017 • Environment Protection Regulations 2021 • Industrial Waste Resource Guidelines 2009 EPA Publication 701, Sampling and Analysis of Waters, Wastewaters, Soils and Wastes • Industrial Waste Resource Guidelines 2009 EPA Publication 702, Soil Sampling. • EPA Victoria Publication 1669.4: Interim Position Statement on PFAS 2020 • EPA Victoria Publication 1828.2: Waste disposal categories - characteristics and thresholds 2021 **Other:** • Melbourne Airport Master Plan 2022 • AS 5667.11:1998 Water Quality-Sampling – Guidance on Sampling of Groundwaters • Standards Australia 2005 AS 4482.1 – 2005, Guide to the sampling and investigation of potentially contaminated soil, Part 1: Non-volatile and semi-volatile compounds • Standards Australia 1999, AS 4482.2 – 1999, Guide to the sampling and investigation of potentially contaminated soil, Part 2: Volatile Substances
Flora and fauna	**Commonwealth:** • Airports (Environment Protection) Regulations 1997 • Environment Protection and Biodiversity Conservation Act 1999 • Environment Protection and Biodiversity Conservation Regulations 2000 **State (Victoria):** • Flora and Fauna Guarantee Act 2020 • Flora and Fauna Guarantee Regulations 2020 • Wildlife Act 1975 • Planning and Environment Act 1987 • Catchment and Land Protection Act 1994 • Fisheries Act 1995 • Guidelines for the removal, destruction or lopping of native vegetation 2017 **Other:** • Melbourne Airport Planting Guidelines • Victoria Biodiversity Assessment Guidelines • Significant Impact Guidelines 1.1: Matters of Environmental Significant 2013 • Significant Impact Guidelines 1.2: Actions on, or impacting upon, Commonwealth Land and actions by Commonwealth Agencies 2013
Cultural and historic heritage	**Commonwealth:** • Environment Protection and Biodiversity Conservation Act 1999 • Environment Protection and Biodiversity Conservation Regulations 2000 • Airports (Environment Protection) Regulations 1997 **State (Victoria):** • Aboriginal Heritage Act 2006 • Aboriginal Heritage Regulations 2007 • Heritage Act 1995. **Other:** • Cultural Heritage Management Plan 12774 • Cultural Heritage Management Plan 16792

Aspect of M3R (cont.)	Legislative and other requirements (cont.)
Waste	**Commonwealth:** • Work Health and Safety Act 2011 No 137 2011 • Work Health and Safety Regulations 2011, Select Legislative Instrument 2011 No 262 **State (Victoria):** • Environment Protection Act 2017 • Environment Protection Regulations 2021 • Dangerous Goods Act 1985 • Dangerous Goods (Storage and Handling) Regulations 2000 • Catchment and Land Protection Act 1994 • Occupational Health and Safety Act 2004 • EPA Victoria Publication 1968.1: Guide to classifying industrial waste 2021 • Occupational Health and Safety Regulations 2017 **Other:** • EPA Victoria Publication 1828.2: Waste disposal categories - characteristics and thresholds 2021 • WorkSafe Managing Asbestos in Workplaces – Compliance Code 2008
Hazardous materials and dangerous goods	**State (Victoria):** • Environment Protection Act 2017 • Environment Protection Regulations 2021 • Dangerous Goods Act 1985 • Dangerous Goods (Storage and Handling) Regulations 2000 **Other:** • Dangerous Goods Act 1985 • Code of Practice for the Storage and Handling of Dangerous Goods 2013 • Compliance Code, Hazardous Substances, WorkSafe Victoria, July 2018 • Guidance for those who have duties or obligations in relation to hazardous substances under the Occupational Health and Safety Act 2004 (OHS Act) and Occupational Health and Safety Regulations 2017 (OHS Regulations)
Energy	**Commonwealth:** • National Greenhouse and Energy Reporting Act 2007 • National Greenhouse and Energy Reporting Regulations 2008 **State (Victoria):** • Climate Change Act 2017 • Climate Change and Environment Protection Amendment Act 2012 **Other:** • National Climate Resilience and Adaption Strategy 2015 • Critical Infrastructure Resilience Strategy 2015
Ozone depleting substances	**State (Victoria):** • Industrial Waste Management Policy (Protection of the Ozone Layer) 2001
Land management	**Commonwealth:** • Environment Protection and Biodiversity Conservation Act 1999 • Environment Protection and Biodiversity Conservation Regulations 2000 • Airports (Environment Protection) Regulations 1997 **State (Victoria):** • Environment Protection Act 2017 • Environment Protection Regulations 2021 • Catchment and Land Protection Act 1994
Surface transport	**State (Victoria):** • Transport Integration Act 2010 • Plan Melbourne 2014 • Network Development Plan 2012 • Victoria, the Freight State: the Victorian Freight and Logistics Plan 2013 • Victoria's 30-Year Infrastructure Strategy 2016 **Local:** • Hume Integrated Land Use and Transport Strategy 2011
Landscape and visual amenity	**Commonwealth:** • Environment Protection and Biodiversity Conservation Act 1999 • Environment Protection and Biodiversity Conservation Regulations 2000 • Airports (Environment Protection) Regulations 1997 **Other:** • Melbourne Airport Planting Guidelines • AS4282 – Control of the Obtrusive Effects of Outdoor Lighting (Council of Standards Australia) 1997 • Guidance for the Reduction of Obtrusive Light (Institution of Lighting Professionals UK) 2005

Chapter E3
Offset Management Strategy

Summary of key findings:

- Melbourne Airport's Third Runway project will have significant residual impacts on 78.74 hectares of Grey Box Woodland, 90.49 hectares of Natural Temperate Grassland of the Victorian Volcanic Plain, 9.75 hectares of Golden Sun Moth habitat, 64.34 hectares of Growling Grass Frog habitat and 68.02 hectares of Swift Parrot habitat
- Melbourne Airport has agreements in place for most of the required direct offsets and is in the process of securing the remainder. This is expected to include on-airport offset sites and more off-airport offset sites.
- The offset strategy estimates the direct offsets required for suitable, low-risk and proportionate conservation outcomes in accordance with the EPBC Act Environmental Offsets Policy. Other compensatory measures may be considered when the strategy is finalised and all proposed offset sites are identified.

CHAPTER E3 CONTENTS

CHAPTER E3 FIGURES

CHAPTER E3 TABLES

E3.1
INTRODUCTION

This chapter describes the strategy to secure environmental offsets for Melbourne Airport's Third Runway (M3R) in accordance with the Environmental Offsets Policy of the *Commonwealth Government's Environment Protection and Biodiversity Conservation Act 1999* (the EPBC Act).

Offsets will compensate for residual significant impacts on the environment and Matters of National Environmental Significance (MNES). These are the impacts remaining after implementation of the avoidance, management and mitigation measures as described in **Chapter B5: Ecology**.

The impact area for the project referred to in this chapter is described in detail in **Chapter B5: Ecology** and **Figure E3.1**. The ecological surveys described in **Chapter B5: Ecology** were used to quantify the draft offset requirements in this chapter.

E3.2
OFFSET REQUIREMENTS

E3.2.1
Avoidance, management and mitigation measures

The primary measures for minimising impacts on the environment and MNES in the impact area are avoidance, management and mitigation. Offsets are required only when all reasonable avoidance and mitigation measures have been exhausted, yet the residual impacts are still significant.

Section B5.7 of Chapter B5: Ecology describes the avoidance, management and mitigation measures relative to the environment and MNES in the impact area. General details on management and mitigation measures during M3R construction can be found in Chapter A5: Project Construction. Further details on measures to mitigate and manage impacts on ecological values can be found in Chapter E2: Environmental Management Framework and will also be included in the project-specific Construction Environment Management Plan (CEMP).

E3.2.2
Policy requirements

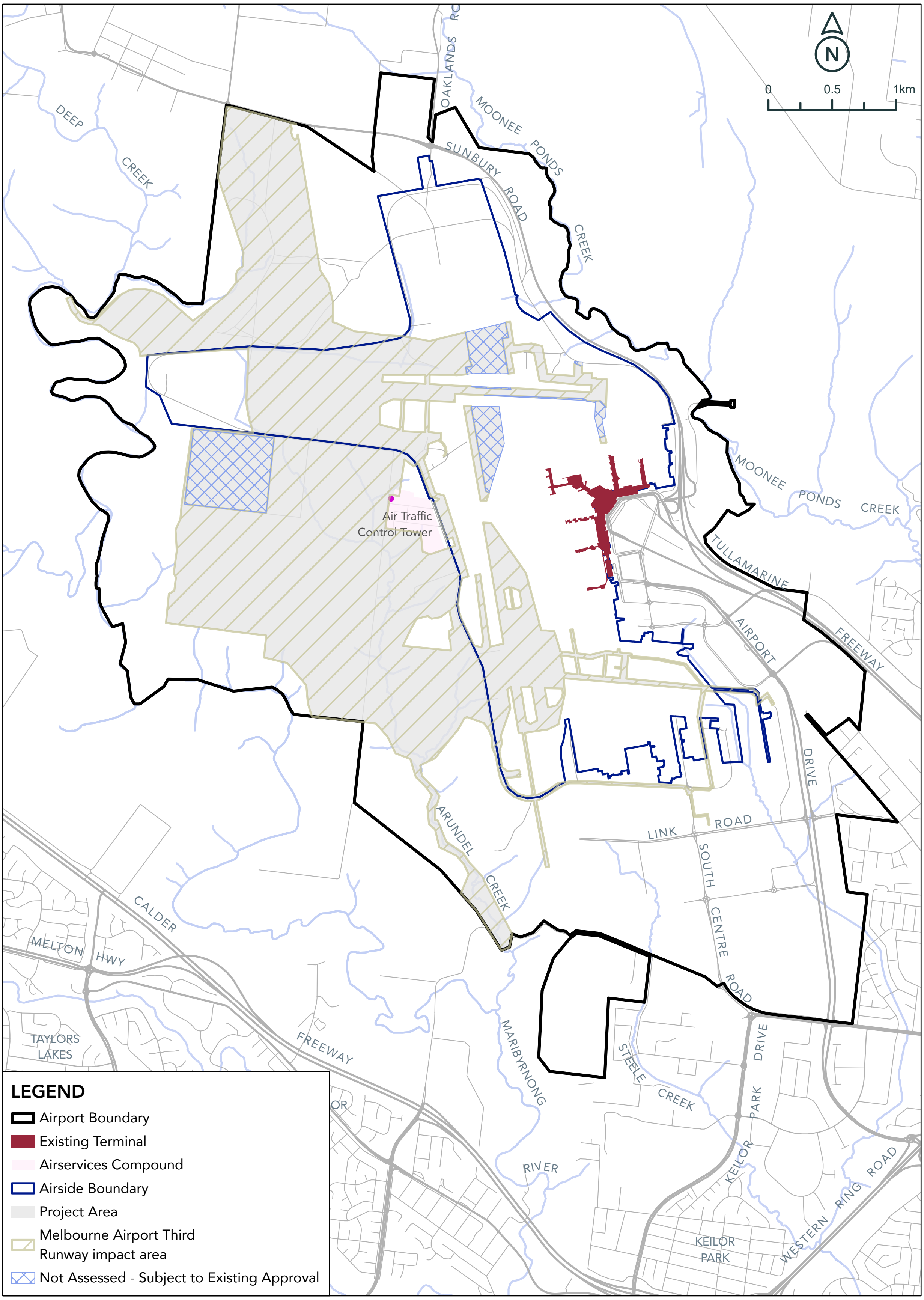
The EPBC Act's Environmental Offsets Policy' (DSEWPaC, 2012a) outlines the Commonwealth Government's approach to using environmental offsets. It is accompanied by the 'Offsets Assessment Guide' (DSEWPaC, 2012b) and accompanying 'How to Use the Offsets Assessment Guide'.

The Offsets Assessment Guide implements the requirements of the Environmental Offsets Policy using a balance-sheet approach that estimates the impacts to, and offsets for, the threatened species and Threatened Ecological Communities (TECs) listed under the EPBC Act.

Together, the policy and guide give a decision support framework to normalise the judgments associated with determining the proposed offsets for a given impact.

Their overarching test is that suitable offsets must deliver an overall conservation outcome that either improves or maintains the viability of an aspect of the environment that is protected by national environment law and affected by the proposed action. The Environmental Offsets Policy applies only to threatened species and TECs where a significant impact has been determined by the Significant Impact Criteria (DoE, 2013).

Figure E3.1
Location of the impact area for Melbourne Airport's Third Runway project



The Environmental Offsets Policy states that offsets:

- Must be compensatory and deliver an overall conservation outcome that either improves or maintains the viability of the MNES
- Must be additional to what is already required by law, planning regulations or other programs that impose pre-existing management requirements
- Should be tailored to the specific attribute of the impacted environment or MNES (e.g. foraging habitat should be offset with foraging habitat).

Although offset arrangements can be a combination of direct offsets and other measures, for any given impact at least 90 per cent must be direct offsets.

Direct offsets provide a measurable conservation gain for MNES such as protecting, improving and/or creating habitat for the MNES. Other compensatory measures provide indirect benefits to the affected MNES and include funding of research or educational programs.

Compared to direct offsets, these other compensatory measures have a greater risk of not providing the required conservation gains (this is factored into calculating what other compensatory measures may be required).

E3.3 METHODOLOGY

E3.3.1 Determining residual significant impacts

A significant impact assessment undertaken in Chapter B5: Ecology Section B5.6 details the extent of impacts to threatened species, ecological communities, listed migratory species and relevant ecological features on Commonwealth land resulting from the M3R project.

EPBC Act listed species and TECs for which a significant impact is likely as a result of the project have been included in this offset strategy chapter.

Offsets for the removal of native vegetation (or species-specific offsets) are not triggered under the Victorian *Planning and Environment Act 1987*. However, offsets secured under the EPBC Act's Environmental Offsets Policy will substantially secure habitat for those Victorian Flora and Fauna Guarantee Act (FFG Act) listed species that are likely to occur, or do occur, in the impact area; along with native vegetation offsets potentially proportionate to what would be required under the *Planning and Environment Act* if relevant.

E3.3.1.1 Residual significant impacts

The project is highly likely to result in a significant impact to the following EPBC Act listed threatened species and ecological communities:

- Natural Temperate Grassland of the Victorian Volcanic Plain (NTGVVP)
- Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia (treed and derived native grassland condition states) subsequently referred to as Grey Box Woodland
- Swift Parrot
- Growling Grass Frog
- Golden Sun Moth.

It is also highly likely that the project will result in a significant impact to the environment on Commonwealth land. This is due to large-scale clearing of native vegetation; the removal of EPBC Act and FFG Act listed threatened species habitat and TECs; loss of habitat for local wildlife populations; and substantial alteration to landscape features through the removal of the majority of Arundel Creek and approximately half the Grey Box Woodland.

Residual significant impacts have been identified as the permanent removal of, or impacts to, EPBC Act listed threatened species habitat or TECs within the impact area. Table E3.1 and Figure E3.2 summarise the EPBC Act listed ecological values that would be impacted by the project through direct loss of TECs and habitat.

By offsetting the large-scale removal of TECs for the project, the proposed offset strategy will contribute conservation gains that will mitigate significant impacts to the environment as a whole on Commonwealth land.

E3.3.2 Calculation of residual impact

Three attributes are used to calculate the 'total quantum of impact' for a species or TEC:

- Annual probability of extinction: the conservation status of the protected matter based on the International Union for Conservation of Nature's category definitions (determined by the impact calculator)
- Protected matter attributes: how much of the attribute is being impacted (area of habitat, birth rate, mortality rate, number of features or number of individuals). In this case, area of habitat or ecological community in the impact area has been used (the area of impact determined by field assessment and mapping)
- Quality: an impacted attribute's importance to the ecology of the protected matter i.e. the quality of the habitat/ecological community. This was calculated by a unique quality scoring system for each threatened species and ecological community (developed by ecology consultants Biosis using standard condition metrics where available).

Table E3.1
Listed threatened species and ecological communities with a residual significant impact in the impact area

Ecological value	Impact area (ha)
EPBC Act listed TEC	
Grey Box Grassy Woodlands and Derived Grasslands of South-eastern Australia – treed condition state (EVC 71 and parts of EVC 803)	68.02
Grey Box Grassy Woodlands and Derived Grasslands of South-eastern Australia – derived native grassland (treeless EVC 803)	10.72
Natural Temperate Grassland of the Victorian Volcanic Plain (total) (EVC 132)	90.49
Fauna habitat	
Golden Sun Moth	9.75
Growling Grass Frog	64.34
Swift Parrot	68.02

Although the Environmental Offsets Policy and **Offsets Assessment Guide** give a decision support framework, they do not provide a scoring system for determining the quality for each threatened species and TEC. For this, a scoring system has been developed that determines the quality score for input into the impact calculator.

The quality scoring system developed for each threatened species and TEC is described in detail below. It has been determined following the principles of the Offsets Assessment Guide, published documentation for each threatened species and TEC, and expert understanding of each species' and TEC's ecology.

Note that:

- The quality scoring system for TECs was previously used by Biosis for unrelated projects approved under the *Airports Act 1996* (Airports Act) at Melbourne Airport and EPBC Act elsewhere
- A similar GSM quality scoring system was previously used by Biosis for unrelated projects that were approved under the EPBC Act but located outside of Melbourne Airport. Some minor edits were made to the scoring system so that it would be more applicable to the M3R impact site
- The quality scoring systems for the Growling Grass Frog and Swift Parrot have not been previously provided to the Commonwealth.

E3.3.3
Calculation of offset package

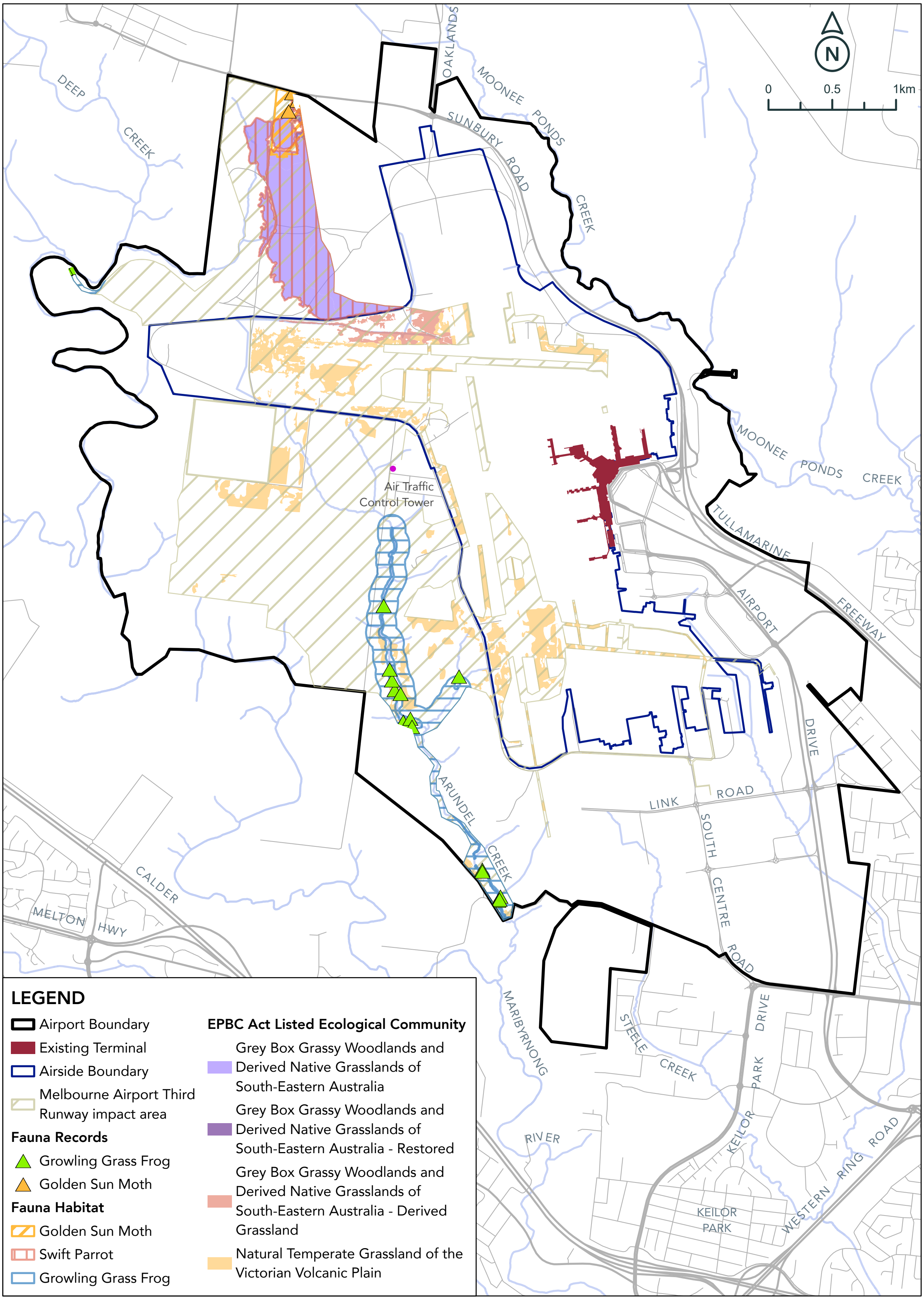
The offset package must be at least 90 per cent direct offsets and no more than 10 per cent other compensatory measures (e.g. education projects to address threats, or research projects for species/ community recovery).

Direct offsets must deliver a tangible and measurable on-ground conservation gain. The components used to calculate the offset package can be finalised only when an offset site is determined (however, assumptions of unknown components may estimate the offset area required).

The inputs utilised to calculate the 'minimum conservation gain' include:

- Improvement expected to be delivered by the offset for the attribute being impacted (i.e. time until ecological benefit and confidence in result)
- Level of averted loss expected to result from the proposed offset (i.e. the change in risk of loss before and after the offset site is protected, time over which loss is averted and confidence in result)
- Start offset area (in hectares)
- Quality before offset, and future quality with and without the offset (measured consistently for offset site and impact site).

Figure E3.2
EPBC-listed species and ecological communities within the impact area – Melbourne Airport



E3.3.4
Calculation of habitat quality

The Offsets Assessment Guide requires protected matter to be given a quality score out of 10, divided into three components:

- Site context: the relative importance of a site in terms of its position in the landscape, taking into account the 'connectivity needs' of a threatened species or ecological community. Includes considerations such as movement patterns of the species, the proximity of the site in relation to other areas of suitable habitat, and the role of the site in relation to the overall population or extent of a species or community
- Site condition: the condition of a site in relation to the ecological requirements of a threatened species or ecological community. Includes considerations such as vegetation condition and structure, the diversity of habitat, and the number of relevant habitat features
- Species stocking rate: the usage and/or density of a species at a particular site. This principle acknowledges that a particular site may have a high value for a particular threatened species despite appearing to be in a poor condition and/or context. Includes considerations such as survey data for a site regarding a particular species population or, in the case of a threatened ecological community, a number of different populations. It also includes consideration of the role of the site population regarding the overall species' population viability or community extent.

The weighting for each component was based on the varying ecological requirements of the impacted species or ecological community. The sections below describe the weighting given to each component for each species or ecological community; and the scoring system used to determine their quality score.

Note that the habitat quality must be assessed consistently for both the impact and the offset sites. There is no published 'scoring system' for each individual protected matter.

A scoring system was therefore been developed for each of the protected matters within the impact area that will be significantly impacted by the project. Using expert knowledge of the protected matters and published guidance, the scoring system was determined for each individual protected matter based on its relevant key ecological attributes (taken from How to use the Offsets Assessment Guide) including but not limited to:

- Habitat requirements and variability
- Lifecycle and population dynamics
- Movement and distribution patterns
- Threatening processes.

E3.3.4.1
Quality-scoring system for Threatened Ecological Communities (TECs)

A Vegetation Quality Assessment (VQA) was undertaken for all patches of NTGVVP and Grey Box Woodland (both treed and derived grassland states) in the project area.

This used the Victorian Department of Environment, Land, Water and Planning (DELWP) VQA method, underpinning the 'habitat hectares' concept (DSE, 2004). Native vegetation was defined in accordance with the 'Guidelines for the removal, destruction or lopping of native vegetation' (DELWP, 2017).

'Habitat hectares' is Victoria's standard metric to quantify native vegetation losses and gains for regulatory approvals and biodiversity offsets. It gives habitats a score out of 100: a site condition score out of 75 plus a landscape context score out of 25.

This number when divided by 100 gives a site condition score that is then multiplied by the area of the vegetation (habitat zone) to calculate the number of habitat hectares in a patch of vegetation.

This method is a useful surrogate for habitat quality because it considers important structural and functional elements. These include the density of large trees, understorey complexity, plant species richness, weediness, plant recruitment and coarse woody debris. It also considers the physical connectivity of native vegetation in the landscape (e.g. patch size, configuration and continuity).

A habitat score is readily converted to a score out of 10 for use in the Offsets Assessment Guide as shown in the Table E3.2.

A total weighted average habitat score was determined for NTGVVP, Grey Box Woodland (treed) and Grey Box Woodland (derived native grassland) for the project area. The weighting was based on the area that each patch contributed to the total area of TEC in the project area.

The Grey Box Woodland community is present as both treed and derived native grassland in the project area and impact area. These 'condition states' are subject to separate assessment criteria; therefore quality and offset calculations were produced independently for each condition state. This was to reflect the differing ecological value of intact remnant woodland i.e. (treed) compared to derived native grassland (where the trees have been previously been removed; diminishing the community's value and ecological function). Areas of naturally regenerated and restored woodland are included in the treed condition state calculations.

Weighted-average habitat scores were rounded to the nearest 10 for entry in the Offsets Assessment Guide. Scores with a next-digital-place value of less than 5 were rounded down, scores with a next-digital-place value of 5 or above were rounded up as shown in Table E3.3.

Table E3.2
Threatened Ecological Community habitat score conversion to quality scoring system

Parameter	Components measured	Max. habitat score (Victoria)	Equivalent Quality score (Commonwealth)
Site condition and stocking rate equivalent	• Number of species, cover and diversity of lifeforms • Percentage of weed cover moderated by percentage of high threat weed cover • Percentage of recruiting woody species or recruitment area (scaled by herb diversity for treeless EVCs) • Percentage cover of organic litter scaled to litter type (native/non-native)	75/100	7.5/10
Site context	• Size of patch • Neighbourhood measured as percentage of surrounding area • Distance to large areas of native vegetation (core areas >50 ha)	25/100	2.5/10
Total score		100/100	10/10

Table E3.3
Habitat-score rounding for the EPBC Calculator

Score	Rounded Score (/100)	Score for Calculator (/10)
0 to <5	0	0
≥5 to <15	10	1
≥15 to <25	20	2
≥25 to <35	30	3
≥35 to <45	40	4
≥45 to <55	50	5
≥55 to <65	60	6
≥65 to <75	70	7
≥75 to <85	80	8
≥85 to <95	90	9
≥95 to <100	100	10

E3.3.4.2
Golden Sun Moth habitat-quality scoring system

The Offsets Assessment Guide requires Golden Sun Moth habitat to be given a score out of 10.

This is scored on three components, Site Context, Site Condition and Species Stocking Rate. These have been scored out of 3, 3 and 4 respectively; the total giving a quality score out of 10.

The Site Condition scoring system was established to account for the Golden Sun Moth requiring a known food source (i.e. Wallaby Grass, Spear Grass or introduced Chilean Needle-grass). The inclusion of the VQA site condition scores is a way of differentiating between higher-quality habitat dominated by native grasses and other habitat types in a standardised and repeatable way.

The scoring system for Site Context was developed to account for larger habitat patches with reduced edge effects being of higher conservation value, impacted less by disturbance, and providing a more stable area of habitat for the species. The habitat-patch size thresholds were developed to account for the species persisting in very small isolated areas of habitat and allows for the quality value to increase if a habitat patch provides habitat connectivity between populations.

Note that the Species Stocking Rate is not a true reflection of actual stocking rates for a species on the site. However, it does provide a number enabling comparison between the impact and offset sites when surveys are undertaken in line with Golden Sun Moth survey guidelines.

The Golden Sun Moth habitat was assigned a quality score according to the system detailed in Table E3.4.

Table E3.4
Golden Sun Moth habitat-quality scoring system

Parameter	Scoring system
Site condition (max. 3 points)	• 1/3 (1 out of 3) = Native or introduced vegetation with <20% cover of known food plants. • 2/3 = Native vegetation with 20-40% cover known food plants or predominantly introduced vegetation with >20% cover of known food plants" • 3/3 = High quality native vegetation (Condition Score 46+/75) with > 40% cover known food plants.
Site context (max. 3 points)	• 1/3 = Habitat patch[1] more than 0.252 ha and up to 1 ha[2] • 2/3 = Habitat patch more than 1 ha and up to 10 ha • 3/3 = Habitat patch size more than 10 ha
Species stocking rate[3,4] (max. 4 points)	• 1/4 = >0-5 males per hectare • 2/4 = 6-20 males per hectare • 3/4 = 21-50 males per hectare • 4/4 = >50 males per hectare

[1] A patch is considered to be an area of Golden Sun Moth habitat separated from other areas of suitable habitat by >200 m of unsuitable habitat or barriers to flight (e.g. buildings, solid fences). A habitat patch should not be defined by administrative boundaries such as farm fencing, title or lot boundaries if habitat is continuous on either side of the boundary. According to the guidelines, if the amount of Golden Sun Moth habitat adjoining the site of the action cannot be determined, the area of habitat will be considered to be the same as that identified within the site.
[2] Add 1 point (up to a maximum of 3) where a patch is an occupied linkage between two populations.
[3] Stocking rate (measured as males per hectare) calculated as: total number of males recorded across four surveys in one flight season divided by area of habitat surveyed (with survey area confirmed with GPS tracks). It is not expected that results can be extrapolated across unsurveyed areas unless justification is given (e.g. the surveyed area is a sub-sample of the total area). Stocking rate calculations to be rounded up if required.
[4] It is expected that impact and offset sites will be surveyed on four occasions during the flying season and the survey results to be summed (consistent with survey guidelines). Justification will need to be provided to the Department to support proceeding in the absence of suitable survey effort.
For clarity, if lower survey effort than four complete surveys is accepted, the Department will consider:
– For impact sites: the highest recorded density is assumed to be the remaining score (e.g. if three surveys detect 5, 10, 15 males/ha, the assumed score for the last survey is 15 males/ha).
– For offset sites: the lowest record is assumed to be the remaining score (e.g. if three surveys detect 5, 10, 15 males/ha, the assumed score for the last survey is 5 males/ha).
– For either type of site, if one survey records 5 males/ha, then assumed total of four surveys is 20 males/ha.

E3.3.4.3
Swift Parrot habitat-quality scoring system

The Offsets Assessment Guide requires Swift Parrot habitat to be given a quality score out of 10.

This is scored on three components: Site Condition, Site Context and Species Stocking Rate. These are scored out of 3, 5 and 2 respectively; the total giving a habitat score out of 10.

The parameters below have been developed utilising the National Recovery Plan (Saunders & Tzaros 2011), the updated National Recovery Plan currently in draft format (DoEE 2019) and background document (Saunders et al. 2010).

The Swift Parrot habitat in the impact area's Grey Box Woodland was assigned a quality score according to the scoring system provided in **Table E3.5**.

Table E3.5
Swift Parrot habitat-quality scoring system

Parameter	Scoring system
Site condition (max. 3 points)	The VQA site condition score component of the habitat score (i.e. a score out of 75) was used as a surrogate for site condition parameter for Swift Parrot habitat in this case. A weighted average of all Site Condition scores was produced to determine the site condition score. The VQA site condition score provides an assessment of quality of native vegetation which includes: • Tree cover • Abundance of large trees • Number of plant species, cover and diversity of lifeforms • Percentage of weed cover moderated by percentage of high threat weed cover • Percentage of recruitment area • Percentage cover of organic litter scaled to litter type (native/non-native) Overall the VQA site condition score gives an indication of overall functioning ecosystem health which directly affects the condition of the Swift Parrot habitat. The following scores are assigned for different VQA site condition scores: • 1/2 (1 out of 2) = VQA site condition is 10-29 out of 75 • 2/2 = VQA site condition is 30- 59 out of 75 • 3/3 = VQA site condition is 60-75 out of 75
Site context (max. 5 points)	Site context takes into consideration all available Swift Parrot habitat on mainland Australia and Tasmania. Swift Parrot habitat is described in detail in the National Recovery Plan for the species. Habitat patches are defined as patches of woodland and forest dominated by one or more tree species listed in Table 1 or Table 2 of the National Recovery Plan. The project area includes a large patch of mainland foraging habitat dominated by a key tree species (Grey Box) and the species has been confirmed as using the site on multiple occasions. The following scores are assigned for different site context scenarios: • 1/5 = Habitat patch between < 20 ha • 2/5 = Habitat patch between 20 and 49 ha • 3/5 = Habitat patch between 50 and 100 ha • 4/5 = Habitat patch > 100 ha • 5/5 = Any breeding habitat or • 5/5 = one of the 40 priority habitat sites listed in the National Recovery Plan (Saunders & Tzaros 2011) or • 5/5 = any habitat which, from survey data, is shown to support a large proportion of the Swift Parrot population or is used repeatedly between seasons (annual site fidelity) or for prolonged periods of time.
Species stocking rate (max. 2 points)	Species stocking rate has been given a low weighting in this scoring system due to the highly mobile, migratory nature of this species. Whether the species has been recorded utilising habitat in the region is a surrogate for stocking rate in this instance using the assumption that if the species visits the local area it is likely to utilise and require the available habitat. The following scores are assigned for different stocking rate scenarios: • 1/2 = Species has been recorded from the habitat patch or from similar habitat within 10 km of the habitat patch in the past 20 years. • 2/2 Species has been regularly recorded (more than once in every 10 years) from the habitat patch or from similar habitat within 5 km of the habitat patch in the past 20 years.

E3.3.4.4
Growling Grass Frog habitat-quality scoring system

Potential impacts to the Growling Grass Frog vary between the waterbodies and habitat in the impact area. Individual significant impact assessments were therefore undertaken for each waterbody area.

Impacts to Growling Grass Frog habitat in Arundel Creek are likely to result in residual significant impacts to the species

Impacts to Growling Grass Frog habitat in Deep Creek/ Maribyrnong River are unlikely to result in a residual significant impact given the current design description for these areas (**Chapter B5: Ecology**).

Offsets under the EPBC Act are required only for residual significant impacts. Therefore impacts to the habitat in Deep Creek/Maribyrnong River are unlikely to trigger the requirement for environmental offsets.

However, this chapter does include offset estimates for all Growling Grass Frog habitats within the impact area, whether or not the impact is considered significant.

The definition of Growling Grass Frog habitat used to calculate offsets is:

> *'One hundred meters either side of all occupied waterways and drainage lines providing dispersal routes to occupied waterbodies except where terrestrial features (i.e. steep escarpments) are likely to prevent the species' movement.'*

A detailed description of habitat mapping including where the 100-meter buffer has been reduced is described further in **Chapter B5: Ecology**.

The Offsets Assessment Guide requires Growling Grass Frog habitat to be given a quality score out of 10. This is scored on three components: Site Condition, Site Context and Species Stocking Rate. These have been scored out of 5, 3 and 2 respectively.

The quality scoring method is based on ecological knowledge of Growling Grass Frog populations in the Melbourne region (principally work undertaken by Dr Geoffrey Heard and his colleagues). Its application may therefore be unsuitable for all regions occupied by Growling Grass Frog (e.g. riverine floodplains of the lower Murray-Darling). However, it is suitable for use throughout much of southern and central Victoria, where the meta-population dynamics of the species are probably similar to populations studied in the Melbourne region.

The scoring method follows Heard et al (2010). Specifically, aquatic vegetation cover is based on the estimation method shown in **Table E3.6** and should be assessed in the field from late spring through to the end of summer – coinciding with the Growling Grass Frog survey period.

Waterbody hydroperiod is based on the wetland hydroperiod classification system shown in Table 1 of Heard et al. (2010); connectivity is based on the formula shown in the same table. Where there is insufficient information on occupancy of neighbouring waterbodies to apply the connectivity formula, the distance to the nearest known occupied site may be used as a surrogate.

Larger, deeper wetlands have been positively correlated with occupancy and persistence of the Growling Grass Frog and are therefore considered higher quality compared to smaller wetlands. Wetland size has been accounted for by assuming that wetlands with increasing hydroperiod are likely to be larger; the converse being true for smaller wetlands. However, this is not the case in all situations (e.g. small deep dams or spring-fed small wetlands with permanent water).

A site condition score of 5 is applied to any lentic (i.e. still water) waterbody or pool within a stream which – based on measurements of key wetland parameters (e.g. water temperature, salinity, lack of shading, cover of aquatic vegetation) or other wetland characteristics (e.g. large, spring-fed quarry hole) – is considered likely to constitute a 'chytrid refuge' for the species (see paper by Heard et al. 2014).

Terrestrial habitat (e.g. foraging, dispersal or overwintering habitat) within 100 metres of the edge of an occupied waterbody or stream is given the same quality score as the nearest occupied waterbody or stream, unless considered unlikely to provide habitat for the species (e.g. roads, buildings, high-density residential areas and hard stand).

Stocking rate is determined by targeted surveys using the methods described in Heard et al. (2006) or other indirect detection methods such as bioacoustics (the recording of advertisement calls from males). Evidence of breeding includes presence of Growling Grass Frog tadpoles, metamorphs, juveniles/sub-adults or the detection of more than 10 adults during a single survey. Growling Grass Frog habitat in the impact area was assigned a quality score according to the scoring system provided in **Table E3.6**.

Table E3.6
Growling Grass Frog habitat-quality scoring system

<table>
<tr><th>Parameter</th><th colspan="5">Scoring system</th></tr>
<tr><td rowspan="7">Site condition
(max. 5 points)</td><th rowspan="2">Aquatic Vegetation cover %</th><th colspan="4">Waterbody hydroperiod</th></tr>
<tr><th>Intermittent</th><th>Ephemeral</th><th>Semi-permanent</th><th>Permanent</th></tr>
<tr><td>0</td><td>1</td><td>1</td><td>2</td><td>3</td></tr>
<tr><td>1-20</td><td>1</td><td>1</td><td>2</td><td>4</td></tr>
<tr><td>21-50</td><td>1</td><td>2</td><td>3</td><td>5</td></tr>
<tr><td>51-80</td><td>1</td><td>2</td><td>3</td><td>5</td></tr>
<tr><td colspan="5">• Scoring Matrix for habitat condition:
• Any wetland considered to be a ‘chytrid refuge’ is given a default site condition score of 5.</td></tr>
<tr><td>Site context
(max. 3 points)</td><td colspan="5">• 1/3 = Connectivity score < 10 or off-stream waterbody > 500 m from occupied off-stream waterbody or stream.
• 2/3 = Connectivity score between 10 and 30 or any off-stream waterbody occurring within 200 and 500 m of occupied waterbody or stream
• 3/3= Connectivity score > 30 or < 200 m from occupied waterbody or stream or any population inhabiting a stream.</td></tr>
<tr><td>Species stocking rate (max. 2 points)</td><td colspan="5">• 1/2 = Adults present, no evidence of breeding.
• 2/2 = Evidence of breeding or breeding inferred based on large numbers of adults present (i.e. > 10 individuals).</td></tr>
</table>

E3.4 PROPOSED OFFSETS

E3.4.1 Direct offsets

Melbourne Airport intends to source direct offsets, providing up to 100 per cent offset of the residual impact. A number of potential offset sites have already been identified, and agreements are in place to secure these offsets. Other potential offset sites are currently being sought, and their suitability determined, to meet the full direct offset requirements for the project.

Melbourne Airport is also committed to first party direct offsets in a number of locations on the airport estate.

Offset-area estimates for each listed species and TEC for which a residual significant impact is likely have been prepared using the Offsets Assessment Guide (refer Appendix E3.A). The estimates have been prepared to provide a 100 per cent offset of the residual impact.

The offset calculations are accurate to the level of current information available for the project impact area. The inputs to the offset calculations are detailed in Appendix E3.A. Where potential offset sites have not yet been identified, assumptions have been adopted which must be updated when suitable offset sites are found and the starting quality of that site is assessed. Until this is completed, the offset calculations can provide only an estimate of the total offset area required.

E3.4.2 Other compensatory measures

The proposed offset sites are expected to meet 100 per cent of the direct offset requirements for the project's residual significant impacts. Other compensatory offsets are therefore unlikely to be required.

E3.4.3 Securing offsets

Offset sites will be secured before any significant impact on MNES takes place within the impact area. Site-specific management details will be addressed in OMPs for each offset location and MNES. Each offset site will be secured in perpetuity through one of the following mechanisms, all of which entail an encumbrance being registered on the title to the offset site:

- An agreement under section 69 of the *Conservation, Forests and Lands Act 1987* (Vic) executed by the Secretary of the Victorian Government Department of Environment, Land, Water and Planning
- An agreement under section 173 of the *Planning and Environment Act 1987* (Vic) executed by the relevant local government
- A covenant under section 3A of the *Conservation Trust Act 1972* (Vic) executed by the Trust for Nature.

E3.4.4 Monitoring and management

Ecological surveys of the proposed future offset sites will be conducted to confirm their baseline ecological conditions, identify issues that have the potential to adversely affect MNES, and inform management actions to improve site conditions. Before any significant impact on MNES occurs within the impact area, detailed OMPs will be prepared for the offset sites and approval of the OMPs sought from the Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW).

The approved OMPs will outline the required management actions. These include protective fencing, weed elimination, pest animal eradication, and supplementary planting of indigenous flora. They will also give a timeline for implementation of management actions and a protocol for annual monitoring of site conditions. Annual monitoring reports will be prepared during the first 10 years of management. These will inform ongoing management of the offset sites and ensure conservation gains are being achieved.

E3.4.5
Offset costs

Costs for securing the required offsets will be negotiated with the landowners of the final offset sites, including negotiations on the management actions required to maintain and improve the sites relative to the MNES.

E3.5
OFFSET SUITABILITY

To be considered suitable, offsets must meet the following criteria in the EPBC Act Offsets Assessment Guide:

1. Deliver an overall conservation outcome that improves or maintains the viability of the aspect of the environment, that is protected by national environment law and affected by the proposed action
2. Be built around direct offsets but may include other compensatory measures
3. Be in proportion to the level of statutory protection that applies to the protected matter
4. Be of a size and scale proportionate to the residual impacts on the protected matter
5. Effectively account for, and manage the risks of, the offset not succeeding
6. Be additional to what is already required, determined by law or planning regulations, or agreed to under other schemes or programs
7. Be efficient, effective, timely, transparent, scientifically robust and reasonable
8. Have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced.

These suitability criteria are detailed below.

E3.5.1
Deliver overall conservation outcome

The proposed future offsets are expected to provide an appropriate conservation outcome for NTGVVP, Grey Box Woodland, GGF, GSM and Swift Parrot.

They meet the like-for-like principle because the offset sites relate to the attributes of the MNES that are subject to the project's significant residual impacts. The offsets would improve or maintain the quality of areas of NTGVVP, Grey Box Woodland, Growling Grass Frog, Golden Sun Moth and Swift Parrot habitat.
The proposed offsets are therefore consistent with conservation advice and recovery planning for these MNES.

E3.5.2
Built around direct offsets

As previously noted, under the EPBC Act Environmental Offsets Policy (DSEWPaC, 2012a), at least 90 per cent of offsets must be direct offsets. For M3R, all residual significant impacts are expected to be offset via direct offsets.

These direct offsets would be on private land and permanently secured for conservation purposes by an encumbrance on the property title. Performance of offset management obligations would be monitored annually over the first 10 years to demonstrate compliance.

E3.5.3
Proportionate to statutory protection

MNES with a higher conservation status are at greater risk of extinction than MNES with a lower conservation status. These risks are defined according to International Union for Conservation of Nature data and factored into offset calculations by the EPBC Act Offsets Assessment Guide balance sheets. A proportionally greater quantity of offsets is therefore proposed for NTGVVP and Swift Parrot habitat (critically endangered) than for Grey Box Woodland (endangered) or Growling Grass Frog and Golden Sun Moth habitat (vulnerable).

E3.5.4
Proportionate to residual impacts

The proposed direct offsets are proportionate to the size and scale of the residual significant impacts on MNES.

All proposed direct offsets would involve protection of a greater area of habitat offsite than would be removed within the study area; and be permanently protected by an on-title conservation agreement or covenant reflecting the permanent nature of residual significant impacts. The greater the scale of impacts, the greater the offset requirements and the greater the risks involved in securing the required offsets.

E3.5.5
Account for and manage: safeguard/take into account/plan for failure

The risk associated with the securing and managing of offsets has several elements. All of these are incorporated into offset calculations. They include:

- The length of time likely to be taken for an offset to yield a conservation gain for the MNES, and the risk to the MNES during this period

- The risk of losing a proposed offset site if it is not secured as an offset, and the degree to which the offset protection alleviates this risk
- The risk of the proposed offset never providing the required conservation gain.

Where possible, these risks have been reduced, as discussed below.

E3.5.5.1
Risk of taking too long

The time between a residual significant impact occurring and conservation gains being realised is a risk to the MNES in question. This risk will be reduced by securing the offsets before commencing M3R construction work that impacts on MNES.

It has been estimated that all direct offsets will yield the required conservation gains within 10 years. (This estimate is conservative and considers the maximum time required to achieve the required conservation gains.)

E3.5.5.2
Risk of no offset protection

The threat to proposed offset sites is estimated to be relatively low (10 per cent) if they are not afforded offset protection.

The present low risk is partly due to protection provided by Victoria's native vegetation controls. However, offset protection would still considerably reduce the risk (to an estimated one per cent).

E3.5.5.3
Risk of being unsuccessful

The greater the impacts, the greater the offset requirements – and the greater the risk that the offsets may not achieve required conservation gains. In essence, greater offset requirements carry greater risk.

Similarly, the greater the contribution to an offset proposal made by other measures – such as research funding or educational programs that provide indirect conservation gains – the greater the risk that a given MNES will not receive the required conservation gains.

The main step to minimise the risk of offsets not achieving the required conservation gains is by 100 per cent of offset requirements being met through direct offsets. Direct offsets will be managed according to approved OMPs and monitored annually for the first ten years, to ensure that conservation gains are being achieved.

E3.5.6
Additional to existing management requirements

All direct offsets would be located on private land yet to be covered by a conservation covenant, overlay or other instrument that protects its ecological values; the existing zoning of which does not preclude developments that would threaten MNES. Because the landholders are currently under no obligation to manage the land for conservation purposes, proposed management of the land as offset sites would be significantly above and beyond what is currently required by law.

E3.5.7
Efficient, robust and reasonable

The proposed direct offsets are an efficient and scientifically robust means of securing the offset requirements for M3R.

Melbourne Airport has sufficient resources to allocate to the future proposed offset sites to achieve the required conservation gains. Ecological surveys will confirm that the required conservation gains are achievable through management actions at each offset site, and these will be detailed in approved OMPs.

Programs for monitoring management actions and conservations gains at each offset site will not be onerous. They will follow simple yet scientifically robust and repeatable procedures.

E3.5.8
Measurable, auditable and enforceable

Management of the offset sites will provide a measurable conservation gain. Before the management actions specified in the OMPs begin, ecological monitoring will collect baseline data against which the success of the offset sites will be determined.

Melbourne Airport has experience with similar ecological management and monitoring programs, such as the Grey Box Woodland Environmental Management Plan, the Grassland Monitoring Program, and the Melbourne Airport Biodiversity Conservation Management Plan.

Management of the offset sites will be by either landowners or specialist contractors. They will be responsible for carrying out actions such as fencing, weed elimination, pest animal eradication and revegetation.

Landowners and specialist contractors will work closely with independent qualified ecologists, who will conduct annual monitoring and reporting. Reports provided to DCCEEW will ensure that governance of the offset sites remains transparent, and that management actions can be adapted (where necessary) to achieve the conservation end gains.

E3.6
CONCLUSION

M3R will have significant impacts on the Natural Temperate Grassland of the Victorian Volcanic Plain, Grey Box Woodland; and the habitats of the Golden Sun Moth, Growling Grass Frog and Swift Parrot. Melbourne Airport is committed to identifying and securing offset sites that would meet all offset requirements for these significant impacts when the sites are protected in perpetuity and actively managed, maintained and/or improved over 10 years.

This offset strategy estimates the direct offsets required for suitable, low-risk and proportionate conservation outcomes in accordance with the EPBC Act Environmental Offsets Policy. Other compensatory measures may be considered when the strategy is finalised and all proposed offset sites identified.

REFERENCES

DELWP, Guidelines for the removal, destruction or lopping of native vegetation, Department of Environment, Land, Water, and Planning, East Melbourne, Victoria, 2017

DEWHA, Significant impact guidelines for the critically endangered golden sun moth (Synemon plana), Australian Government Department of the Environment, Water, Heritage and the Arts, Canberra, 2009a

DSEWPaC, Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy. October 2012. Australian Government Department of Sustainability, Environment, Water, Population and Communities, Canberra 2012a

DSEWPaC, Offsets Assessment Guide for use in determining offsets under the Environment Protection and Biodiversity Conservation Act 1999 October 2012. Australian Government Department of Sustainability, Environment, Water, Population and Communities, Canberra 2012b

DSE, Native Vegetation: Sustaining a living landscape, Vegetation Quality Assessment Manual – Guidelines for applying the Habitat hectares scoring method, Version 1.3, Victorian Government Department of Sustainability and Environment, Melbourne, Victoria, 2004

DoE, Matters of National Environmental Significance: Significant Impact Guidelines 1.1. Environment Protection and Biodiversity Conservation Act 1999, Australian Government Department of the Environment, Canberra, 2013

DoEE, National Recovery Plan for the Swift Parrot (Lathamus discolor) (draft), Australian Government Department of Environment and Energy, Canberra, 2019

Saunders, D., Tzaros, C., Webb, M. & Thurstans, S, Background Document National Recovery Plan for the Swift Parrot Lathamus discolor, Birds Australia, Melbourne, 2010

Saunders, D.L. and Tzaros, C.L., National Recovery Plan for the Swift Parrot Lathamus discolor. Birds Australia, Melbourne, 2011

Heard, G.W., Robertson, P. and Scroggie, M.P., Assessing detection probabilities for the endangered growling grass frog (Litoria raniformis) in southern Victoria, Wildlife Research 33: 557–564, 2006

Heard, G.W., Scroggie, M.P. & Clemann, N., Guidelines for managing the endangered Growling Grass Frog in urbanising landscapes, Victorian Government Department of Sustainability and Environment, Melbourne, 2010

Heard, G.W., Scroggie, M.P., Clemann, N. & Ramsey, D.S.L., Wetland characteristics influence disease risk for a threatened amphibian, Ecological Applications 24(4): 650-662, 2014

APPENDIX E3.A
OFFSET CALCULATIONS

Summary

- Offset assessment guide inputs
- Offset-area estimates for each listed species and TEC for which a residual significant impact is likely, prepared using the EPBC Act Offsets Assessment Guide

Grey Box Woodland

The M3R impact area includes:

- 68.02 hectares of Grey Box Woodland in a treed condition state.
- 10.72 hectares of Grey Box Woodland in a derived grassland condition state.

Collectively, this represents 78.74 hectares of the Grey Box Woodland threatened ecological community. The same vegetation quality scoring system, the habitat hectares method (DSE 2004), has been applied consistently by the same assessors at the impact and offset sites.

First party offsets

It is proposed that the retained Grey Box Woodland that is landside at Radar Hill would be protected and managed in perpetuity as a first party offset site. This is likely to provide 29.53% of M3R's offset requirements for Grey Box Woodland. The offset assessment guide inputs are outlined in Table E3.A.1, and the offset calculations in Table E3.A.2.

Table E3.A.1
Offset assessment guide inputs for Radar Hill Grey Box Woodland offset site

Parameter	Input	Justification for input
Time over which loss is averted	20 years	The offset site will be protected and managed as a conservation area in perpetuity, but 20 years is the maximum time period that can be entered into this field.
Start area	83.53 ha	This is the area of Grey Box Woodland retained at Radar Hill after construction of M3R, with suitable buffers applied.
Risk of loss (%) without offset	10%	Since the annual probability of extinction for Grey Box Woodland across its entire distribution is 1.2%, the risk of Grey Box Woodland being lost from Radar Hill over the next 20 years must inherently be higher than 1.2%. The risk that the Grey Box Woodland at Radar Hill would be lost without protection as an offset site is low but not negligible. Existing legislative protections would require APAM to seek and receive approval to remove the retained Grey Box Woodland. However, APAM's lease also requires APAM to develop Melbourne Airport to the quality standards reasonably expected of a major international airport in Australia. A risk of loss of 10% reflects the threats to Grey Box Woodland that exist at Radar Hill, assuming continued current land use and lack of protection as an offset site. Biosis has previously determined, in consultation with DCCEEW, that a risk of loss of 10% is appropriate for threatened ecological communities in this context and location.
Risk of loss (%) with offset	1%	The offset site will be protected by an appropriate security mechanism and managed in perpetuity. With the security mechanism and management in place, the risk of loss of the offset site would reduce from low (10%) to very low (1%). Risk of loss would not be 0% because this would imply absolute certainty, which is not possible to achieve. Possible sources of risk of loss to the offset area include anthropogenic climate change, new human- mediated disease or pest invasion or other unanticipated threats that cannot be completely eliminated by management actions. Biosis has previously determined, in consultation with DCCEEW, that a reduction in risk of loss from 10% to 1% is appropriate for threatened ecological communities protected as offset sites in this context and location.
Confidence in result – risk of loss	90%	There is a high level of confidence that an appropriate security mechanism can be implemented and provide legal protection over the site in perpetuity. There is a high level of confidence that APAM and/or future lessees will have the support and advice needed to comply with the security mechanism. The confidence cannot be 100% as some risk still exists. The largest remaining risk is associated with a change of airport lessee, who may have less of a commitment to conservation management.
Time until ecological benefit	10 years	A measurable improvement in habitat quality will be achieved after 10 years of management in accordance with the future OMP.
Start quality (/10)	7	Biosis assessed the quality of the Grey Box Woodland at Radar Hill in January 2020 using the habitat hectares method (DSE 2004). The weighted average start quality score of the retained Grey Box Woodland at Radar Hill was 70.69/100, which rounds to 7/10. This start quality score has been adjusted downwards from 71.47/100 to account for the reduction in landscape context score that would result from removal of surrounding native vegetation for the M3R project.

Parameter	Input	Justification for input
Future quality without offset (/10)	6	Without protection and management as an offset site, the quality of the Grey Box Woodland at Radar Hill is likely to decline to a weighted average of around 60/100, which would round to 6/10. Assuming current management obligations, management practices and land uses continue at the site, the cover of high threat weeds is likely to increase (leading to a potential quality loss of 3/100). Increased high threat weed cover is likely to cause displacement of at least one understorey life form (a potential quality loss of 5/100). In turn, these changes could contribute to a decline in canopy health e.g. due to disease or insect attack (a potential quality loss of 2/100).
Future quality with offset (/10)	8	Intensive management of the Grey Box Woodland at Radar Hill as an offset site is likely to lead to an increase in its weighted average quality score. It would be realistic to expect a weighted average score of around 79/100, which would round to 8/10. The improvement could be brought about through intensive weed control (a potential weighted average improvement of 2/100), reintroduction of understorey life forms (a potential weighted average improvement of 1/100), reinstatement of logs (a potential weighted average improvement of 1/100), biomass control (a potential weighted average improvement of 1.5/100) and control of herbivores to increase plant recruitment (a potential weighted average improvement of 2.5/100).
Confidence in result – future quality	90%	There is a high level of confidence that APAM and future Melbourne Airport lessees would have the resources to intensively manage the Grey Box Woodland at Radar Hill. Some ecological management already occurs, but the frequency and intensity of this management would need to be scaled up significantly to achieve ecological improvements. There is a high level of confidence that implementation of the actions listed above would result in a 1-point improvement to the future quality of the offset site.
Net present value (adjusted hectares)	16.27 adjusted hectares	This value is set by the Offset Assessment Guide and represents the value of the offset site as an area expressed in adjusted hectares. The absolute area (in hectares) has been adjusted to account for risk of loss (averted loss), future quality, annual probability of extinction and relevant time horizons (time over which loss is averted and time until ecological benefit).
% of impact offset	29.53%	This value is calculated automatically by the Offset Assessment Guide and represents the degree to which the offset (expressed in adjusted hectares) compensates for the total quantum of impact (also expressed in adjusted hectares).

Table E3.A.2
Offset calculations for Radar Hill Grey Box Woodland offset site

Matter of National Environmental Significance	
Name	Grey Box Woodland
EPBC Act status	Endangered
Annual probability of extinction Based on IUCN category definitions	1.2%

Impact calculator						
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Ecological communities						
Area of community	Yes	Impact area: 78.74 ha of Grey Box Woodland (treed and derived grassland condition states) with weighted average quality score of 68.59/100.	Area	78.74	Hectares	
			Quality	7	Scale 0-10	
			Total quantum of impact	55.12	Adjusted hectares	
Threatened species habitat						
Area of habitat	No		Area			
			Quality			
			Total quantum of impact	0.00		
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/ animals	No					

Offset calculator

Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start area and quality	
Ecological communities								
Area of community	Yes	55.12	Adjusted hectares	Offset site: first party offset at Radar Hill, comprising 83.53 ha of Grey Box Woodland with a weighted average start quality score of 70.69/100.	Risk-related time horizon (max. 20 years)	20	Start area (hectares)	83.53
					Time until ecological benefit	10	Start quality (scale of 0-10)	7
Threatened species habitat								
Area of habitat	No				Time over which loss is averted (max. 20 years)		Start area (hectares)	
					Time until ecological benefit		Start quality (scale of 0-10)	
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**	
Number of features e.g. Nest hollows, habitat trees	No							
Condition of habitat Change in habitat condition, but no change in extent	No							
Threatened species								
Birth rate e.g. Change in nest success	No							
Mortality rate e.g Change in number of road kills per year	**No**							
Number of individuals e.g. Individual plants/animals	**No**							

Offset calculator (cont.)

Protected matter attributes	Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)
Ecological communities (cont.)						
Area of community (cont.)	Risk of loss (%) without offset	10%	Risk of loss (%) with offset	1%	7.52	90%
	Future area without offset (adjusted hectares)	75.2	Future area with offset (adjusted hectares)	82.7		
	Future quality without offset (scale of 0-10)	6	Future quality with offset (scale of 0-10)	8	2.00	90%
Threatened species habitat (cont.)						
Area of habitat (cont.)	Risk of loss (%) without offset		Risk of loss (%) with offset			
	Future area without offset (adjusted hectares)	0.0	Future area with offset (adjusted hectares)	0.0		
	Future quality without offset (scale of 0-10)		Future quality with offset (scale of 0-10)			
Number of features (cont.) e.g. Nest hollows, habitat trees	No					
Condition of habitat (cont.) Change in habitat condition, but no change in extent	No					
Threatened species (cont.)						
Birth rate (cont.) e.g. Change in nest success	No					
Mortality rate (cont.) e.g Change in number of road kills per year	No					
Number of individuals (cont.) e.g. Individual plants/ animals	No					

Adjusted gain	Net present value (adjusted hectares)		% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
6.77	5.33	16.27	29.53%	No		
1.80	1.60					

Third party offsets

Three properties have been identified which contain potential offsets for Grey Box Woodland:

- Grey Box Woodland at the Orana and Kinrara properties could be protected and managed in perpetuity as third party offset sites. Orana and Kinrara are likely to provide 43.87% and 17.93% respectively of M3R's offset requirements for Grey Box Woodland. The offset assessment guide inputs for Orana are outlined in Table E3.A.3, and the offset calculations in Table E3.A.4. The offset assessment guide inputs for Kinrara are outlined in Table E3.A.5, and the offset calculations in Table E3.A.6.
- In addition, the property at Morrl Morrl supports 19.90 hectares of Grassy Woodland, which also has potential as a third party offset site for Grey Box Woodland. The Grassy Woodland at Morrl Morrl did not meet the condition thresholds for Grey Box Woodland when assessed in October 2021. Assuming this Grassy Woodland can be improved such that it meets the condition thresholds for Grey Box Woodland, this site is likely to provide 23.25% of M3R's offset requirements for Grey Box Woodland. Refer to the offset assessment guide inputs in Table E3.A.7, and the offset calculations in Table E3.A.8.

Table E3.A.3
Offset assessment guide inputs for Orana Grey Box Woodland offset site

Parameter	Input	Justification for input
Time over which loss is averted	20 years	The offset site will be protected and managed as a conservation area in perpetuity, but 20 years is the maximum time period that can be entered into this field.
Start area	128.31 ha	This is the area of Grey Box Woodland at the Orana property, as assessed in October 2021. Note that approximately 10.15 ha of this 128.31 ha sits outside of a recently-constructed predator-proof fence.
Risk of loss (%) without offset	10%	Since the annual probability of extinction for Grey Box Woodland across its entire distribution is 1.2%, the risk of Grey Box Woodland being lost from Orana over the next 20 years must inherently be higher than 1.2%. The risk of loss without protection as an offset site is low but not negligible. Without protection as an offset site, continued agricultural land use could lead to the incremental and ultimate loss of Grey Box Woodland from the site. Biosis has previously determined, in consultation with DCCEEW, that a risk of loss of 10% is appropriate for threatened ecological communities in this context and location.
Risk of loss (%) with offset	1%	The offset site will be protected by an appropriate security mechanism, such as a conservation covenant, and managed in perpetuity. With the security mechanism and management in place, the risk of loss of the offset site would reduce from low (10%) to very low (1%). Risk of loss would not be 0% because this would imply absolute certainty, which is not possible to achieve. Possible sources of risk of loss to the offset area include anthropogenic climate change, new human-mediated disease or pest invasion or other unanticipated threats that cannot be completely eliminated by management actions. Biosis has previously determined, in consultation with DCCEEW, that a reduction in risk of loss from 10% to 1% is appropriate for threatened ecological communities protected as offset sites in this context and location.
Confidence in result – risk of loss	90%	There is a high level of confidence that a conservation covenant or similar can be implemented and provide legal protection over the site in perpetuity. There is a high level of confidence that the landowner will have the support and advice needed to comply with the conservation covenant. The confidence cannot be 100% as some risk still exists. The largest remaining risk is associated with a change of landowner, who may have less of an understanding of conservation management.
Time until ecological benefit	10 years	A measurable improvement in habitat quality will be achieved after 10 years of management in accordance with the future OMP (although the improvement may not register once rounding has occurred, as explained below).
Start quality (/10)	7	Biosis assessed the quality of the Grey Box Woodland at Orana in October 2021 using the habitat hectares method (DSE 2004). The weighted average start quality score of the retained Grey Box Woodland at Orana is 66.38/100, which rounds to 7/10. Note that this start quality is close to 6/10, which makes it less likely that ecological improvements will register as an increase in the future quality score as the calculator only allows for the use of integers.

Parameter	Input	Justification for input
Future quality without offset (/10)	5	Without protection and management as an offset site, the quality of the Grey Box Woodland at Orana is likely to decline to a weighted average of around 54/100, which would round to 5/10. Assuming current management obligations, management practices and land uses continue at the site, weed cover is likely to increase (leading to a potential quality loss of 3/100), organic litter cover may increase beyond the current benchmark range (a potential quality loss of 2/100) and logs could be removed from the site (a potential quality loss of 2/100). Increased weed cover is likely to displace understorey life forms (a potential quality loss of 4/100). In turn, these changes could contribute to a decline in canopy health e.g. due to disease or insect attack (a potential quality loss of 1.5/100).
Future quality with offset (/10)	7	Intensive management of the Grey Box Woodland at Orana as an offset site is likely to lead to measurable ecological improvements but unlikely to register as an increased future quality score. This is because the start quality is 66.38/100 (between 6/10 and 7/10) and scores out of 100 are rounded to an integer score out of 10. Ecological improvement could be brought about through reinstating large logs (a potential improvement of 1/100), weed control, pest animal control and reintroduction of understorey life forms (a potential weighted average improvement of 1/100), all of which is likely to also encourage more diverse understorey recruitment (a potential improvement of 4/100) and possibly lead to improved canopy health (a further potential weighted average improvement of 1/100). It would therefore be realistic to expect an increase in the weighted average score from 66.38/100 to around 73/100, which would still round to 7/10.
Confidence in result – future quality	90%	There is a high level of confidence that the landowner and future landowners would have the support, guidance and resources to intensively manage the Grey Box Woodland at Orana. There is a high level of confidence that implementation of the actions listed above would result in no loss in the quality of the offset site.
Net present value (adjusted hectares)	24.18 adjusted hectares	This value is set by the Offset Assessment Guide and represents the value of the offset site as an area expressed in adjusted hectares. The absolute area (in hectares) has been adjusted to account for risk of loss (averted loss), future quality, annual probability of extinction and relevant time horizons (time over which loss is averted and time until ecological benefit).
% of impact offset	43.87%	This value is calculated automatically by the Offset Assessment Guide and represents the degree to which the offset (expressed in adjusted hectares) compensates for the total quantum of impact (also expressed in adjusted hectares).

Table E3.A.4
Offset calculations for Orana Grey Box Woodland offset site

Matter of National Environmental Significance	
Name	Grey Box Woodland
EPBC Act status	Endangered
Annual probability of extinction Based on IUCN category definitions	1.2%

Impact calculator						
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Ecological communities						
Area of community	Yes	Impact area: 78.74 ha of Grey Box Woodland (treed and derived grassland condition states) with weighted average quality score of 68.59/100.	Area	78.74	Hectares	
			Quality	7	Scale 0-10	
			Total quantum of impact	55.12	Adjusted hectares	
Threatened species habitat						
Area of habitat	No		Area			
			Quality			
			Total quantum of impact	0.00		
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/ animals	No					

Offset calculator								
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start area and quality**	
Ecological Communities								
Area of community	Yes	55.12	Adjusted hectares	Offset site: third party offset at Orana, comprising 128.31 ha of Grey Box Woodland with a weighted average start quality score of 66.38/100.	Risk-related time horizon (max. 20 years)	20	Start area (hectares)	128.31
					Time until ecological benefit	10	Start quality (scale of 0-10)	7
Threatened species habitat								
Area of habitat	No				Time over which loss is averted (max. 20 years)		Start area (hectares)	
					Time until ecological benefit		Start quality (scale of 0-10)	
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**	
Number of features e.g. Nest hollows, habitat trees	No							
Condition of habitat Change in habitat condition, but no change in extent	No							
Threatened species								
Birth rate e.g. Change in nest success	No							
Mortality rate e.g Change in number of road kills per year	No							
Number of individuals e.g. Individual plants/animals	No							

Offset calculator (cont.)						
Protected matter attributes	**Future area and quality without offset**		**Future area and quality with offset**		**Raw gain**	**Confidence in result (%)**
Ecological communities (cont.)						
Area of community (cont.)	Risk of loss (%) without offset	10%	Risk of loss (%) with offset	1%	11.55	90%
	Future area without offset (adjusted hectares)	115.5	Future area with offset (adjusted hectares)	127.0		
	Future quality without offset (scale of 0-10)	5	Future quality with offset (scale of 0-10)	7	2.00	90%
Threatened species habitat (cont.)						
Area of habitat (cont.)	Risk of loss (%) without offset		Risk of loss (%) with offset			
	Future area without offset (adjusted hectares)	0.0	Future area with offset (adjusted hectares)	0.0		
	Future quality without offset (scale of 0-10)		Future quality with offset (scale of 0-10)			
Protected matter attributes	**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**
Number of features (cont.) e.g. Nest hollows, habitat trees						
Condition of habitat (cont.) Change in habitat condition, but no change in extent						
Threatened species (cont.)						
Birth rate (cont.) e.g. Change in nest success						
Mortality rate (cont.) e.g Change in number of road kills per year						
Number of individuals (cont.) e.g. Individual plants/ animals						

Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
10.39	8.19				
	24.18	43.87%	No		
1.80	1.60				

Adjusted gain	Net present value	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source

Table E3.A.5
Offset assessment guide inputs for Kinrara Grey Box Woodland offset site

Parameter	Input	Justification for input
Time over which loss is averted	20 years	The offset site will be protected and managed as a conservation area in perpetuity, but 20 years is the maximum time period that can be entered into this field.
Start area	52.45 ha	This is the area of Grey Box Woodland at the Kinrara property, as assessed in October 2021.
Risk of loss (%) without offset	10%	Since the annual probability of extinction for Grey Box Woodland across its entire distribution is 1.2%, the risk of Grey Box Woodland being lost from Kinrara over the next 20 years must inherently be higher than 1.2%. The risk of loss without protection as an offset site is low but not negligible. Without protection as an offset site, continued agricultural land use could lead to the incremental and ultimate loss of Grey Box Woodland from the site. Biosis has previously determined, in consultation with DCCEEW, that a risk of loss of 10% is appropriate for threatened ecological communities in this context and location.
Risk of loss (%) with offset	1%	The offset site will be protected by an appropriate security mechanism, such as a conservation covenant, and managed in perpetuity. With the security mechanism and management in place, the risk of loss of the offset site would reduce from low (10%) to very low (1%). Risk of loss would not be 0% because this would imply absolute certainty, which is not possible to achieve. Possible sources of risk of loss to the offset area include anthropogenic climate change, new human-mediated disease or pest invasion or other unanticipated threats that cannot be completely eliminated by management actions. Biosis has previously determined, in consultation with DCCEEW, that a reduction in risk of loss from 10% to 1% is appropriate for threatened ecological communities protected as offset sites in this context and location.
Confidence in result – risk of loss	90%	There is a high level of confidence that a conservation covenant or similar can be implemented and provide legal protection over the site in perpetuity. There is a high level of confidence that the landowner will have the support and advice needed to comply with the conservation covenant. The confidence cannot be 100% as some risk still exists. The largest remaining risk is associated with a change of landowner, who may have less of an understanding of conservation management.
Time until ecological benefit	10 years	A measurable improvement in habitat quality will be achieved after 10 years of management in accordance with the future OMP.
Start quality (/10)	6	Biosis assessed the quality of the Grey Box Woodland at Kinrara in October 2021 using the habitat hectares method (DSE 2004). The weighted average start quality score of the retained Grey Box Woodland at Kinrara is 63.58/100, which rounds to 6/10.

Parameter	Input	Justification for input
Future quality without offset (/10)	5	Without protection and management as an offset site, the quality of the Grey Box Woodland at Kinrara is likely to decline to a weighted average of around 54/100, which would round to 5/10. Assuming current management obligations, management practices and land uses continue at the site, weed cover is likely to increase (leading to a potential weighted quality loss of 4.5/100), biomass may continue to accumulate and smother the ground layer (a potential weighted quality loss of 1.5/100) and logs could be removed from the site (a potential weighted quality loss of 2/100). Increased weed cover is likely to displace understorey life forms and lead to a decline in understorey recruitment (a potential weighted quality loss of 1.5/100).
Future quality with offset (/10)	7	Intensive management of the Grey Box Woodland at Kinrara as an offset site is likely to lead to an increase in its weighted average quality score. It would be realistic to expect a weighted average score of around 73/100, which would round to 7/10. The improvement could be brought about through intensive weed control (a potential weighted average improvement of 2.5/100) and management of pest animals and ground layer biomass (a potential weighted average improvement of 1/100), which could lead to improved understorey recruitment (a potential weighted average improvement of 4/100). In turn, these improvements could lead to improved canopy health (a potential weighted average improvement of 2/100).
Confidence in result – future quality	90%	There is a high level of confidence that the landowner and future landowners would have the support, guidance and resources to intensively manage the Grey Box Woodland at Kinrara. There is a high level of confidence that implementation of the actions listed above would result in a 1-point improvement to the future quality of the offset site.
Net present value (adjusted hectares)	9.88 adjusted hectares	This value is set by the Offset Assessment Guide and represents the value of the offset site as an area expressed in adjusted hectares. The absolute area (in hectares) has been adjusted to account for risk of loss (averted loss), future quality, annual probability of extinction and relevant time horizons (time over which loss is averted and time until ecological benefit).
% of impact offset	17.93%	This value is calculated automatically by the Offset Assessment Guide and represents the degree to which the offset (expressed in adjusted hectares) compensates for the total quantum of impact (also expressed in adjusted hectares).

Table E3.A.6
Offset calculations for Kinrara Grey Box Woodland offset site

Matter of National Environmental Significance	
Name	Grey Box Woodland
EPBC Act status	Endangered
Annual probability of extinction Based on IUCN category definitions	1.2%

Impact calculator						
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Ecological communities						
Area of community	Yes	Impact area: 78.74 ha of Grey Box Woodland (treed and derived grassland condition states) with weighted average quality score of 68.59/100.	Area	78.74	Hectares	
			Quality	7	Scale 0-10	
			Total quantum of impact	55.12	Adjusted hectares	
Threatened species habitat						
Area of habitat	No		Area			
			Quality			
			Total quantum of impact	0.00		
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/animals	No					

Offset calculator								
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start area and quality**	
Ecological Communities								
Area of community	Yes	55.12	Adjusted hectares	Offset site: third party offset at Kinrara, comprising 52.45 ha of Grey Box Woodland with a weighted average start quality score of 63.58/100.	Risk-related time horizon (max. 20 years)	20	Start area (hectares)	52.45
					Time until ecological benefit	10	Start quality (scale of 0-10)	6
Threatened species habitat								
Area of habitat	No				Time over which loss is averted (max. 20 years)		Start area (hectares)	
					Time until ecological benefit		Start quality (scale of 0-10)	
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**	
Number of features e.g. Nest hollows, habitat trees	No							
Condition of habitat Change in habitat condition, but no change in extent	No							
Threatened species								
Birth rate e.g. Change in nest success	No							
Mortality rate e.g Change in number of road kills per year	No							
Number of individuals e.g. Individual plants/animals	No							

Offset calculator (cont.)

Protected matter attributes	Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)
Ecological Communities (cont.)						
Area of community (cont.)	Risk of loss (%) without offset	10%	Risk of loss (%) with offset	1%	4.72	90%
	Future area without offset (adjusted hectares)	47.2	Future area with offset (adjusted hectares)	51.9		
	Future quality without offset (scale of 0-10)	5	Future quality with offset (scale of 0-10)	7	2.00	90%
Threatened species habitat (cont.)						
Area of habitat (cont.)	Risk of loss (%) without offset		Risk of loss (%) with offset			
	Future area without offset (adjusted hectares)	0.0	Future area with offset (adjusted hectares)	0.0		
	Future quality without offset (scale of 0-10)		Future quality with offset (scale of 0-10)			
Protected matter attributes	**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**
Number of features (cont.) e.g. Nest hollows, habitat trees						
Condition of habitat (cont.) Change in habitat condition, but no change in extent						
Threatened species (cont.)						
Birth rate (cont.) e.g. Change in nest success						
Mortality rate (cont.) e.g Change in number of road kills per year						
Number of individuals (cont.) e.g. Individual plants/ animals						

Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
4.25	3.35				
	9.88	17.93%	No		
1.80	1.60				

Adjusted gain	Net present value	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source

Table E3.A.7
Offset assessment guide inputs for Morrl Morrl Grey Box Woodland offset site

Parameter	Input	Justification for input
Time over which loss is averted	20 years	The offset site will be protected and managed as a conservation area in perpetuity, but 20 years is the maximum time period that can be entered into this field.
Start area	19.90 ha	This is the area of Grassy Woodland that is potential future Grey Box Woodland at the Morrl Morrl property, as assessed in October 2021.
Risk of loss (%) without offset	10%	While the Grassy Woodland at Morrl Morrl does not meet the condition thresholds to be recognised as Grey Box Woodland, it holds inherent value as potential future Grey Box Woodland. This value would be completely lost if the site were to be cleared of native vegetation. The probability that the site would be cleared over the next 20 years is low but not negligible. Without protection as an offset site, continued agricultural land use could lead to the incremental and ultimate loss of Grassy Woodland from the site. Therefore, risk of loss of Grassy Woodland at Morrl Morrl is likely to be similar to the risk of loss of Grey Box Woodland at other offset sites i.e. 10%. Biosis has previously determined, in consultation with DCCEEW, that a risk of loss of 10% is appropriate for threatened ecological communities in this context and location.
Risk of loss (%) with offset	1%	The offset site will be protected by an appropriate security mechanism, such as a conservation covenant, and managed in perpetuity. With the security mechanism and management in place, the risk of loss of the offset site would reduce from low (10%) to very low (1%). Risk of loss would not be 0% because this would imply absolute certainty, which is not possible to achieve. Possible sources of risk of loss to the offset area include anthropogenic climate change, new human-mediated disease or pest invasion or other unanticipated threats that cannot be completely eliminated by management actions.
Confidence in result – risk of loss	90%	There is a high level of confidence that a conservation covenant or similar can be implemented and provide legal protection over the site in perpetuity. There is a high level of confidence that the landowner will have the support and advice needed to comply with the conservation covenant. The confidence cannot be 100% as some risk still exists. The largest remaining risk is associated with a change of landowner, who may have less of an understanding of conservation management.
Time until ecological benefit	10 years	A measurable improvement in habitat quality, such that the Grassy Woodland meets the condition thresholds for the Grey Box Woodland threatened ecological community, will be achieved after 10 years of management in accordance with the future OMP.
Start quality (/10)	2	Biosis assessed the quality of the Grassy Woodland at Morrl Morrl in October 2021 using the habitat hectares method (DSE 2004), which includes a site condition score (out of 75) and a landscape context score (out of 25). The Grassy Woodland scored a weighted average of 66.50/100, comprising a weighted average site condition score of 49.50/75 and a weighted average landscape context score of 17.00/25. However, these scores are based on a comparison of the characteristics of the Morrl Morrl Grassy Woodland with a pre-determined government benchmark for Grassy Woodland in the same bioregion (DSE 2004). The benchmark represents the characteristics of a mature and long-undisturbed Grassy Woodland but does not equate to the condition thresholds for the Grey Box Woodland ecological community (TSSC 2010). The benchmarks and habitat hectares method are useful tools for assessing the condition of an example of the community, given that the community often represents the better quality examples of Grassy Woodland, but these tools should not be used to determine whether the community is present. The quality score should therefore be adjusted to account for the fact that the Grassy Woodland at Morrl Morrl did not meet the condition thresholds for Grey Box Woodland (i.e. the community is not currently present) but nevertheless holds some inherent value as potential future Grey Box Woodland. The listing advice for the community notes that native vegetation that does not meet the condition thresholds may still retain important values (e.g. landscape context) and, with suitable management actions, may be improved to the point that it can be regarded as part of the ecological community (TSSC 2010). Given that the Grassy Woodland at Morrl Morrl did not meet the condition thresholds but still has inherent value, it was assigned a nominal weighted average starting quality score of 17/100 (i.e. 2/10), equivalent to the landscape context component of its overall habitat hectares score.

Parameter	Input	Justification for input
Future quality without offset (/10)	2	Without protection and management as an offset site, the quality of the Grassy Woodland at Morrl Morrl is unlikely to improve to the point that it meets the condition thresholds for the Grey Box Woodland community. If anything, continuation of current management obligations, management practices and land uses is likely to reduce the condition of the Grassy Woodland. The landscape context score is likely to remain the same or similar and therefore contribute 2 points towards the Grassy Woodland's future quality score. Without meeting the condition thresholds for Grassy Woodland, the site condition component of the habitat hectares score would still not apply.
Future quality with offset (/10)	7	There is potential for the Grassy Woodland at Morrl Morrl to be actively improved such that it meets the condition thresholds for Grey Box Woodland. Active improvement would need to involve control of weeds (especially non-grass weeds), re-introduction of understorey life forms (such as native grasses) and stabilisation and control of existing gully erosion. If the Grassy Woodland were to meet the Grey Box Woodland condition thresholds, it would be valid to apply the site condition score and landscape context score (as opposed to only the landscape context score, used for patches that do not meet the condition thresholds). The weighted average quality score (combined site condition and landscape context scores) for the Grassy Woodland is currently 66.50/100. With the active improvements needed to meet the condition thresholds, it is reasonable to expect that the future quality would be up to 73/100, which rounds to 7/10.
Confidence in result – future quality	50%	There is a moderate level of confidence that the landowner and/or future landowners at Morrl Morrl would be able to implement the improvements required for the Grassy Woodland to meet the condition thresholds for Grey Box Woodland. The improvements are considered achievable in a standard 10-year OMP period but come with inherent risks and uncertainty. For example, the success in controlling gully erosion may depend on the actions of landowners from neighbouring properties, from where run-off originates. For this reason, the confidence level has been set at moderate (50%) rather than high (90%).
Net present value (adjusted hectares)	12.82 adjusted hectares	This value is set by the Offset Assessment Guide and represents the value of the offset site as an area expressed in adjusted hectares. The absolute area (in hectares) has been adjusted to account for risk of loss (averted loss), future quality, annual probability of extinction and relevant time horizons (time over which loss is averted and time until ecological benefit).
% of impact offset	23.25%	This value is calculated automatically by the Offset Assessment Guide and represents the degree to which the offset (expressed in adjusted hectares) compensates for the total quantum of impact (also expressed in adjusted hectares).

Table E3.A.8
Offset calculations for Morrl Morrl Grey Box Woodland offset site

Matter of National Environmental Significance	
Name	Grey Box Woodland
EPBC Act status	Endangered
Annual probability of extinction Based on IUCN category definitions	1.2%

Impact calculator						
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Ecological communities						
Area of community	Yes	Impact area: 78.74 ha of Grey Box Woodland (treed and derived grassland condition states) with weighted average quality score of 68.59/100.	Area	78.74	Hectares	
			Quality	7	Scale 0-10	
			Total quantum of impact	55.12	Adjusted hectares	
Threatened species habitat						
Area of habitat	No		Area			
			Quality			
			Total quantum of impact	0.00		
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/ animals	No					

Offset calculator								
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start area and quality**	
Ecological Communities								
Area of community	Yes	55.12	Adjusted hectares	Offset site: third party offset at Morrl Morrl, comprising 19.90 ha of Grassy Woodland (future Grey Box Woodland) with a weighted average start quality score of 17/100.	Risk-related time horizon (max. 20 years)	20	Start area (hectares)	52.45
					Time until ecological benefit	10	Start quality (scale of 0-10)	2
Threatened species habitat								
Area of habitat	No				Time over which loss is averted (max. 20 years)		Start area (hectares)	
					Time until ecological benefit		Start quality (scale of 0-10)	
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**	
Number of features e.g. Nest hollows, habitat trees	No							
Condition of habitat Change in habitat condition, but no change in extent	No							
Threatened species								
Birth rate e.g. Change in nest success	No							
Mortality rate e.g Change in number of road kills per year	No							
Number of individuals e.g. Individual plants/animals	No							

Offset calculator (cont.)

Protected matter attributes	Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)
Ecological Communities (cont.)						
Area of community (cont.)	Risk of loss (%) without offset	10%	Risk of loss (%) with offset	1%	4.72	90%
	Future area without offset (adjusted hectares)	47.2	Future area with offset (adjusted hectares)	51.9		
	Future quality without offset (scale of 0-10)	2	Future quality with offset (scale of 0-10)	7	5.00	50%
Threatened species habitat (cont.)						
Area of habitat (cont.)	Risk of loss (%) without offset		Risk of loss (%) with offset			
	Future area without offset (adjusted hectares)		Future area with offset (adjusted hectares)			
	Future quality without offset (scale of 0-10)		Future quality with offset (scale of 0-10)			

Protected matter attributes	Future value without offset	Future value with offset	Raw gain	Confidence in result (%)
Number of features (cont.) e.g. Nest hollows, habitat trees	No			
Condition of habitat (cont.) Change in habitat condition, but no change in extent	No			
Threatened species (cont.)				
Birth rate (cont.) e.g. Change in nest success	No			
Mortality rate (cont.) e.g Change in number of road kills per year	No			
Number of individuals (cont.) e.g. Individual plants/ animals	No			

Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
4.25	3.35	23.25%	No		
2.50	2.22				

Adjusted gain	Net present value	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source

Residual offset requirements

If all first party and third party Grey Box Woodland offsets were implemented, there would be sufficient offsets to meet 114.58% of the Grey Box Woodland offset requirements for M3R. There would be no residual offset requirements.

NTGVVP

The M3R impact area includes 90.49 hectares of NTGVVP. The same vegetation quality scoring system, the habitat hectares method (DSE 2004), has been applied consistently by the same assessors at the impact and offset sites.

First party offsets

It is proposed that an area of retained NTGVVP that is landside at the corner of Arundel and McNabs Roads would be protected and managed in perpetuity as a first party offset site. This is likely to provide 4.20% of M3R's offset requirements for NTGVVP. The offset assessment guide inputs are outlined in Table E3.A.9, and the offset calculations in Table E3.A.10.

Table E3.A.9
Offset assessment guide inputs for Arundel Road NTGVVP offset site

Parameter	Input	Justification for input
Time over which loss is averted	20 years	The offset site will be protected and managed as a conservation area in perpetuity, but 20 years is the maximum time period that can be entered into this field.
Start area	12.47 ha	This is the area of NTGVVP retained at the corner of Arundel and McNabs Roads after construction of M3R, with suitable buffers applied.
Risk of loss (%) without offset	50%	Since the annual probability of extinction for NTGVVP across its entire distribution is 6.8%, the risk of NTGVVP being lost from the Arundel Road site over the next 20 years must inherently be higher than 6.8%. The risk that the NTGVVP at Arundel Road would be lost without protection as an offset site is moderate (not high but also not low). Existing legislative protections would require APAM to seek and receive approval to remove the NTGVVP. However, APAM's lease also requires APAM to develop Melbourne Airport to the quality standards reasonably expected of a major international airport in Australia. The Arundel Road NTGVVP is situated is the southern half of the Melbourne Airport estate, where much of the master planning development (e.g. for the Melbourne Airport Business Park) has occurred and is likely to continue to occur in coming years. A risk of loss of 50% therefore reflects the threats to NTGVVP that exist at the Arundel Road site, assuming continued current land use and lack of protection as an offset site.
Risk of loss (%) with offset	1%	The offset site will be protected by an appropriate security mechanism and managed in perpetuity. With the security mechanism and management in place, the risk of loss of the offset site would reduce from moderate (50%) to very low (1%) as the likelihood of the site being developed would be effectively removed. Risk of loss would not be 0% because this would imply absolute certainty, which is not possible to achieve. Possible ongoing sources of risk of loss to the offset area include anthropogenic climate change, new human-mediated disease or pest invasion or other unanticipated threats that cannot be completely eliminated by management actions.
Confidence in result – risk of loss	90%	There is a high level of confidence that an appropriate security mechanism can be implemented and provide legal protection over the site in perpetuity. There is a high level of confidence that APAM and/or future lessees will have the support and advice needed to comply with the security mechanism. The confidence cannot be 100% as some risk still exists. The largest remaining risk is associated with a change of airport lessee, who may have less of a commitment to conservation management.
Time until ecological benefit	10 years	A measurable improvement in habitat quality will be achieved after 10 years of management in accordance with the future OMP.
Start quality (/10)	4	Biosis assessed the quality of the NTGVVP at Arundel Road in January 2020 using the habitat hectares method (DSE 2004). The quality score of the NTGVVP was 42.36/100, which rounds to 4/10. This start quality score has been adjusted downwards from 44.36/100 to account for the reduction in landscape context score that would result from removal of surrounding native vegetation for the M3R project.

Parameter	Input	Justification for input
Future quality without offset (/10)	1	Without protection and management as an offset site, the quality of the NTGVVP at Arundel Road is likely to decline to such a point that it no longer meets the condition thresholds for NTGVVP. Around one third of total vegetation cover was made up of perennial weeds when assessed in January 2020. It would take a relatively small increase in the cover of perennial weeds for native species to no longer be dominant and for the NTGVVP condition thresholds to no longer be met. This type of change has been observed in other NTGVVP patches in the vicinity of Melbourne Airport when basic biomass management ceases. If the grassland at Arundel Road no longer met the NTGVVP condition thresholds, it would be assigned a nominal score based on its landscape context. Its landscape context score would be 11/25, which accounts for the reduction that would result from removal of surrounding native vegetation for the M3R project. Without the addition of a site condition score, the landscape score would be the only contribution to the total quality score. The future quality score would therefore by 11/100, which rounds to 1/10.
Future quality with offset (/10)	5	Intensive management of the NTGVVP at Arundel Road as an offset site is likely to lead to an increase in its weighted average quality score. It would be realistic to expect a weighted average score of around 52/100, which would round to 5/10. The improvement could be largely brought about by the reintroduction of understorey life forms (a potential improvement of 10/100). In order to be successful, this strategic revegetation would need to be accompanied by intensive weed control (beyond existing obligations and in perpetuity), adjustments to the grazing regime and implementation of ecological burning. Pulse grazing and ecological burning has the potential to return organic litter (biomass) levels closer to benchmark levels, which could provide a further improvement of 2/100 but not enough to materially change the rounded future quality score.
Confidence in result – future quality	90%	There is a high level of confidence that APAM and future Melbourne Airport lessees would have the resources to intensively manage the NTGVVP at Arundel Road. While some management already occurs at the site, the frequency, intensity and ecological focus of this management would need to be strengthened to achieve ecological improvements. There is a high level of confidence that implementation of the actions listed above would result in a 1-point improvement to the future quality of the offset site.
Net present value (adjusted hectares)	1.90 adjusted hectares	This value is set by the Offset Assessment Guide and represents the value of the offset site as an area expressed in adjusted hectares. The absolute area (in hectares) has been adjusted to account for risk of loss (averted loss), future quality, annual probability of extinction and relevant time horizons (time over which loss is averted and time until ecological benefit).
% of impact offset	4.20%	This value is calculated automatically by the Offset Assessment Guide and represents the degree to which the offset (expressed in adjusted hectares) compensates for the total quantum of impact (also expressed in adjusted hectares).

Table E3.A.10
Offset calculations for Arundel Road NTGVVP offset site

Matter of National Environmental Significance	
Name	Natural Temperate Grassland
EPBC Act status	Critically Endangered
Annual probability of extinction Based on IUCN category definitions	6.8%

Impact calculator						
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Ecological communities						
Area of community	Yes	Impact area: 90.49 ha of Natural Temperate Grassland with weighted average quality score of 47.24/100.	Area	90.49	Hectares	
			Quality	5	Scale 0-10	
			Total quantum of impact	45.25	Adjusted hectares	
Threatened species habitat						
Area of habitat	No		Area			
			Quality			
			Total quantum of impact	0.00		
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/ animals	No					

Offset calculator								
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start area and quality**	
Ecological Communities								
Area of community	Yes	45.25	Adjusted hectares	Offset site: first party offset area on corner of Arundel and McNabs Roads, comprising 12.47 ha of Natural Temperate Grassland with a start quality score of 42.36/100.	Risk-related time horizon (max. 20 years)	20	Start area (hectares)	12.47
					Time until ecological benefit	10	Start quality (scale of 0-10)	4
Threatened species habitat								
Area of habitat	No				Time over which loss is averted (max. 20 years)		Start area (hectares)	
					Time until ecological benefit		Start quality (scale of 0-10)	
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**	
Number of features e.g. Nest hollows, habitat trees	No							
Condition of habitat Change in habitat condition, but no change in extent	No							
Threatened species								
Birth rate e.g. Change in nest success	No							
Mortality rate e.g Change in number of road kills per year	No							
Number of individuals e.g. Individual plants/animals	No							

Offset calculator (cont.)						
Protected matter attributes	**Future area and quality without offset**		**Future area and quality with offset**		**Raw gain**	**Confidence in result (%)**
Ecological Communities (cont.)						
Area of community	Risk of loss (%) without offset	50%	Risk of loss (%) with offset	1%	6.11	90%
	Future area without offset (adjusted hectares)	6.2	Future area with offset (adjusted hectares)	12.3		
	Future quality without offset (scale of 0-10)	1	Future quality with offset (scale of 0-10)	5	4.00	90%
Threatened species habitat (cont.)						
Area of habitat	Risk of loss (%) without offset		Risk of loss (%) with offset			
	Future area without offset (adjusted hectares)	0.0	Future area with offset (adjusted hectares)	0.0		
	Future quality without offset (scale of 0-10)		Future quality with offset (scale of 0-10)			
Protected matter attributes	**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species (cont.)						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/ animals	No					

Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
5.50	1.48				
	1.90	4.20%	No		
3.60	1.86				

Adjusted gain	Net present value	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source

Third party offsets

A site has been identified at Stockyard Hill containing high quality grassland. It is proposed that NTGVVP at the Stockyard Hill property will be protected and managed in perpetuity as a third party offset site. This site is currently being established as an advanced offset, whereby the offset site is secured, management commences and ecological benefits materialise before the impact occurs. For the purposes of offset calculations, it was assumed that construction of M3R would commence in mid-2025, allowing for two years of advanced offset management. With two years of advanced management, the NTGVVP at Stockyard Hill is likely to provide 63.08% of M3R's offset requirements for NTGVVP.

In addition, Stockyard Hill supports 5.60 hectares of Plains Grassland that did not meet the condition thresholds for NTGVVP when assessed in January/February 2022. There is potential for this Plains Grassland to be improved such that it meets the condition thresholds for NTGVVP (referred to as future NTGVVP). Assuming this is achieved, the additional 5.60 hectares of Plains Grassland at Stockyard Hill is likely to provide a further 2.57% of M3R's offset requirements for NTGVVP.

The offset assessment guide inputs for the Stockyard Hill NTGVVP offset site are outlined in Table E3.A.11, and the offset calculations in Table E3.A.12 (current NTGVVP) and Table E3.A.13 (future NTGVVP).

Table E3.A.11
Offset assessment guide inputs for Stockyard Hill NTGVVP offset site

Parameter	Input	Justification for input
Time over which loss is averted	20 years	The Advanced OMP will require active conservation management (and improvements) for the first 10 years, after which the offset area is to be managed and maintained as a conservation area in perpetuity. However, 20 years is the maximum value that can be entered into the Offsets Assessment Guide.
Start area	257.30 and 5.60	257.30 ha of NTGVVP is available for use as an offset at Stockyard Hill. A further 5.60 ha of Plains Grassland could be improved such that it meets the conditions thresholds of NTGVVP in the near future (referred to as future NTGVVP).
Risk of loss (%) without offset	10%	Since the annual probability of extinction for NTGVVP across its entire distribution is 6.8%, the risk of NTGVVP being lost from Stockyard Hill over the next 20 years must inherently be higher than 6.8%. The risk of loss without protection as an offset site is low but not negligible. Without protection as an offset site, continued agricultural land use could lead to the incremental and ultimate loss of NTGVVP from the site. Biosis has previously determined, in consultation with DCCEEW, that a risk of loss of 10% is appropriate for threatened ecological communities in this context and location. It is likely that the risk of loss without the offset site would be similar for the areas of Plains Grassland that do not meet the condition thresholds for NTGVVP. The value of these areas as potential future NTGVVP would be completely lost if the site were to be cleared of native vegetation. This clearing could occur through a permit and approval process or could occur gradually and incrementally through continued agricultural land use.
Risk of loss (%) with offset	1%	The offset site will be protected by an appropriate security mechanism, such as a conservation covenant, and managed in perpetuity. With the security mechanism and management in place, the risk of loss of the offset site would reduce from low (10%) to very low (1%). Risk of loss would not be 0% because this would imply absolute certainty, which is not possible to achieve. Possible ongoing sources of risk of loss to the offset area include anthropogenic climate change, new human-mediated disease or pest invasion or other unanticipated threats that cannot be completely eliminated by management actions.
Confidence in result – risk of loss	90%	A 90% confidence reflects that there is a high degree of confidence that implementing a conservation covenant over the proposed offset site will limit the risk of loss to 1% over the 20-year time horizon. There is a high degree of confidence that the landowner will have the support and advice in place to comply with the covenant.
Time until ecological benefit	8 years	This timeframe is normally set at 10 years from the time of impact, to allow time for management actions to be implemented and for a measurable improvement in habitat quality to be achieved. However, Stockyard Hill is being established as an advanced offset. It is likely to receive the benefit of 2 years of intensive management prior to construction of M3R, which is expected in mid-2025. It is therefore reasonable to expect that the ecological benefit will be achieved within 8 years of the impact occurring, rather than the usual 10 years.

Parameter	Input	Justification for input
Start quality (/10)	6 and 1	Biosis assessed the quality of the NTGVVP at Stockyard Hill in January/February 2022 using the habitat hectares method (DSE 2004). The quality score of the NTGVVP was 63.33/100, which rounds to 6/10. The quality score is currently being re-assessed as part of baseline monitoring for the advanced offset site and is expected to be slightly reduced due to increased weed cover (the result of an unusually wet spring and early summer in 2022). The weighted average start quality score is not expected to be below 60/100, meaning that the rounded score would ultimately not be affected. Areas of Plains Grassland that did not meet the condition thresholds for NTGVVP (i.e. areas of possible future NTGVVP) were assigned a landscape context score only, rather than a landscape context score and site condition score. It is inappropriate to assign a site condition score to vegetation that does not meet the basic condition thresholds for the threatened community. Doing so would allow for grassland patches that do not meet the community's condition thresholds to score just as highly (and possibly more highly) than grassland patches that are recognisable as the community. This is because the habitat hectares method is designed to assess the value of native vegetation as habitat, rather than its value as or contribution to a threatened ecological community. Nevertheless, it is a useful proxy for assessing the quality of a community when applied with caution. The listing advice for NTGVVP states that EVC benchmarks do not equate directly with the condition thresholds for the community but that a patch of grassland that met the relevant EVC benchmark would likely meet the condition thresholds for the community (TSSC 2008). Without the site condition score applied, the weighted average start quality of these areas of Plains Grassland was a nominal 8.37/100, which rounds to 1/10. This score is based on the weighted average landscape context score, which was 8.37/25. The score is relatively low because many of these patches of native vegetation are small and isolated (although they still meet the size thresholds for NTGVVP). The score acknowledges the fact that these areas hold an inherent value as possible future NTGVVP.
Future quality without offset (/10)	5 and 1	Without the proposed offset site, it is anticipated that existing threats, such as weed infestations and pest animal species, will contribute to a decline in the quality of existing NTGVVP at Stockyard Hill. Assuming current management obligations, management practices and land uses continue at the site, weed cover is likely to increase (leading to a potential weighted quality loss of 2/100), biomass may accumulate and smother the ground layer (a potential weighted quality loss of 2.5/100), which in turn would restrict the recruitment area available (a potential weighted quality loss of 1.5 to 9.5/100). Increased weed cover is also likely to displace understorey life forms (a potential weighted quality loss of 2.5/100). Such declines have been noted at similar vegetation types in the region and would reduce the weighted average quality score of the NTGVVP to around 50/100, which rounds to 5/10. Such a score is common for NTGVVP in highly modified grassland systems. Without the proposed offset site and its associated protection and management, the remaining patches of Plains Grassland will continue to fall short of NTGVVP condition thresholds and will therefore continue to score 1 out of 10.
Future quality with offset (/10)	7 and 5	It is anticipated that through intensive control of weeds, pest animals and biomass as part of implementation of the OMP, the weighted average quality score for existing NTGVVP would be elevated from around 60/100 to approximately 70/100, which would round to 7/10. Implementation of the OMP is expected to reduce total weed cover (a potential weighted quality improvement of 2/100), which is likely to increase inter- tussock space, total recruitment area (a potential weighted quality improvement of 4/100) and understorey life form diversity (a potential weighted quality improvement of 4/100). It is also anticipated that the patches of Plains Grassland that do not currently meet NTGVVP condition thresholds will improve to the point that they do meet the condition thresholds and therefore register a site condition score (in addition to their nominal landscape context score). A score of 5 out of 10 is common for NTGVVP in highly modified grassland systems and is the current weighted average quality score of NTGVVP at the impact site.
Confidence in result – future quality	90%	An 90% confidence in the result reflects that there is a high level of confidence that the landowner will be able to bring about moderate improvements in quality over a 10-year period, albeit through intensive weed management and pest animal control. There is nevertheless a small level of uncertainty about the successful achievement of increasing the quality of existing NTGVVP by 1 point and bringing remaining Plains Grassland up to NTGVVP condition thresholds.
Net present value (adjusted hectares)	28.54 and 1.16	This value is set by the Offset Assessment Guide. The value of the offset in hectares is adjusted to take into account the risks associated with the offset site and the fact that the full benefits of the offset will be realised after the impact occurs (even in most cases of advanced offsets).
% of impact offset	63.08% and 2.57%	This value is calculated automatically by the Offset Assessment Guide and represents the degree to which the offset (expressed in adjusted hectares) compensates for the total quantum of impact (also expressed in adjusted hectares).

Table E3.A.12
Offset calculations for Stockyard Hill NTGVVP offset site (current NTGVVP)

Matter of National Environmental Significance	
Name	Natural Temperate Grassland
EPBC Act status	Critically Endangered
Annual probability of extinction Based on IUCN category definitions	6.8%

Impact calculator						
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Ecological communities						
Area of community	Yes	Impact area: 90.49 ha of Natural Temperate Grassland with weighted average quality score of 47.24/100.	Area	90.49	Hectares	
			Quality	5	Scale 0-10	
			Total quantum of impact	45.25	Adjusted hectares	
Threatened species habitat						
Area of habitat	No		Area			
			Quality			
			Total quantum of impact	0.00		
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/ animals	No					

Offset calculator

Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start area and quality	
Ecological Communities								
Area of community	Yes	45.25	Adjusted hectares	Offset site: third party offset at Stockyard Hill, comprising 257.30 ha of Natural Temperate Grassland with a weighted average start quality score of 63.33/100.	Risk-related time horizon (max. 20 years)	20	Start area (hectares)	257.3
					Time until ecological benefit	8	Start quality (scale of 0-10)	6
Threatened species habitat								
Area of habitat	No				Time over which loss is averted (max. 20 years)		Start area (hectares)	
					Time until ecological benefit		Start quality (scale of 0-10)	
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**	
Number of features e.g. Nest hollows, habitat trees	No							
Condition of habitat Change in habitat condition, but no change in extent	No							
Threatened species								
Birth rate e.g. Change in nest success	No							
Mortality rate e.g Change in number of road kills per year	No							
Number of individuals e.g. Individual plants/animals	No							

Offset calculator (cont.)						
Protected matter attributes	**Future area and quality without offset**		**Future area and quality with offset**		**Raw gain**	**Confidence in result (%)**
Ecological Communities (cont.)						
Area of community	Risk of loss (%) without offset	10%	Risk of loss (%) with offset	1%	23.16	90%
	Future area without offset (adjusted hectares)	231.6	Future area with offset (adjusted hectares)	254.7		
	Future quality without offset (scale of 0-10)	5	Future quality with offset (scale of 0-10)	7	2.00	90%
Threatened species habitat (cont.)						
Area of habitat	Risk of loss (%) without offset		Risk of loss (%) with offset			
	Future area without offset (adjusted hectares)	0.0	Future area with offset (adjusted hectares)	0.0		
	Future quality without offset (scale of 0-10)		Future quality with offset (scale of 0-10)			
Protected matter attributes	**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species (cont.)						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/ animals	No					

Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
20.84	5.59				
	28.54	63.08%	No		
1.8	1.06				

Adjusted gain	Net present value	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source

Table E3.A.13
Offset calculations for Stockyard Hill NTGVVP offset site (future NTGVVP)

Matter of National Environmental Significance	
Name	Natural Temperate Grassland
EPBC Act status	Critically Endangered
Annual probability of extinction Based on IUCN category definitions	6.8%

Impact calculator						
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Ecological communities						
Area of community	Yes	Impact area: 90.49 ha of Natural Temperate Grassland with weighted average quality score of 47.24/100.	Area	90.49	Hectares	
			Quality	5	Scale 0-10	
			Total quantum of impact	45.25	Adjusted hectares	
Threatened species habitat						
Area of habitat	No		Area			
			Quality			
			Total quantum of impact	0.00		
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/ animals	No					

Offset calculator								
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start area and quality**	
Ecological Communities								
Area of community	Yes	45.25	Adjusted hectares	Offset site: third party offset at Stockyard Hill, comprising 5.60 ha of Plains Grassland (future Natural Temperate Grassland)with a weighted average start quality score of 8.37/100.	Risk-related time horizon (max. 20 years)	0	Start area (hectares)	5.6
					Time until ecological benefit	8	Start quality (scale of 0-10)	1
Threatened species habitat								
Area of habitat	No				Time over which loss is averted (max. 20 years)		Start area (hectares)	
					Time until ecological benefit		Start quality (scale of 0-10)	
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	Proposed offset	**Time horizon (years)**		**Start value**	
Number of features e.g. Nest hollows, habitat trees	No							
Condition of habitat Change in habitat condition, but no change in extent	No							
Threatened species								
Birth rate e.g. Change in nest success	No							
Mortality rate e.g Change in number of road kills per year	No							
Number of individuals e.g. Individual plants/animals	No							

Offset calculator (cont.)						
Protected matter attributes	**Future area and quality without offset**		**Future area and quality with offset**		**Raw gain**	**Confidence in result (%)**
Ecological Communities (cont.)						
Area of community	Risk of loss (%) without offset	0%	Risk of loss (%) with offset	1%	-0.06	100%
	Future area without offset (adjusted hectares)	5.6	Future area with offset (adjusted hectares)	5.5		
	Future quality without offset (scale of 0-10)	1	Future quality with offset (scale of 0-10)	5	4.00	90%
Threatened species habitat (cont.)						
Area of habitat	Risk of loss (%) without offset		Risk of loss (%) with offset			
	Future area without offset (adjusted hectares)	0.0	Future area with offset (adjusted hectares)	0.0		
	Future quality without offset (scale of 0-10)		Future quality with offset (scale of 0-10)			
Protected matter attributes	**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species (cont.)						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/ animals	No					

	Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
	-0.06	-0.06				
		1.16	2.57%	No		
	4.00	2.13				

	Adjusted gain	Net present value	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source

Residual offset requirements

The first party offset site at Arundel Road and third party offset site at Stockyard Hill would collectively meet 69.85% of the NTGVVP offset requirements for M3R.

The residual offset requirements could be met by securing and managing approximately 138 hectares of existing NTGVVP in perpetuity, at a site with similar characteristics (i.e. same risk of loss, start quality and future quality) as the existing NTGVVP at Stockyard Hill. The required area would be less if the offset site was established in advance of the impact occurring and there was sufficient information to demonstrate that an ecological benefit had already materialised (DoEE 2017). Offset calculations for the residual offset requirement are presented in Table E3.A.14.

Table E3.A.14
Offset calculations for residual NTGVVP offset requirements

Matter of National Environmental Significance	
Name	Natural Temperate Grassland
EPBC Act status	Critically Endangered
Annual probability of extinction Based on IUCN category definitions	6.8%

Impact calculator						
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Ecological communities						
Area of community	Yes	Impact area: 90.49 ha of Natural Temperate Grassland with weighted average quality score of 47.24/100.	Area	90.49	Hectares	
			Quality	5	Scale 0-10	
			Total quantum of impact	45.25	Adjusted hectares	
Threatened species habitat						
Area of habitat	No		Area			
			Quality			
			Total quantum of impact	0.00		
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					

Impact calculator					
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**	**Units**	**Information source**
Threatened species					
Birth rate e.g. Change in nest success	No				
Mortality rate e.g Change in number of road kills per year	No				
Number of individuals e.g. Individual plants/ animals	No				

Offset calculator								
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start area and quality**	
Ecological Communities								
Area of community	Yes	45.25	Adjusted hectares	Offset site: hypothetical offset to meet residual offset requirements for Natural Temperate Grassland.	Risk-related time horizon (max. 20 years)	20	Start area (hectares)	1.38
					Time until ecological benefit	10	Start quality (scale of 0-10)	6
Threatened species habitat								
Area of habitat	No				Time over which loss is averted (max. 20 years)		Start area (hectares)	
					Time until ecological benefit		Start quality (scale of 0-10)	
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	Proposed offset	**Time horizon (years)**		**Start value**	
Number of features e.g. Nest hollows, habitat trees	No							
Condition of habitat Change in habitat condition, but no change in extent	No							
Threatened species								
Birth rate e.g. Change in nest success	No							
Mortality rate e.g Change in number of road kills per year	No							
Number of individuals e.g. Individual plants/animals	No							

Offset calculator (cont.)

Protected matter attributes	Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)
Ecological Communities (cont.)						
Area of community	Risk of loss (%) without offset	10%	Risk of loss (%) with offset	1%	12.42	90%
	Future area without offset (adjusted hectares)	124.2	Future area with offset (adjusted hectares)	136.6		
	Future quality without offset (scale of 0-10)	5	Future quality with offset (scale of 0-10)	7	2.00	90%
Threatened species habitat (cont.)						
Area of habitat	Risk of loss (%) without offset		Risk of loss (%) with offset			
	Future area without offset (adjusted hectares)	0.0	Future area with offset (adjusted hectares)	0.0		
	Future quality without offset (scale of 0-10)		Future quality with offset (scale of 0-10)			

Protected matter attributes	Future value without offset	Future value with offset	Raw gain	Confidence in result (%)
Number of features e.g. Nest hollows, habitat trees				
Condition of habitat Change in habitat condition, but no change in extent				
Threatened species (cont.)				
Birth rate e.g. Change in nest success				
Mortality rate e.g Change in number of road kills per year				
Number of individuals e.g. Individual plants/ animals				

Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
11.18	3.00				
	13.68	30.23%	No		
1.80	0.93				

Adjusted gain	Net present value	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source

Golden Sun Moth

The M3R impact area includes 9.75 hectares of occupied Golden Sun Moth habitat. The same Golden Sun Moth habitat scoring system, as documented in the M3R Ecology Technical Report (Biosis 2021), has been applied consistently at the impact and offset sites.

First party offsets

No first party offsets for Golden Sun Moth are proposed.

Third party offsets

More than half (161.41 hectares) of the 262.51 hectares of Plains Grassland at Stockyard Hill is suitable habitat for Golden Sun Moth, based on abundance of known food plants for the species, aspect and micro-topography, and their previously recorded survey presence at this site. This has the potential to provide 347.91% of M3R's offset requirement for Golden Sun Moth. The offset assessment guide inputs are outlined in Table E3.A.15, and the offset calculations in Table E3.A.16.

Table E3.A.15
Offset assessment guide inputs for Stockyard Hill Golden Sun Moth offset site

Parameter	Input	Justification for input
Time over which loss is averted	20 years	The Advanced OMP will require active conservation management (and improvements) for the first 10 years, after which the offset area is to be managed and maintained as a conservation area in perpetuity. However, 20 years is the maximum value that can be entered into the Offsets Assessment Guide.
Start area	161.41	Stockyard Hill supports 161.41 hectares of suitable Golden Sun Moth habitat. Suitable habitat was mapped in December 2022, based on abundance of known food plants for the species, aspect and micro-topography. However, the area of this habitat that is occupied by Golden Sun Moth still requires confirmation through targeted surveys for the species. The final area of occupied habitat may be less than 161.41 hectares.
Risk of loss (%) without offset	10%	Most of the suitable habitat for Golden Sun Moth at Stockyard Hill corresponds with NTGVVP at the site, which has a risk of loss of 10% without protection as an offset site. The risk of loss of Golden Sun Moth habitat from Stockyard Hill is therefore likely to be the same i.e. 10%. Without protection as an offset site, continued agricultural land use could lead to the incremental and ultimate loss of suitable habitat from the site. Biosis has previously determined, in consultation with DCCEEW, that a risk of loss of 10% is appropriate for Golden Sun Moth habitat in this context and location.
Risk of loss (%) with offset	1%	The offset site will be protected by an appropriate security mechanism, such as a conservation covenant, and managed in perpetuity. With the security mechanism and management in place, the risk of loss of the offset site would reduce from low (10%) to very low (1%). Risk of loss would not be 0% because this would imply absolute certainty, which is not possible to achieve. Possible ongoing sources of risk of loss to the offset area include anthropogenic climate change, new human-mediated disease or pest invasion or other unanticipated threats that cannot be completely eliminated by management actions.
Confidence in result – risk of loss	90%	A 90% confidence reflects that there is a high degree of confidence that implementing a conservation covenant over the proposed offset site will limit the risk of loss to 1% over the 20-year time horizon. There is a high degree of confidence that the landowner will have the support and advice in place to comply with the covenant.
Time until ecological benefit	10 years	A measurable improvement in habitat quality will be achieved after 10 years of management in accordance with the OMP (although the improvement may not register once rounding has occurred, as explained below).
Start quality (/10)	6	For the purposes of offset calculations, it has been assumed that all 161.41 hectares of suitable Golden Sun Moth habitat at Stockyard Hill is occupied by the species but at a low stocking rate (around 1 male per hectare). It has also been assumed that the suitable habitat has an average of 20-40% cover of known food plants (in this case, Wallaby Grasses and Spear Grasses), although it is likely to be at the lower end of this range. These assumptions are based on incidental observations made during NTGVVP mapping and quality assessments in January 2022. Area of occupancy and species stocking rate will need to be confirmed through targeted surveys for the species. The cover of known food plants is currently being determined through baseline vegetation monitoring transects, which are expected to be completed in January 2023. If these assumptions are correct and the same habitat quality scoring system that was used at the impact site is used at the offset site, the start quality of the Golden Sun Moth habitat at Stockyard Hill is likely to be 6/10. This is made up of a site condition score of 2/3 (20-40% cover of known food plants), site context score of 3/3 (habitat patch greater than 10 hectares) and a species stocking rate of 1/4 (up to 5 males per hectare).

Parameter	Input	Justification for input
Future quality without offset (/10)	5	Without the proposed offset site, it is anticipated that existing threats, such as weed infestations and pest animal species, will contribute to a decline in the quality of existing NTGVVP at Stockyard Hill. Assuming current management obligations, management practices and land uses continue at the site, weed cover is likely to increase and biomass may accumulate, reducing inter-tussock space and ultimately reducing the cover of known food plants. The average cover of Wallaby Grasses and Spear Grasses would likely drop below 20%, meaning the site condition score would decrease from 2/3 to 1/3. The declines would reduce the quality score to 5/10.
Future quality with offset (/10)	6	It is anticipated that through intensive control of weeds, pest animals and biomass as part of implementation of the OMP, the cover of known food plants would increase at the offset site and the Golden Sun Moth habitat is therefore likely to improve. However, it is unlikely that the cover of known food plants would increase beyond 40% or translate into an increases stocking rate of more than 5 males per hectare. As a result, despite the likely improvements to the Golden Sun Moth habitat, they are unlikely to register as an improved score.
Confidence in result – future quality	90%	There is a high level of confidence that the landowner and future landowners would have the support, guidance and resources to intensively manage the Golden Sun Moth habitat at Stockyard Hill. There is a high level of confidence that implementation of the actions listed above would result in no loss in the quality of the offset site.
Net present value (adjusted hectares)	20.35	This value is set by the Offset Assessment Guide. The value of the offset in hectares is adjusted to take into account the risks associated with the offset site and the fact that the full benefits of the offset will be realised after the impact occurs (even in most cases of advanced offsets).
% of impact offset	347.91%	This value is calculated automatically by the Offset Assessment Guide and represents the degree to which the offset (expressed in adjusted hectares) compensates for the total quantum of impact (also expressed in adjusted hectares).

Table E3.A.16
Offset calculations for Stockyard Hill Golden Sun Moth offset site

Matter of National Environmental Significance	
Name	Golden Sun Moth
EPBC Act status	Vulnerable
Annual probability of extinction Based on IUCN category definitions	0.2%

Impact calculator						
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Ecological communities						
Area of community	No		Area			
			Quality			
			Total quantum of impact	0.00		
Threatened species habitat						
Area of habitat	Yes	Impact area: 9.75 ha of occupied Golden Sun Moth habitat with quality score of 6/10 (site condition of 2/3, site context of 3/3 and stocking rate of 1/4).	Area	9.75	Hectares	
			Quality	6	Scale 0-10	
			Total quantum of impact	5.85	Adjusted hectares	
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/ animals	No					

Offset calculator

Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start area and quality	
Ecological Communities								
Area of community	No				Risk-related time horizon (max. 20 years)		Start area (hectares)	
					Time until ecological benefit		Start quality (scale of 0-10)	
Threatened species habitat								
Area of habitat	Yes	5.85	Adjusted hectares	Offset site: third party offset at Stockyard Hill, comprising 161.41 ha of potential Golden Sun Moth habitat with a start quality score of 6/10 (site condition of 2/3, site context of 3/3 and stocking rate of 1/4).	Time over which loss is averted (max. 20 years)	20	Start area (hectares)	161.41
					Time until ecological benefit	10	Start quality (scale of 0-10)	6
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**	
Number of features e.g. Nest hollows, habitat trees	No							
Condition of habitat Change in habitat condition, but no change in extent	No							
Threatened species								
Birth rate e.g. Change in nest success	No							
Mortality rate e.g Change in number of road kills per year	No							
Number of individuals e.g. Individual plants/animals	No							

Offset calculator (cont.)						
Protected matter attributes	**Future area and quality without offset**		**Future area and quality with offset**		**Raw gain**	**Confidence in result (%)**
Ecological Communities (cont.)						
Area of community	Risk of loss (%) without offset		Risk of loss (%) with offset			
	Future area without offset (adjusted hectares)	0.0	Future area with offset (adjusted hectares)	0.0		
	Future quality without offset (scale of 0-10)		Future quality with offset (scale of 0-10)			
Threatened species habitat (cont.)						
Area of habitat	Risk of loss (%) without offset	10%	Risk of loss (%) with offset	1%	14.53	90%
	Future area without offset (adjusted hectares)	145.3	Future area with offset (adjusted hectares)	159.8		
	Future quality without offset (scale of 0-10)	5	Future quality with offset (scale of 0-10)	6	1.00	90%
Protected matter attributes	**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**
Number of features e.g. Nest hollows, habitat trees						
Condition of habitat Change in habitat condition, but no change in extent						
Threatened species (cont.)						
Birth rate e.g. Change in nest success						
Mortality rate e.g Change in number of road kills per year						
Number of individuals e.g. Individual plants/ animals						

Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
13.07	12.56				
	20.35	347.91%	Yes		
0.90	0.88				

Adjusted gain	Net present value	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source

Residual offset requirements

There are unlikely to be any residual offset requirements for Golden Sun Moth, assuming area and quality estimates for Golden Sun Moth habitat at Stockyard Hill are reasonably accurate.

Growling Grass Frog

The M3R impact area includes 64.34 hectares of occupied Growling Grass Frog habitat, split over the following habitat types:

- 4.05 hectares of breeding habitat (6.30% of impact)
- 3.22 hectares of aquatic habitat (5.00% of impact)
- 57.08 hectares of terrestrial habitat (88.70% of impact).

The EPBC Act Environmental Offsets Policy (DSEWPaC 2012a) requires that an offset be tailored specifically to the attribute of the protected matter that is impacted (the so-called 'like for like' principle). In the context of Growling Grass Frog, this means that breeding/aquatic habitat must be offset with breeding/aquatic habitat, not terrestrial habitat. Overall, offsets for Growling Grass Frog would need to comprise at least 11.30% breeding/aquatic habitat because 11.30% of the impact at Melbourne Airport is on breeding/aquatic habitat.

The same Growling Grass Frog habitat scoring system, as documented in the M3R Ecology Technical Report (Biosis 2021), has been applied consistently at the impact and first party offset sites. The scoring system for one of the proposed third party Growling Grass Frog offset sites (the portion of Brady Swamp owned by Doug Craig) differs slightly and was applied by a different consultant (WSP 2020). Biosis understands that WSP's (2020) scoring system has been accepted by DCCEEW. Therefore, WSP's (2020) scoring system has also been applied to the other third party Growling Grass Frog offset site (the portion of Brady Swamp under different ownership) and to the calculation of residual offset requirements.

First party offsets

Two Growling Grass Frog habitat corridors, one along Deep Creek and the Maribyrnong River, and another along Moonee Ponds Creek, have potential to be protected and managed in perpetuity as first party Growling Grass Frog offset sites.

Growling Grass Frog habitat along Deep Creek and the Maribyrnong River was mapped as part of the M3R impact assessments. The Deep Creek and Maribyrnong River offset site would include approximately 62.32 hectares of Growling Grass Frog habitat, of which 14.10 hectares (22.63%) would be breeding/aquatic habitat. This means that the offset site would meet the requirement for at least 11.30% breeding/aquatic habitat (the 'like for like' threshold).

Growling Grass Frog habitat along Moonee Ponds Creek has not been mapped in detail. For the purposes of offset calculations, it was assumed that a 100-metre wide corridor along Moonee Ponds Creek would be habitat for Growling Grass Frog, excluding areas within the Sunbury Road road reserve and proposed future development areas. Based on this assumption, the Moonee Ponds Creek offset site would provide approximately 28.62 hectares of Growling Grass Frog habitat. However, it is yet to be verified the proportion of this offset site that would be breeding/aquatic habitat.

These first party offset sites would occupy most of Melbourne Airport's creek/river frontages along Deep Creek, the Maribyrnong River and Moonee Ponds Creek. Further on-ground site assessment is proposed to determine the precise areas of the offset sites. The site assessment would confirm appropriate boundaries for the offset sites and, in the case of Moonee Ponds Creek, how much breeding/aquatic habitat is present. The first party offset site further assessment will also consider hydrology to determine whether suitable off-line wetlands could be constructed to improve Growling Grass Frog habitat. These further studies would inform the OMP to be prepared for the sites.

For the purposes of offset calculations, it was assumed that 62.32 hectares of the Deep Creek and Maribyrnong River corridor and 28.62 hectares of the Moonee Ponds Creek corridor would be available as first party offset sites. Note that only land controlled by APAM will be eligible for inclusion. Based on these assumptions, Deep Creek and Maribyrnong River are likely to provide 8.68% of M3R's offset requirements for Growling Grass Frog and Moonee Ponds Creek has potential to provide 3.99% of M3R's offset requirements for Growling Grass Frog.

The offset assessment guide inputs for the Deep Creek, Maribyrnong River and Moonee Ponds Creek offset sites are outlined in Table E3.A.17, and the offset calculations in Table E3.A.18 (Deep Creek and Maribyrnong River) and Table E3.A.19 (Moonee Ponds Creek).

Table E3.A.17
Offset assessment guide inputs for Deep Creek, Maribyrnong River and Moonee Ponds Creek Growling Grass Frog offset sites

Parameter	Input	Justification for input
Time over which loss is averted	20 years	The Offset Management Plan (OMP) will require active conservation management (and improvements) for 50 years, after which the offset area is to be managed and maintained as a conservation area in perpetuity. However, 20 years is the maximum value that can be entered into the Offsets Assessment Guide.
Start area	62.32 and 28.62	For the purposes of offset calculations, it was assumed that 62.32 hectares of the Deep Creek and Maribyrnong River corridor and 28.62 hectares of the Moonee Ponds Creek corridor would be available as first party offset sites. Further on-ground site assessment is needed to determine the appropriate boundaries of the offset sites and therefore determine the precise offset areas.
Risk of loss (%) without offset	1%	Unlike first order streams, drainage lines and tributaries, such as Arundel Creek, the risk of loss of a major waterway, such as Deep Creek, Moonee Ponds Creek or the Maribyrnong River, is likely to be very low (1%), even without protection as an offset site. At this location, these major waterways are unlikely to be developed or channelised in the next 20 years. There may be a slightly elevated risk to the terrestrial riparian habitat but, given the location and topography, this risk is still considered to be very low.
Risk of loss (%) with offset	1%	Risk of loss is unlikely to change, despite the added protection as an offset site. The risk of loss is still likely to be very low (1%), but not negligible. Risk of loss would not be 0% because this would imply absolute certainty, which is not possible to achieve. Possible ongoing sources of risk of loss to the offset area include anthropogenic climate change, hydrological changes across the broader landscape, new human-mediated disease or other unanticipated threats that cannot be completely eliminated by management actions.
Confidence in result – risk of loss	90%	A 90% confidence reflects that there is a high degree of confidence that there would be a very low (1%) risk of loss of the Growling Grass Frog habitat, with or without an offset in place.
Time until ecological benefit	50 years	This timeframe is normally set at 10 years from the time of impact, to allow time for management actions to be implemented and for a measurable improvement in habitat quality to be achieved. However, the start quality of the offset sites is high and unlikely to be readily improved (subject to opportunities for wetland creation, as discussed below). Offset management will focus on maintaining the current quality of the offset sites and avoiding a decline in quality. Without an offset, a decline in quality is unlikely in the short- to medium- term (10 years) but likely to materialise in the long-term (50 years).
Start quality (/10)	9 and 7	Biosis assessed the quality of the Growling Grass Frog habitat along Deep Creek and the Maribyrnong River in February 2019. The habitat was assigned a score of 9/10 on the basis of its site condition, site context and species stocking rate. Deep Creek and the Maribyrnong River scored 4/5 for site condition because they are permanent, occupied waterbodies with less than 20% cover of aquatic vegetation on average. With greater than 20% aquatic vegetation cover, the waterways would have scored 5/5 for site condition. They scored 3/3 for site context because they are occupied waterbodies or streams. They scored 2/2 for stocking rate because there was evidence of a breeding population of Growling Grass Frog being present. The start score of the Moonee Ponds Creek habitat is likely to be 7/10 on the basis of its site condition, site context and species stocking rate. Its site condition is likely to be 2/5 because it is a semi-permanent waterbody with less than 20% cover of aquatic vegetation on average. Moonee Ponds Creek has historically been known as Moonee Moonee Chain of Ponds, which is a reference to its hydroperiod. It regularly dries out, leaving pools of water in deeper sections of the creek. Despite its semi-permanent nature, Moonee Ponds Creek is likely to score 3/3 for connectivity because its chain of ponds is either occupied by Growling Grass Frog (which would need to be confirmed through targeted surveys) or within 200 metres of known occupied waterbodies. While Growling Grass has not been recorded from Moonee Ponds Creek itself (along the section that coincides with Melbourne Airport land), it has been recorded at the edge of waterbodies within 60 metres of the creek. Moonee Ponds Creek would therefore likely score 1/2 for stocking rate, because the species is likely to occupy the creek but there is no evidence that the creek is used for breeding.
Future quality without offset (/10)	8 and 6	Without the proposed offset site, it is anticipated that existing threats, such as pest animal species (e.g. predatory fish), disease (e.g. chytrid fungus), water pollution and weed infestations, will contribute to a decline in the quality of Growling Grass Frog habitat in the long-term (50 years). The decline might materialise as a loss of aquatic vegetation cover, fragmentation of the Growling Grass Frog habitat and/or loss of suitable breeding habitat (or the ability to reproduce at the site). This is likely to correspond to a 1-point decline in the habitat quality at each site.

Parameter	Input	Justification for input
Future quality with offset (/10)	9 and 7	Due to the connected nature of the offset sites, with influences from upstream and from the opposite streambanks (which APAM does not control), some of the existing threats to Growling Grass Frog at the sites will be challenging to manage. For example, APAM will be able to control the incursion of predatory fish from tributaries or drainage channels emanating from Melbourne Airport but is unlikely to be able to control the incursion of predatory fish from third parties upstream or on the opposite side of the creeks/river. The management that APAM does provide, intensively over the first 50 years and then ongoing maintenance in perpetuity, is likely to be able to arrest the decline in habitat quality. No improvement to Growling Grass Frog habitat is likely, unless APAM can establish off-line wetlands within the first party offset sites and the wetlands were constructed to the Growling Grass Frog Habitat Design Standards (DELWP 2017). Such wetlands are likely to improve the site condition score at the Deep Creek and Maribyrnong River site by 1/10, by providing waterbodies with greater aquatic plant cover and waterbodies that can be more readily managed and controlled. A water source for these wetlands would need to be assured. Note that such wetlands are unlikely to be suitable at the Moonee Ponds Creek site because construction of the wetlands would require removal of occupied Golden Sun Moth habitat. For the purposes of offset calculations, Biosis has assumed that no wetlands would be constructed and that the future quality of the Growling Grass Frog habitat would be maintained rather than improved.
Confidence in result – future quality	90%	An 90% confidence in the result reflects that there is a high level of confidence that APAM and/or future airport lessees would be able to maintain the quality of the Growling Grass Frog habitat along Deep Creek, the Maribyrnong River and Moonee Ponds Creek in perpetuity.
Net present value (adjusted hectares)	5.02 and 2.31	This value is set by the Offset Assessment Guide. The value of the offset in hectares is adjusted to take into account the risks associated with the offset site and the fact that the full benefits of the offset will be realised after the impact occurs (even in most cases of advanced offsets).
% of impact offset	8.68% and 3.99%	This value is calculated automatically by the Offset Assessment Guide and represents the degree to which the offset (expressed in adjusted hectares) compensates for the total quantum of impact (also expressed in adjusted hectares).

Table E3.A.18
Offset calculations for Deep Creek and Maribyrnong River Growling Grass Frog offset site

Matter of National Environmental Significance	
Name	Growling Grass Frog
EPBC Act status	Vulnerable
Annual probability of extinction Based on IUCN category definitions	0.2%

Impact calculator						
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Ecological communities						
Area of community	No		Area		Hectares	
			Quality		Scale 0-10	
			Total quantum of impact	0.00	Adjusted hectares	
Threatened species habitat						
Area of habitat	Yes	Impact area: 64.34 ha of occupied Growling Grass Frog habitat with quality score of 9/10 (site condition of 4/5, site context of 3/3 and stocking rate of 2/2).	Area	64.34	Hectares	
			Quality	9	Scale 0-10	
			Total quantum of impact	57.91	Adjusted hectares	
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/ animals	No					

Offset calculator								
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start area and quality**	
Ecological Communities								
Area of community	No				Risk-related time horizon (max. 20 years)		Start area (hectares)	
					Time until ecological benefit		Start quality (scale of 0-10)	
Threatened species habitat								
Area of habitat	Yes	57.91	Adjusted hectares	Offset site: first party offset areas along Deep Ck and Maribyrnong R, comprising 30.44 ha of occupied Growling Grass Frog habitat with a start quality score of 9/10 (site condition of 4/5, site context of 3/3 and stocking rate of 2/2).	Time over which loss is averted (max. 20 years)	20	Start area (hectares)	62.32
					Time until ecological benefit	50	Start quality (scale of 0-10)	9
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**	
Number of features e.g. Nest hollows, habitat trees	No							
Condition of habitat Change in habitat condition, but no change in extent	No							
Threatened species								
Birth rate e.g. Change in nest success	No							
Mortality rate e.g Change in number of road kills per year	No							
Number of individuals e.g. Individual plants/animals								

Offset calculator (cont.)

Protected matter attributes	Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)
Ecological Communities (cont.)						
Area of community	Risk of loss (%) without offset		Risk of loss (%) with offset			
	Future area without offset (adjusted hectares)	0.0	Future area with offset (adjusted hectares)	0.0		
	Future quality without offset (scale of 0-10)		Future quality with offset (scale of 0-10)			
Threatened species habitat (cont.)						
Area of habitat	Risk of loss (%) without offset	1%	Risk of loss (%) with offset	1%	0.00	90%
	Future area without offset (adjusted hectares)	61.7	Future area with offset (adjusted hectares)	61.7		
	Future quality without offset (scale of 0-10)	8	Future quality with offset (scale of 0-10)	9	1.00	90%

Protected matter attributes	Future value without offset	Future value with offset	Raw gain	Confidence in result (%)
Number of features e.g. Nest hollows, habitat trees				
Condition of habitat Change in habitat condition, but no change in extent				
Threatened species (cont.)				
Birth rate e.g. Change in nest success				
Mortality rate e.g Change in number of road kills per year				
Number of individuals e.g. Individual plants/ animals				

Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
0.00	0.00				
	5.02	8.68%	No		
0.90	0.90				

Adjusted gain	Net present value	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source

Table E3.A.19
Offset calculations for Moonee Ponds Creek Growling Grass Frog offset site

Matter of National Environmental Significance	
Name	Growling Grass Frog
EPBC Act status	Vulnerable
Annual probability of extinction Based on IUCN category definitions	0.2%

Impact calculator						
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Ecological communities						
Area of community	No		Area			
			Quality			
			Total quantum of impact	0.00		
Threatened species habitat						
Area of habitat	Yes	Impact area: 64.34 ha of occupied Growling Grass Frog habitat with quality score of 9/10 (site condition of 4/5, site context of 3/3 and stocking rate of 2/2	Area	64.34	Hectares	
			Quality	9	Scale 0-10	
			Total quantum of impact	57.91	Adjusted hectares	

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact	Units	Information source
Number of features e.g. Nest hollows, habitat trees	No				
Condition of habitat Change in habitat condition, but no change in extent	No				
Threatened species					
Birth rate e.g. Change in nest success	No				
Mortality rate e.g Change in number of road kills per year	No				
Number of individuals e.g. Individual plants/ animals	No				

Offset calculator								
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start area and quality**	
Ecological Communities								
Area of community	No				Risk-related time horizon (max. 20 years)		Start area (hectares)	
					Time until ecological benefit		Start quality (scale of 0-10)	
Threatened species habitat								
Area of habitat	Yes	57.91	Adjusted hectares	Offset site: first party offset area along Moonee Ponds Ck, comprising 11.73 ha of likely occupied Growling Grass Frog habitat with a start quality score of 7/10 (site condition of 2/5, site context of 3/3 and stocking rate of 2/2).	Time over which loss is averted (max. 20 years)	20	Start area (hectares)	28.62
					Time until ecological benefit	50	Start quality (scale of 0-10)	7
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**	
Number of features e.g. Nest hollows, habitat trees	No							
Condition of habitat Change in habitat condition, but no change in extent	No							
Threatened species								
Birth rate e.g. Change in nest success	No							
Mortality rate e.g Change in number of road kills per year	No							
Number of individuals e.g. Individual plants/animals	No							

Offset calculator (cont.)

Protected matter attributes	Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)
Ecological Communities (cont.)						
Area of community	Risk of loss (%) without offset		Risk of loss (%) with offset			
	Future area without offset (adjusted hectares)	0.0	Future area with offset (adjusted hectares)	0.0		
	Future quality without offset (scale of 0-10)		Future quality with offset (scale of 0-10)			
Threatened species habitat (cont.)						
Area of habitat	Risk of loss (%) without offset	1%	Risk of loss (%) with offset	1%	0.00	90%
	Future area without offset (adjusted hectares)	28.3	Future area with offset (adjusted hectares)	28.3		
	Future quality without offset (scale of 0-10)	6	Future quality with offset (scale of 0-10)	7	1.00	90%

Protected matter attributes	Future value without offset	Future value with offset	Raw gain	Confidence in result (%)
Number of features e.g. Nest hollows, habitat trees				
Condition of habitat Change in habitat condition, but no change in extent				
Threatened species (cont.)				
Birth rate e.g. Change in nest success				
Mortality rate e.g Change in number of road kills per year				
Number of individuals e.g. Individual plants/ animals				

Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
0.00	0.00				
	2.31	3.99%	No		
0.90	0.81				

Adjusted gain	Net present value	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source

Third party offsets

APAM is in discussion with two landowners to secure approximately 200 hectares of occupied Growling Grass Frog breeding, aquatic and terrestrial habitat at Brady Swamp. The habitat is across two properties but contiguous.

Approximately 60 of the 200 hectares was assessed by WSP in 2019/2020 and WSP subsequently prepared an OMP for this area (WSP 2020). WSP's (2020) habitat mapping suggests that approximately one third of the Growling Grass Frog habitat at Brady Swamp is likely to be breeding/aquatic habitat, meaning that Brady Swamp would meet the requirement for at least 11.30% breeding/aquatic habitat (the 'like for like' threshold). The Offsets Assessment Guide from WSP's OMP has formed the basis of the third party Offsets Assessment Guide for M3R. The same inputs have been used for all parameters except start area. This is based on the assumption that these inputs have already been accepted by DCCEEW and would apply to the broader Brady Swamp.

If the above assumptions are valid, Brady Swamp has the potential to provide 58.83% of M3R's offset requirement for Growling Grass Frog. Refer to the offset calculations in Table E3.A.10.

Table E3.A.20
Offset calculations for Brady Swamp Growling Grass Frog offset sites

Matter of National Environmental Significance	
Name	Growling Grass Frog
EPBC Act status	Vulnerable
Annual probability of extinction Based on IUCN category definitions	0.2%

Impact calculator						
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Ecological communities						
Area of community	No		Area			
			Quality			
			Total quantum of impact	0.00		
Threatened species habitat						
Area of habitat	Yes	Impact area: 64.34 ha of occupied Growling Grass Frog habitat with quality score of 9/10 (site condition of 4/5, site context of 3/3 and stocking rate of 2/2).	Area	64.34	Hectares	
			Quality	9	Scale 0-10	
			Total quantum of impact	57.91	Adjusted hectares	
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					

Impact calculator (cont.)					
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**	**Units**	**Information source**
Threatened species					
Birth rate e.g. Change in nest success	No				
Mortality rate e.g Change in number of road kills per year	No				
Number of individuals e.g. Individual plants/ animals	No				

Offset calculator								
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start area and quality**	
Ecological Communities								
Area of community	No				Risk-related time horizon (max. 20 years)		Start area (hectares)	
					Time until ecological benefit		Start quality (scale of 0-10)	
Threatened species habitat								
Area of habitat	Yes	57.91	Adjusted hectares	Offset site: two third party offsets at Brady Swamp, comprising 240 ha of occupied Growling Grass Frog habitat with a start quality score of 8/10 (refer to WSP 2020 for rationale behind inputs).	Time over which loss is averted (max. 20 years)	20	Start area (hectares)	200
					Time until ecological benefit	10	Start quality (scale of 0-10)	8
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	Proposed offset	**Time horizon (years)**		**Start value**	
Number of features e.g. Nest hollows, habitat trees	No							
Condition of habitat Change in habitat condition, but no change in extent	No							
Threatened species								
Birth rate e.g. Change in nest success	No							
Mortality rate e.g Change in number of road kills per year	No							
Number of individuals e.g. Individual plants/animals	No							

Offset calculator (cont.)

Protected matter attributes	Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)
Ecological Communities (cont.)						
Area of community	Risk of loss (%) without offset		Risk of loss (%) with offset			
	Future area without offset (adjusted hectares)	0.00	Future area with offset (adjusted hectares)	0.00		
	Future quality without offset (scale of 0-10)		Future quality with offset (scale of 0-10)			
Threatened species habitat (cont.)						
Area of habitat	Risk of loss (%) without offset	20%	Risk of loss (%) with offset	10%	20.00	70%
	Future area without offset (adjusted hectares)	160.0	Future area with offset (adjusted hectares)	180.0		
	Future quality without offset (scale of 0-10)	7	Future quality with offset (scale of 0-10)	9	2.00	70%
Protected matter attributes	**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**
Number of features e.g. Nest hollows, habitat trees						
Condition of habitat Change in habitat condition, but no change in extent						
Threatened species (cont.)						
Birth rate e.g. Change in nest success						
Mortality rate e.g Change in number of road kills per year						
Number of individuals e.g. Individual plants/ animals						

Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
14.00	13.45				
	34.06	58.83%	No		
1.40	1.37				

Adjusted gain	Net present value	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source

<u>Residual offset requirements</u>

The first party offset sites at Deep Creek, the Maribyrnong River and Moonee Ponds Creek and third party offset sites at Brady Swamp could collectively meet 71.50% of the Growling Grass Frog offset requirements for M3R.

The residual offset requirements could be met by securing and managing approximately 96.9 hectares of occupied Growling Grass Frog in perpetuity, at a site with similar characteristics (i.e. same risk of loss, start quality and future quality) as the Growling Grass Frog habitat at Brady Swamp. The required area would be less if the offset site was established in advance of the impact occurring and there was sufficient information to demonstrate that an ecological benefit had already materialised (DoEE 2017). Offset calculations for the residual offset requirement are presented in Table E3.A.21.

Table E3.A.21
Offset calculations for residual Growling Grass Frog offset requirements

Matter of National Environmental Significance	
Name	Growling Grass Frog
EPBC Act status	Vulnerable
Annual probability of extinction Based on IUCN category definitions	0.2%

Impact calculator						
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Ecological communities						
Area of community	No		Area			
			Quality			
			Total quantum of impact	0.00		
Threatened species habitat						
Area of habitat	Yes	Impact area: 64.34 ha of occupied Growling Grass Frog habitat with quality score of 9/10 (site condition of 4/5, site context of 3/3 and stocking rate of 2/2).	Area	64.34	Hectares	
			Quality	9	Scale 0-10	
			Total quantum of impact	57.91	Adjusted hectares	
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					

Impact calculator (cont.)					
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**	**Units**	**Information source**
Threatened species					
Birth rate e.g. Change in nest success	No				
Mortality rate e.g Change in number of road kills per year	No				
Number of individuals e.g. Individual plants/ animals	No				

Offset calculator								
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start area and quality**	
Ecological Communities								
Area of community	No				Risk-related time horizon (max. 20 years)		Start area (hectares)	
					Time until ecological benefit		Start quality (scale of 0-10)	
Threatened species habitat								
Area of habitat	Yes	57.91	Adjusted hectares	Offset site: hypothetical offset to meet residual offset requirements for Growling Grass Frog (refer to WSP 2020 for rationale behind inputs).	Time over which loss is averted (max. 20 years)	20	Start area (hectares)	96.9
					Time until ecological benefit	10	Start quality (scale of 0-10)	8
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**	
Number of features e.g. Nest hollows, habitat trees	No							
Condition of habitat Change in habitat condition, but no change in extent	No							
Threatened species								
Birth rate e.g. Change in nest success	No							
Mortality rate e.g Change in number of road kills per year	No							
Number of individuals e.g. Individual plants/animals	No							

Offset calculator (cont.)						
Protected matter attributes	**Future area and quality without offset**		**Future area and quality with offset**		**Raw gain**	**Confidence in result (%)**
Ecological Communities (cont.)						
Area of community	Risk of loss (%) without offset		Risk of loss (%) with offset			
	Future area without offset (adjusted hectares)		Future area with offset (adjusted hectares)			
	Future quality without offset (scale of 0-10)		Future quality with offset (scale of 0-10)			
Threatened species habitat (cont.)						
Area of habitat	Risk of loss (%) without offset	20%	Risk of loss (%) with offset	10%		
	Future area without offset (adjusted hectares)	77.5	Future area with offset (adjusted hectares)	87.2	9.69	70%
	Future quality without offset (scale of 0-10)	7	Future quality with offset (scale of 0-10)	9	2.00	70%
Protected matter attributes	**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**
Number of features e.g. Nest hollows, habitat trees						
Condition of habitat Change in habitat condition, but no change in extent						
Threatened species (cont.)						
Birth rate e.g. Change in nest success						
Mortality rate e.g Change in number of road kills per year						
Number of individuals e.g. Individual plants/ animals						

Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
6.78	6.52				
	16.50	28.50%	No		
1.40	1.37				

Adjusted gain	Net present value	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source

Swift Parrot

The M3R impact area includes 68.02 hectares of Swift Parrot foraging habitat. The habitat that would be removed for construction of M3R corresponds with the treed condition state of the Grey Box Woodland threatened ecological community.

In addition, construction of M3R would have an indirect impact on the 85.98 hectares of Swift Parrot foraging habitat retained at Radar Hill. DCCEEW has advised that this indirect impact should be assessed using the 'area of habitat' row of the Offsets Assessment Guide, in the same way that the direct impact is assessed.

Collectively, the direct and indirect impacts on Swift Parrot foraging habitat at Radar Hill amount to 56.21 adjusted hectares. This is equivalent to the complete loss of 80.30 hectares of Swift Parrot habitat with a quality score of 7/10 (80.30 x 0.7 = 56.21). An impact area of 80.30 hectares and quality score of 7/10 has therefore been used to represent all direct and indirect impacts in the Offset Assessment Guides for Swift Parrot. Apart from this adjustment, the same Swift Parrot habitat scoring system, as documented in the M3R Ecology Technical Report (Biosis 2021), has been applied consistently at the impact and offset sites.

First party offsets

It is proposed that the retained Grey Box Woodland that is landside at Radar Hill would be protected and managed in perpetuity as a first party offset site. Approximately one quarter of the retained area is immature Grey Box Woodland that APAM has revegetated and is likely to provide 1.82% of M3R's offset requirements for Swift Parrot. The remaining three quarters of retained Grey Box Woodland is established and mature woodland, which is likely to provide 6.60% of M3R's offset requirements for Swift Parrot. Collectively, the retained Grey Box Woodland is likely to provide 8.42% of M3R's offset requirements for Swift Parrot. The offset assessment guide inputs for the Radar Hill Swift Parrot offset site are outlined in Table E3.A.22, and the offset calculations in Table E3.A.23 (mature Grey Box Woodland) and Table E3.A.24 (immature Grey Box Woodland).

Table E3.A.22
Offset assessment guide inputs for Radar Hill Swift Parrot offset site

Parameter	Input	Justification for input
Time over which loss is averted	20 years	The offset site will be protected and managed as a conservation area in perpetuity, but 20 years is the maximum time period that can be entered into this field.
Start area	64.88 ha and 18.65 ha	Collectively, this is the 83.53 hectares of Grey Box Woodland retained at Radar Hill after construction of M3R, with suitable buffers applied. 64.88 hectares refers to the area of mature and established Grey Box Woodland. 18.65 hectares refers to the area of immature Grey Box Woodland that APAM has revegetated.
Risk of loss (%) without offset	10%	Refer to Table E3.A.1.
Risk of loss (%) with offset	1%	Refer to Table E3.A.1.
Confidence in result – risk of loss	90%	Refer to Table E3.A.1.
Time until ecological benefit	10 years	A measurable improvement in habitat quality will be achieved after 10 years of management in accordance with the future OMP (although the improvement may not register once rounding has occurred, as explained below).

Parameter	Input	Justification for input
Start quality (/10)	6 and 5	The current value of the retained Grey Box Woodland as habitat for Swift Parrot has been assessed as 6/10 on basis of its site condition, site context and species stocking rate. Biosis assessed the site condition of the Grey Box Woodland at Radar Hill in January 2020 using the habitat hectares method (DSE 2004). The weighted average site condition score of the retained Grey Box Woodland at Radar Hill was 54.69/75 (59.49/75 for the mature Grey Box Woodland and 38.00/75 for the immature Grey Box Woodland). The Swift Parrot habitat scoring system (Biosis 2021) rounds a site condition score of 30-59/75 to 2/3. A site condition score of 3/3 would therefore apply to the mature retained Grey Box Woodland at Radar Hill, while a site condition score of 2/3 would apply to the immature retained Grey Box Woodland. The Swift Parrot habitat scoring system (Biosis 2021) assigns a site context score of 2/5 to any non-breeding habitat between 51 and 100 hectares in size. The mature and immature Grey Box Woodland are contiguous with each other and collectively provide 83.53 hectares of habitat. The Swift Parrot habitat scoring system (Biosis 2021) assigns a stocking rate of 1/2 for habitat patches where the species has been recorded in the past 20 years (but not regularly recorded).
Future quality without offset (/10)	5 and 4	Without protection and management as an offset site, the quality of the Grey Box Woodland at Radar Hill is likely to decline such that the site condition of the mature Grey Box Woodland drops to 2/3 (i.e. less than or equal to 59/75 using the habitat hectares method) and site condition of the immature grey Box Woodland drops to 1/3 (i.e. less than or equal to 29/75). Both the mature and immature Grey Box Woodland patches are already close to these thresholds. Assuming current management obligations, management practices and land uses continue at the site, the cover of high threat weeds is likely to increase (leading to a potential quality loss of 3/75). Increased high threat weed cover is likely to cause displacement of at least one understorey life form (a potential quality loss of 5/75). In turn, these changes could contribute to a decline in canopy health e.g. due to disease or insect attack (a potential quality loss of 2/75). A decline in canopy health could reduce the value of the offset site as a foraging resource for Swift Parrot.
Future quality with offset (/10)	6 and 5	Intensive management of the Grey Box Woodland at Radar Hill as an offset site is likely to lead to an increase in its site condition score but, due to rounding, the increase is unlikely to register as an improvement when transferred to the Swift Parrot scoring system. Increases in the site condition score could be brought about through intensive weed control, reintroduction of understorey life forms, reinstatement of logs, biomass control and control of herbivores to increase plant recruitment. Together, these actions are likely to improve canopy health and therefore the foraging resource available to Swift Parrot. However, the improvements would not be sufficient enough to increase the site condition score of the mature Grey Box Woodland (which is already at 3/3) or the immature Grey Box Woodland (which is at the low end of 2/3).
Confidence in result – future quality	90%	There is a high level of confidence that APAM and future Melbourne Airport lessees would have the resources to intensively manage the Grey Box Woodland at Radar Hill. Some ecological management already occurs, but the frequency and intensity of this management would need to be scaled up significantly to achieve ecological improvements. There is a high level of confidence that implementation of the actions listed above would result in maintenance of the site condition of the Grey Box Woodland and therefore maintenance of the quality of the Swift Parrot habitat at the offset site.
Net present value (adjusted hectares)	3.71 and 1.03 adjusted hectares	This value is set by the Offset Assessment Guide and represents the value of the offset site as an area expressed in adjusted hectares. The absolute area (in hectares) has been adjusted to account for risk of loss (averted loss), future quality, annual probability of extinction and relevant time horizons (time over which loss is averted and time until ecological benefit).
% of impact offset	6.60% and 1.82%	This value is calculated automatically by the Offset Assessment Guide and represents the degree to which the offset (expressed in adjusted hectares) compensates for the total quantum of impact (also expressed in adjusted hectares).

Table E3.A.23
Offset calculations for Radar Hill Swift Parrot offset site (mature Grey Box Woodland)

Matter of National Environmental Significance	
Name	Swift Parot
EPBC Act status	Critically Endangered
Annual probability of extinction Based on IUCN category definitions	6.8%

Impact calculator							
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Ecological communities						
Area of community	No		Area			
			Quality			
			Total quantum of impact	0.00		
Threatened species habitat						
Area of habitat	Yes	Impact area: 68.02 ha of Swift Parrot habitat with quality score of 7/10 (site condition of 2/3, site context of 4/5 and stocking rate of 1/2). Additional indirect impact: reduction in site context of 1/10 for remaining 85.98 ha of Swift Parrot habitat. Collectively equivalent to removal of 80.3 ha of Swift Parrot habitat with quality score of 7/10.	Area	80.3	Hectares	
			Quality	7	Scale 0-10	
			Total quantum of impact	56.21	Adjusted hectares	
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/ animals	No					

Offset calculator

Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start area and quality	
Ecological Communities								
Area of community	No				Risk-related time horizon (max. 20 years)		Start area (hectares)	
					Time until ecological benefit		Start quality (scale of 0-10)	
Threatened species habitat								
Area of habitat	Yes	56.21	Adjusted hectares	Offset site: first party offset at Radar Hill, comprising 64.88 ha of mature foraging habitat (Grey Box Woodland) for Swift Parrot with a start quality score of 6/10 (site condition of 2/3, site context of 3/5 and stocking rate of 1/2).	Time over which loss is averted (max. 20 years)	20	Start area (hectares)	64.88
					Time until ecological benefit	10	Start quality (scale of 0-10)	6
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**	
Number of features e.g. Nest hollows, habitat trees	No							
Condition of habitat Change in habitat condition, but no change in extent	No							
Threatened species								
Birth rate e.g. Change in nest success	No							
Mortality rate e.g Change in number of road kills per year	No							
Number of individuals e.g. Individual plants/animals	No							

Offset calculator (cont.)						
Protected matter attributes	**Future area and quality without offset**		**Future area and quality with offset**		**Raw gain**	**Confidence in result (%)**
Ecological Communities (cont.)						
Area of community	Risk of loss (%) without offset		Risk of loss (%) with offset			
	Future area without offset (adjusted hectares)	0.0	Future area with offset (adjusted hectares)	0.0		
	Future quality without offset (scale of 0-10)		Future quality with offset (scale of 0-10)			
Threatened species habitat (cont.)						
Area of habitat	Risk of loss (%) without offset	10%	Risk of loss (%) with offset	1%	5.84	90%
	Future area without offset (adjusted hectares)	58.4	Future area with offset (adjusted hectares)	64.2		
	Future quality without offset (scale of 0-10)	6	Future quality with offset (scale of 0-10)	7	1.00	90%
Protected matter attributes	**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**
Number of features e.g. Nest hollows, habitat trees						
Condition of habitat Change in habitat condition, but no change in extent						
Threatened species (cont.)						
Birth rate e.g. Change in nest success						
Mortality rate e.g Change in number of road kills per year						
Number of individuals e.g. Individual plants/ animals						

Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
5.26	1.41				
	3.71	6.60%	No		
0.90	0.47				

Adjusted gain	Net present value	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source

Table E3.A.24
Offset calculations for Radar Hill Swift Parrot offset site (immature Grey Box Woodland)

Matter of National Environmental Significance	
Name	Swift Parrot
EPBC Act status	Critically Endangered
Annual probability of extinction Based on IUCN category definitions	6.8%

Impact calculator						
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Ecological communities						
Area of community	No		Area			
			Quality			
			Total quantum of impact			
Threatened species habitat						
Area of habitat	Yes	Impact area: 68.02 ha of Swift Parrot habitat with quality score of 7/10 (site condition of 2/3, site context of 4/5 and stocking rate of 1/2). Additional indirect impact: reduction in site context of 1/10 for remaining 85.98 ha of Swift Parrot habitat. Collectively equivalent to removal of 80.3 ha of Swift Parrot habitat with quality score of 7/10.	Area	80.3	Hectares	
			Quality	7	Scale 0-10	
			Total quantum of impact	56.21	Adjusted hectares	
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/ animals	No					

Offset calculator

Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start area and quality	
Ecological Communities								
Area of community	No				Risk-related time horizon (max. 20 years)		Start area (hectares)	
					Time until ecological benefit		Start quality (scale of 0-10)	
Threatened species habitat								
Area of habitat	Yes	56.21	Adjusted hectares	Offset site: first party offset at Radar Hill, comprising 18.65 ha of immature foraging habitat (Grey Box Woodland) for Swift Parrot with a start quality score of 6/10 (site condition of 2/3, site context of 3/5 and stocking rate of 1/2).	Time over which loss is averted (max. 20 years)	20	Start area (hectares)	18.65
					Time until ecological benefit	10	Start quality (scale of 0-10)	6
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**	
Number of features e.g. Nest hollows, habitat trees	No							
Condition of habitat Change in habitat condition, but no change in extent	No							
Threatened species								
Birth rate e.g. Change in nest success	No							
Mortality rate e.g Change in number of road kills per year	No							
Number of individuals e.g. Individual plants/animals	No							

Offset calculator (cont.)

Protected matter attributes	Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)
Ecological Communities (cont.)						
Area of community	Risk of loss (%) without offset		Risk of loss (%) with offset			
	Future area without offset (adjusted hectares)	0.0	Future area with offset (adjusted hectares)	0.0		
	Future quality without offset (scale of 0-10)		Future quality with offset (scale of 0-10)			
Threatened species habitat (cont.)						
Area of habitat	Risk of loss (%) without offset	10%	Risk of loss (%) with offset	1%	1.68	90%
	Future area without offset (adjusted hectares)	16.8	Future area with offset (adjusted hectares)	18.5		
	Future quality without offset (scale of 0-10)	5	Future quality with offset (scale of 0-10)	6	1.00	90%

Protected matter attributes	Future value without offset	Future value with offset	Raw gain	Confidence in result (%)
Number of features e.g. Nest hollows, habitat trees				
Condition of habitat Change in habitat condition, but no change in extent				
Threatened species (cont.)				
Birth rate e.g. Change in nest success				
Mortality rate e.g Change in number of road kills per year				
Number of individuals e.g. Individual plants/ animals				

Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
1.5	0.41				
	1.03	1.82%	No		
0.90	0.47				

Adjusted gain	Net present value	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source

Third party offsets

Grey Box Woodland and/or Box Ironbark Forest at the Morrl Morrl, Orana and Kinrara properties could be protected and managed in perpetuity as third party offset sites. Collectively, these sites have the potential to provide 48.07% of M3R's offset requirements for Swift Parrot. Refer to the offset assessment guide inputs in Table E3.A.25, and the offset calculations for the Orana, Kinrara and Morrl Morrl Swift Parrot offset sites in Table E3.A.26, Table E3.A.27 and Table E3.A.28 respectively.

Table E3.A.25
Offset assessment guide inputs for Orana, Kinrara and Morrl Morrl Swift Parrot offset sites

Parameter	Input	Justification for input
Time over which loss is averted	20 years	The offset site will be protected and managed as a conservation area in perpetuity, but 20 years is the maximum time period that can be entered into this field.
Start area	78.35 ha, 128.31 ha and 58.46 ha	The area of Swift Parrot habitat at Morrl Morrl is 78.35 hectares. The area of potential Swift Parrot habitat at Orana and Kinrara is 128.31 hectares and 58.46 hectares respectively.
Risk of loss (%) without offset	10%	Refer to Tables E3.A.2, E3.A.3 and E3.A.4.
Risk of loss (%) with offset	1%	Refer to Tables E3.A.2, E3.A.3 and E3.A.4.
Confidence in result – risk of loss	90%	Refer to Tables E3.A.2, E3.A.3 and E3.A.4.
Time until ecological benefit	10 years	A measurable improvement in habitat quality will be achieved after 10 years of management in accordance with the future OMP.
Start quality (/10)	8, 7 and 7	Biosis assessed the Swift Parrot habitat at these offset sites in October 2021. The Morrl Morrl Swift Parrot habitat was assigned a score of 8/10, which was made up of a site condition score of 2/3 (corresponding with a weighted average habitat hectares site condition score of 49.13/75), a site context score of 4/5 (because the habitat is contiguous with the Morrl Morrl Nature Conservation Reserve, which itself provides more than 100 hectares of habitat) and a stocking rate of 2/2 (because Swift Parrot have been regularly and repeatedly recorded within the Morrl Morrl Nature Conservation Reserve). When assessed by Biosis in 2021, the potential Swift Parrot habitat at Orana and Kinrara was assigned a score of 6/10, which was made up of a site condition score of 2/3 (corresponding with a weighted average habitat hectares site condition score of 50.79/75 and 47.53/75 respectively), a site context score of 4/5 (because Orana and Kinrara are contiguous and collectively provide more than 100 hectares of potential Swift Parrot habitat) and a stocking rate of 0/2 (because no Swift Parrot have been recorded within 10 kilometres of the properties). However, DCCEEW has suggested that it would need to be demonstrated that Swift Parrot use Orana and Kinrara or similar habitat in proximity to the properties for the properties to be eligible as Swift Parrot offset sites. Note: Swift Parrot have been recorded ~17km from the sites and forage over large areas. In other words, sites with a stocking rate of 0/2 are unlikely to be eligible Swift Parrot offset sites. For the purposes of offset calculations, a stocking rate of 1/2 (and an overall score of 7/10) has therefore been assigned to the potential Swift Parrot habitat at Orana and Kinrara because this is the minimum stocking rate that the sites will need to achieve to be eligible as offset sites for the species. A stocking rate of 1/2 would ultimately be assigned to the sites if it could be demonstrated that Swift Parrot use the sites or similar habitat within 10 kilometres of the sites.

Parameter	Input	Justification for input
Future quality without offset (/10)	7, 6 and 6	Without protection and management as an offset site, the quality of the (potential) Swift Parrot habitat is likely to decline such that the site condition loses 1 point or the stocking rate loses 1 point (e.g. due to a decline in site condition). This is assuming that current management obligations, management practices and land uses continue at the sites. As documented in Tables 2, 3 and 4, a decline in site condition of around 10/75 is conceivable. This may not be sufficient for a decline in the rounded site condition score from 2/3 to 1/3 but may be sufficient for there to be a decline in the regularity with which Swift Parrot uses the sites. Together, the decline in site condition and potential decline in stocking rate are best expressed as a 1-point loss in quality score.
Future quality with offset (/10)	9, 8 and 8	Intensive management of the Grey Box Woodland and/or Box Ironbark Forest at Morrl Morrl, Orana and Kinrara is likely to lead to an increase in their weighted site condition scores to above 59/75, which would be enough to register as a rounded score of 3/3. Increases in the site condition score could be brought about through a combination of intensive weed control, reintroduction of understorey life forms, reinstatement of logs, biomass control and control of herbivores to increase plant recruitment. Further detail is documented in Tables 2, 3 and 4 (although note that Table 4 pertains only to the Grassy Woodland at Morrl Morrl and not the Box Ironbark Forest). If these actions are not sufficient for an increase in the rounded site condition score from 2/3 to 3/3, they are likely to improve canopy health and therefore the foraging resource available to Swift Parrot. Together, the improvement in site condition and potential improvement in stocking rate are best expressed as a 1-point improvement in quality score.
Confidence in result – future quality	90%	There is a high level of confidence that the landowners and future landowners of Morrl Morrl, Orana and Kinrara would have the support, guidance and resources to intensively manage the (potential) Swift Parrot habitat that is present at these sites. There is a high level of confidence that implementation of the actions listed above would result in a 1-point improvement to the future quality of the offset sites. Note, however, that these scores are premised on confirmation that Swift Parrot uses the Orana and Kinrara sites (or similar habitat within 10 kilometres).
Net present value (adjusted hectares)	8.11, 13.00 and 5.92 adjusted hectares	This value is set by the Offset Assessment Guide and represents the value of the offset site as an area expressed in adjusted hectares. The absolute area (in hectares) has been adjusted to account for risk of loss (averted loss), future quality, annual probability of extinction and relevant time horizons (time over which loss is averted and time until ecological benefit).
% of impact offset	14.42%, 23.12% and 10.53%	This value is calculated automatically by the Offset Assessment Guide and represents the degree to which the offset (expressed in adjusted hectares) compensates for the total quantum of impact (also expressed in adjusted hectares).

Table E3.A.26
Offset calculationss for Orana Swift Parrot offset site

Matter of National Environmental Significance	
Name	Swift Parrot
EPBC Act status	Critically Endangered
Annual probability of extinction Based on IUCN category definitions	6.8%

Impact calculator

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Ecological communities						
Area of community	No		Area			
			Quality			
			Total quantum of impact	0.00		
Threatened species habitat						
Area of habitat	Yes	Impact area: 68.02 ha of Swift Parrot habitat with quality score of 7/10 (site condition of 2/3, site context of 4/5 and stocking rate of 1/2). Additional indirect impact: reduction in site context of 1/10 for remaining 85.98 ha of Swift Parrot habitat. Collectively equivalent to removal of 80.3 ha of Swift Parrot habitat with quality score of 7/10.	Area	80.3	Hectares	
			Quality	7	Scale 0-10	
			Total quantum of impact	56.21	Adjusted hectares	

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact	Units	Information source
Number of features e.g. Nest hollows, habitat trees	No				
Condition of habitat Change in habitat condition, but no change in extent	No				
Threatened species					
Birth rate e.g. Change in nest success	No				
Mortality rate e.g Change in number of road kills per year	No				
Number of individuals e.g. Individual plants/ animals	No				

Offset calculator								
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start area and quality**	
Ecological Communities								
Area of community	No				Risk-related time horizon (max. 20 years)		Start area (hectares)	
					Time until ecological benefit		Start quality (scale of 0-10)	
Threatened species habitat								
Area of habitat	Yes	56.21	Adjusted hectares	Offset site: third party offset at Orana, comprising 128.31 ha of potential Swift Parrot foraging habitat with an assumed start quality score of 7/10 (site condition of 2/3, site context of 4/5 and stocking rate of 1/2).	Time over which loss is averted (max. 20 years)	20	Start area (hectares)	128.31
					Time until ecological benefit	10	Start quality (scale of 0-10)	7
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**	
Number of features e.g. Nest hollows, habitat trees	No							
Condition of habitat Change in habitat condition, but no change in extent	No							
Threatened species								
Birth rate e.g. Change in nest success	No							
Mortality rate e.g Change in number of road kills per year	No							
Number of individuals e.g. Individual plants/animals	No							

Offset calculator (cont.)

Protected matter attributes	Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)
Ecological Communities (cont.)						
Area of community	Risk of loss (%) without offset		Risk of loss (%) with offset			
	Future area without offset (adjusted hectares)	0.0	Future area with offset (adjusted hectares)	0.0		
	Future quality without offset (scale of 0-10)		Future quality with offset (scale of 0-10)			
Threatened species habitat (cont.)						
Area of habitat	Risk of loss (%) without offset	10%	Risk of loss (%) with offset	1%	11.55	90%
	Future area without offset (adjusted hectares)	115.5	Future area with offset (adjusted hectares)	127.0		
	Future quality without offset (scale of 0-10)	6	Future quality with offset (scale of 0-10)	8	2.00	90%

Protected matter attributes	Future value without offset	Future value with offset	Raw gain	Confidence in result (%)
Number of features e.g. Nest hollows, habitat trees				
Condition of habitat Change in habitat condition, but no change in extent				
Threatened species (cont.)				
Birth rate e.g. Change in nest success				
Mortality rate e.g Change in number of road kills per year				
Number of individuals e.g. Individual plants/ animals				

Adjusted gain	Net present value (adjusted hectares)		% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
10.39	2.79	13.00	23.12%	No		
1.80	0.93					

Adjusted gain	Net present value	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source

Table E3.A.27
Offset calculations for Kinrara Swift Parrot offset site

Matter of National Environmental Significance	
Name	Swift Parrot
EPBC Act status	Critically Endangered
Annual probability of extinction Based on IUCN category definitions	6.8%

Impact calculator						
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Ecological communities						
Area of community	No		Area		Hectares	
			Quality		Scale 0-10	
			Total quantum of impact	0.00	Adjusted hectares	
Threatened species habitat						
Area of habitat	No		Area	80.3	Hectares	
			Quality	7	Scale 0-10	
			Total quantum of impact	56.21	Adjusted hectares	
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					
Threatened species						
Birth rate e.g. Change in nest success	No					
Mortality rate e.g Change in number of road kills per year	No					
Number of individuals e.g. Individual plants/ animals	No					

Offset calculator

Protected matter attributes	Attribute relevant to case?	Total quantum of impact	Units	Proposed offset	Time horizon (years)		Start area and quality	
Ecological Communities								
Area of community	No			.	Risk-related time horizon (max. 20 years)		Start area (hectares)	
					Time until ecological benefit		Start quality (scale of 0-10)	
Threatened species habitat								
Area of habitat	Yes	56.21	Adjusted hectares	Offset site: third party offset at Kinrara, comprising 58.46 ha of potential Swift Parrot foraging habitat with an assumed start quality score of 7/10 (site condition of 2/3, site context of 4/5 and stocking rate of 1/2).	Time over which loss is averted (max. 20 years)	20	Start area (hectares)	58.46
					Time until ecological benefit	10	Start quality (scale of 0-10)	7
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**	
Number of features e.g. Nest hollows, habitat trees	No							
Condition of habitat Change in habitat condition, but no change in extent	No							
Threatened species								
Birth rate e.g. Change in nest success	No							
Mortality rate e.g Change in number of road kills per year	No							
Number of individuals e.g. Individual plants/animals	No							

Offset calculator (cont.)

Protected matter attributes	Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)
Ecological Communities (cont.)						
Area of community (cont.)	Risk of loss (%) without offset		Risk of loss (%) with offset			
	Future area without offset (adjusted hectares)	0.0	Future area with offset (adjusted hectares)	0.0		
	Future quality without offset (scale of 0-10)		Future quality with offset (scale of 0-10)			
Threatened species habitat (cont.)						
Area of habitat (cont.)	Risk of loss (%) without offset	10%	Risk of loss (%) with offset	1%	5.26	90%
	Future area without offset (adjusted hectares)	52.6	Future area with offset (adjusted hectares)	57.9		
	Future quality without offset (scale of 0-10)	6	Future quality with offset (scale of 0-10)	8	2.00	90%
Protected matter attributes	**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**
Number of features (cont.) e.g. Nest hollows, habitat trees						
Condition of habitat (cont.) Change in habitat condition, but no change in extent						
Threatened species (cont.)						
Birth rate (cont.) e.g. Change in nest success						
Mortality rate (cont.) e.g Change in number of road kills per year						
Number of individuals (cont.) e.g. Individual plants/ animals						

Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
4.74	1.27				
	5.92	10.53%	No		
1.80	0.93				

Adjusted gain	Net present value	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source

Table E3.A.28
Offset calculations for Morrl Morrl Swift Parrot offset site

Matter of National Environmental Significance	
Name	Swift Parrot
EPBC Act status	Critically Endangered
Annual probability of extinction Based on IUCN category definitions	6.8%

Impact calculator

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Units	Information source
Ecological communities						
Area of community	No		Area			
			Quality			
			Total quantum of impact	0.00		
Threatened species habitat						
Area of habitat	Yes	Impact area: 68.02 ha of Swift Parrot habitat with quality score of 7/10 (site condition of 2/3, site context of 4/5 and stocking rate of 1/2). Additional indirect impact: reduction in site context of 1/10 for remaining 85.98 ha of Swift Parrot habitat. Collectively equivalent to removal of 80.3 ha of Swift Parrot habitat with quality score of 7/10.	Area	80.3	Hectares	
			Quality	7	Scale 0-10	
			Total quantum of impact	56.21	Adjusted hectares	

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact	Units	Information source
Number of features e.g. Nest hollows, habitat trees	No				
Condition of habitat Change in habitat condition, but no change in extent	No				
Threatened species					
Birth rate e.g. Change in nest success	No				
Mortality rate e.g Change in number of road kills per year	No				
Number of individuals e.g. Individual plants/ animals	No				

Offset calculator								
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start area and quality**	
Ecological Communities								
Area of community	No				Risk-related time horizon (max. 20 years)		Start area (hectares)	
					Time until ecological benefit		Start quality (scale of 0-10)	
Threatened species habitat								
Area of habitat	Yes	56.21	Adjusted hectares	Offset site: third party offset at Morrl Morrl, comprising 64.88 ha of Swift Parrot foraging habitat with a start quality score of 8/10 (site condition of 2/3, site context of 4/5 and stocking rate of 2/2).	Time over which loss is averted (max. 20 years)	20	Start area (hectares)	78.35
					Time until ecological benefit	10	Start quality (scale of 0-10)	8
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start value**	
Number of features e.g. Nest hollows, habitat trees	No							
Condition of habitat Change in habitat condition, but no change in extent	No							
Threatened species								
Birth rate e.g. Change in nest success	No							
Mortality rate e.g Change in number of road kills per year	No							
Number of individuals e.g. Individual plants/animals	No							

Offset calculator (cont.)

Protected matter attributes	Future area and quality without offset		Future area and quality with offset		Raw gain	Confidence in result (%)
Ecological Communities (cont.)						
Area of community (cont.)	Risk of loss (%) without offset		Risk of loss (%) with offset			
	Future area without offset (adjusted hectares)	0.0	Future area with offset (adjusted hectares)	0.0		
	Future quality without offset (scale of 0-10)		Future quality with offset (scale of 0-10)			
Threatened species habitat (cont.)						
Area of habitat (cont.)	Risk of loss (%) without offset	10%	Risk of loss (%) with offset	1%	7.05	90%
	Future area without offset (adjusted hectares)	70.5	Future area with offset (adjusted hectares)	77.6		
	Future quality without offset (scale of 0-10)	7	Future quality with offset (scale of 0-10)	9	2.00	90%
Protected matter attributes	**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**
Number of features (cont.) e.g. Nest hollows, habitat trees						
Condition of habitat (cont.) Change in habitat condition, but no change in extent						
Threatened species (cont.)						
Birth rate (cont.) e.g. Change in nest success						
Mortality rate (cont.) e.g Change in number of road kills per year						
Number of individuals (cont.) e.g. Individual plants/ animals						

Adjusted gain	Net present value (adjusted hectares)		% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
6.35	1.70					
		8.11	14.42%	No		
1.80	0.93					

Adjusted gain	Net present value	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source

Residual offset requirements

The first party offset site at Radar Hill and third party offset sites at Orana, Kinrara and Morrl Morrl, would collectively meet 56.49% of the Swift Parrot offset requirements for M3R.

The residual offset requirements could be met by securing and managing approximately 237 hectares of regularly-occupied Swift Parrot habitat in perpetuity, at a site with similar characteristics (i.e. same risk of loss, start quality and future quality) as the Swift Parrot habitat at Morrl Morrl. The required area would be less if the offset site was established in advance of the impact occurring and there was sufficient information to demonstrate that an ecological benefit had already materialised (DoEE 2017). Offset calculations for the residual offset requirement are presented in Table E3.A.29.

Table E3.A.29
Offset calculations for residua Swift Parrot offset requirements

Matter of National Environmental Significance	
Name	Swift Parrot
EPBC Act status	Critically Endangered
Annual probability of extinction Based on IUCN category definitions	6.8%

Impact calculator						
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Ecological communities						
Area of community	No		Area			
			Quality			
			Total quantum of impact	0.00		
Threatened species habitat						
Area of habitat	Yes	Impact area: 68.02 ha of Swift Parrot habitat with quality score of 7/10 (site condition of 2/3, site context of 4/5 and stocking rate of 1/2). Additional indirect impact: reduction in site context of 1/10 for remaining 85.98 ha of Swift Parrot habitat. Collectively equivalent to removal of 80.3 ha of Swift Parrot habitat with quality score of 7/10.	Area	80.3	Hectares	
			Quality	7	Scale 0-10	
			Total quantum of impact	56.21	Adjusted hectares	
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**		**Units**	**Information source**
Number of features e.g. Nest hollows, habitat trees	No					
Condition of habitat Change in habitat condition, but no change in extent	No					

Impact calculator (cont.)					
Protected matter attributes	**Attribute relevant to case?**	**Description**	**Quantum of impact**	**Units**	**Information source**
Threatened species					
Birth rate e.g. Change in nest success	No				
Mortality rate e.g Change in number of road kills per year	No				
Number of individuals e.g. Individual plants/ animals	No				

Offset calculator								
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	**Proposed offset**	**Time horizon (years)**		**Start area and quality**	
Ecological Communities								
Area of community	No				Risk-related time horizon (max. 20 years)		Start area (hectares)	
					Time until ecological benefit		Start quality (scale of 0-10)	
Threatened species habitat								
Area of habitat	Yes	56.21	Adjusted hectares	Offset site: hypothetical offset to meet residual offset requirements for Swift Parrot	Time over which loss is averted (max. 20 years)	20	Start area (hectares)	237
					Time until ecological benefit	10	Start quality (scale of 0-10)	8
Protected matter attributes	**Attribute relevant to case?**	**Total quantum of impact**	**Units**	Proposed offset	**Time horizon (years)**		**Start value**	
Number of features e.g. Nest hollows, habitat trees	No							
Condition of habitat Change in habitat condition, but no change in extent	No							
Threatened species								
Birth rate e.g. Change in nest success	No							
Mortality rate e.g Change in number of road kills per year	No							
Number of individuals e.g. Individual plants/animals	No							

Offset calculator (cont.)						
Protected matter attributes	**Future area and quality without offset**		**Future area and quality with offset**		**Raw gain**	**Confidence in result (%)**
Ecological Communities (cont.)						
Area of community	Risk of loss (%) without offset		Risk of loss (%) with offset			
	Future area without offset (adjusted hectares)	0.0	Future area with offset (adjusted hectares)	0.0		
	Future quality without offset (scale of 0-10)		Future quality with offset (scale of 0-10)			
Threatened species habitat (cont.)						
Area of habitat	Risk of loss (%) without offset	10%	Risk of loss (%) with offset	1%	21.33	90%
	Future area without offset (adjusted hectares)	213.3	Future area with offset (adjusted hectares)	234.6		
	Future quality without offset (scale of 0-10)	7	Future quality with offset (scale of 0-10)	9	2.00	90%
Protected matter attributes	**Future value without offset**		**Future value with offset**		**Raw gain**	**Confidence in result (%)**
Number of features e.g. Nest hollows, habitat trees						
Condition of habitat Change in habitat condition, but no change in extent						
Threatened species (cont.)						
Birth rate e.g. Change in nest success						
Mortality rate e.g Change in number of road kills per year						
Number of individuals e.g. Individual plants/ animals						

Adjusted gain	Net present value (adjusted hectares)	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source
19.20	5.15				
	24.52	43.62%	No		
1.80	0.93				

Adjusted gain	Net present value	% of impact offset	Minimum (90%) direct offset requirement met?	Cost ($ total)	Information source

القطرية
QATAR

Chapter E4
Draft Runway Operating Plan

CHAPTER E4 CONTENTS

CHAPTER E4 FIGURES

CHAPTER E4 TABLES

E4.1 INTRODUCTION

So that the parallel-runway system can deliver Melbourne Airport's required capacity, the completion of Melbourne Airport's Third Runway (M3R) will be accompanied by changes to airspace architecture. The safe and efficient movement of aircraft to and from Melbourne Airport is a fundamental objective of airport and airspace operations. The airport runway system's operating modes play an important role in achieving this.

Whole-of-environment outcomes (especially regarding aircraft noise and vibration, as well as social and health impacts on the community) were taken into account when designing the flight paths, air traffic management procedures and M3R's proposed modes of operation.

M3R provides new opportunities to implement different operating modes during night-time periods, when it is less busy. These were therefore considered when developing the preliminary airspace design for operation of M3R.

This chapter presents the Draft Runway Operating Plan for M3R that Melbourne Airport envisages will be adopted when M3R becomes operational. The airspace architecture (including flight paths and proposed operating modes) has been developed by Melbourne Airport with input from Airservices. This is detailed in **Chapter C2: Airspace Architecture and Capacity, Chapter C3: Aircraft Noise Modelling Methodology** and **Chapter C4: Aircraft Noise and Vibration.**

The preliminary airspace design, including this Draft Runway Operating Plan, is agreed in principle as being technically feasible to implement, and confirmed by Airservices as meeting its planning requirements. Although this preliminary airspace design meets the requirements of both Airservices and Melbourne Airport, the airspace architecture concepts are preliminary and subject to further development through the detailed airspace design. Alterations to the future Melbourne Basin air traffic management network could result in changes to the proposed airspace architecture and may require changes to the runway operating plan. Opportunities to incorporate further mitigation of the environmental impacts of M3R operations, including aircraft noise, will continue to be explored throughout the detailed airspace design. Work on the detailed airspace design, following approval, is also an opportunity for further community engagement.

It is important to note that, before the flight path procedure and/or modes of operation can be finalised and implemented for M3R, a full detailed design process (including relevant safety case(s) for parallel runway operations and interaction with Essendon Fields Airport and other Melbourne Basin airports) must be completed by the air navigation services provider (i.e. Airservices) and approved by the Civil Aviation Safety Authority (CASA). This will happen before the opening and operation of M3R.

E4.2 M3R RUNWAY CONFIGURATION

The M3R infrastructure includes:

- A new parallel north-south runway (16R/34L)
- Reduction in length of the existing east-west runway (09/27) to ~1,940 metres
- New taxiway infrastructure to provide access to/from the new north-south runway

The new north-south runway (16R/34L) will be 3,000 metres long and approximately 1,311 metres west of the existing north-south runway (16L/34R).

E4.3 MITIGATION IN AIRSPACE DESIGN

Numerous measures have been incorporated into the airspace architecture design. Their specific objectives are addressing and mitigating the social and health impacts presented by aircraft noise and vibration.

Chapter C2: Airspace Architecture and Capacity details the design principles used to improve the noise and operational outcomes of M3R, including:

- All departures (with the exception discussed below) have been designed to permit Continuous Climb Operations (CCO). This reduces fuel burn and emissions and improves noise outcomes for communities under the flight path.
- All arrivals have been designed to enable Continuous Descent Operations (CDO) thereby minimising both noise and fuel burn emissions.
- Some ultra-long-haul departures to the north west must use the longest runway, 34R. During mixed mode operations, this results in crossing departure flight paths north of the airfield: one of the departing aircraft must therefore maintain a lower climb rate while the other achieves a CCO and passes above. Several designs were tested. However, given that heavy international ultra-long-haul aircraft climb comparatively slowly, applying the lower climb path to those aircraft (departing runway 34R) is least detrimental to efficiency. (This procedure is part of the strategic separation built into the SID design but, if there is no conflicting traffic departing from the other runway, the aircraft will be allowed to climb as if using a CCO design.)
- Flight paths have been designed to follow existing flight path corridors wherever possible under parallel runway operating rules.
- Where use of existing corridors is not possible, flight paths have been designed to avoid overflight of populated areas as much as possible.
- Flight paths enabling arrivals from the north and departures to the north (over Green Wedge land) have been incorporated into the airspace design for use at night, avoiding overflight of populated areas as much as practicable.
- Flight paths enabling the use of segregated modes, when demand is low, have been incorporated in the airspace design. This allows different operating strategies to be considered at night during conditions when SODPROPS cannot be operated safely. Segregated modes may also be available during the day outside peak periods, particularly in the early years of M3R's operation.

It is important to keep in mind that all design decisions made while developing the MDP will be considered by Airservices when they undertake the detailed airspace design. Airspace and flight path solutions can be expected to evolve as traffic demand changes, and aircraft capabilities and air traffic control systems improve, in the coming years.

Aircraft noise and other environmental considerations will continue to influence airspace design, in accordance with the design principles set out in **Chapter C2: Airspace Architecture and Capacity** as the design progresses.

E4.4 FLIGHT PATHS

Flight paths for M3R have been developed by Melbourne Airport with the assistance of Airservices. These, and how they were developed, are discussed in **Chapter C2: Airspace Architecture and Capacity**.

Flight paths are based on the three fundamental principles of safety, efficiency and environmental considerations. However, airspace design at a major airport is complex and so requires careful balancing of these principles to reach optimal outcomes.

The safety of aircraft operations is paramount, and procedures are extensively governed by the standards protecting the safe operation of airspace. Flight paths and procedures must enable efficient processing of the required volume of air traffic. Opportunities to mitigate noise, emissions and other environmental impacts are conditional upon safety and must deliver an adequate level of efficiency to meet future demand.

E4.5 MODES OF OPERATION FOR M3R

This section provides information on the different modes of operation available for M3R, and the procedures proposed, at Melbourne Airport as discussed in **Chapter C2: Airspace Architecture and Capacity, Chapter C3: Aircraft Noise Modelling Methodology** and **Chapter C4: Aircraft Noise and Vibration**.

In the preliminary airspace design, all possible modes of operation were identified and considered for the M3R configuration. The selection of the modes presented in this Draft Runway Operating Plan considered several factors, including:

- Existing flight paths to and from Melbourne Airport
- Optimisation of airport runway capacity and the ability to meet forecast demand

- Current preferred runway selection rules and existing Noise Abatement Procedures (NAPs)
- Options for runway use in varying wind conditions
- Amalgamation of existing procedures with new procedural requirements for parallel runway operations and interaction with Essendon Fields Airport
- Options to minimise aircraft flight over residential areas, especially during the night-time period between 11pm and 6am.
- The M3R modes of operation and flight paths were designed on the following basis:
- All aircraft will be able to land on either of the north-south runways
- Most aircraft will be able to take off from either of the north-south runways. However, some ultra-long-haul aircraft will need to depart from the existing north-south runway (16L/34R).

To maximise airport capacity, use of the existing east-west runway will be limited to when weather conditions (primarily wind speed and direction) preclude use of the parallel runways. Importantly from an environmental perspective, the preliminary airspace design maximises and prioritises the utilisation of noise-preferred modes at night.

The primary modes of operation available for the M3R system are summarised below and discussed in more detail in the following sections:

Mixed Mode Parallel Runway Operations

- Mixed parallel operations on runways 16L and 16R
- Mixed parallel operations on runways 34L and 34R

Segregated Mode Parallel Runway Operations

- SM1 - Segregated north flow with departures on runway 34L and arrivals on 34R
- SM2 - Segregated south flow with departures on runway 16L and arrivals on 16R
- SM3 - Segregated north flow with departures on runway 34R and arrivals on 34L
- SM4 - Segregated south flow with departures on runway 16R and arrivals on 16L

Single Runway Operations

- Single runway operations on runway 34L or 34R
- Single runway operations on runways 16L or 16R
- Single runway operations on runway 09 or 27

Simultaneous Opposite Direction Parallel Runway Operations (SODPROPS)

- SODPROPS with aircraft departing from runway 34R and arriving on 16R

E4.5.1 Mixed parallel operations

The standard mode of operation considered for arrivals and departures on the existing and proposed north-south runways is mixed parallel operations, as illustrated in Figure E4.1. It provides the most capacity for air traffic management during normal operations. Allocating arrivals and departures to both runways maximises utilisation of the airspace and ground infrastructure. Modelling showed that runway capacity of up to 90-95 aircraft movements an hour could be achieved.

In this mode, aircraft will generally be allocated to runways based on the geographic location of the flight's origin or destination. This allows air traffic to be processed most efficiently. Aircraft arriving from, or departing to, northern and western destinations (including Brisbane and Perth) will use the new north-south runway (16R/34L). Aircraft arriving from and departing to eastern destinations (including Sydney and Canberra) would use the existing north-south runway (16L/34R).

To deliver the capacity necessary for Melbourne Airport to meet projected demand, M3R's operating modes will need to prioritise parallel runway operations between 6am and 11pm.

E4.5.2 Segregated parallel operations

In certain situations (e.g. when demand is lower outside peak periods, and in poor weather when low visibility procedures are in use) it may be more efficient and practical to use segregated parallel operations. This is when arrivals are on one runway and departures on the other. The various segregated parallel modes are illustrated in Figure E4.2. Modelling showed that runway capacity of up to 60-70 aircraft movements an hour could be achieved, depending on the mode.

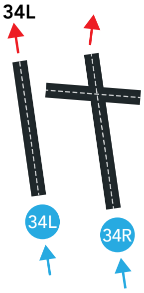
E4.5.3 SODPROPS

The preferred mode of operation for managing the impact of aircraft noise on residential areas between 11pm and 6am (when demand and weather conditions permit) is to process arriving traffic to runway 16R and departing traffic over the largely uninhabited areas to the north via runway 34R. This is the Simultaneous Opposite Direction Parallel Runway Operations (SODPROPS) mode illustrated in Figure E4.3. It is anticipated that this mode could achieve a runway capacity of up to 50 aircraft movements per hour, mirroring SODPROPS modes at Brisbane and Sydney Airport.

Figure E4.1
Mixed mode parallel operations

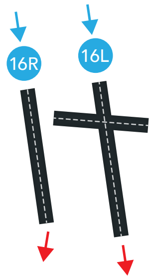
Mode Mixed Mode 34

Arrivals Runway 34R & 34L
Departures Runway 34R & 34L



Mode Mixed Mode 16

Arrivals Runway 16L & 16R
Departures Runway 16L & 16R



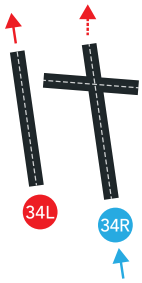
Source: APAM, 2020

Figure E4.2
Segregated parallel modes of operation

Mode SM1

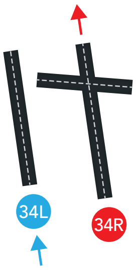
Arrivals Runway 34R
Departures Runway 34L

Aircraft will use existing NS runway for long haul departures when operationally required



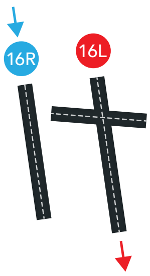
Mode SM3

Arrivals Runway 34L
Departures Runway 34R



Mode SM2

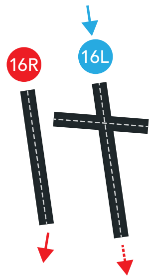
Arrivals Runway 16R
Departures Runway 16L



Mode SM4

Arrivals Runway 16L
Departures Runway 16R

Aircraft will use existing NS runway for long haul departures when operationally required

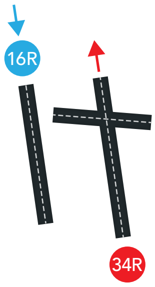


Source: APAM, 2020

Figure E4.3
Simultaneous Opposite Direction Parallel Runway Operations (SODPROPS)

SODPROPS

Arrivals Runway 16R
Departures Runway 34R

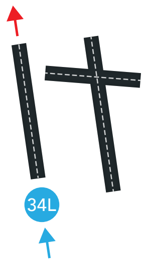


Source: APAM, 2020

Figure E4.4
Single runway modes of operation

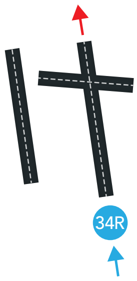
Runway 34L

Arrivals Runway 34L
Departures Runway 34L



Runway 34R

Arrivals Runway 34R
Departures Runway 34R

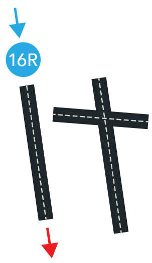


Runway 16L

Arrivals Runway 16L
Departures Runway 16L

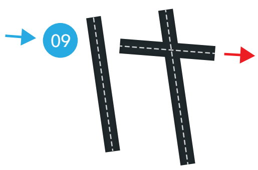
Runway 16R

Arrivals Runway 16R
Departures Runway 16R



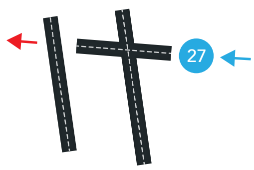
Runway 09

Arrivals Runway 09
Departures Runway 09



Runway 27

Arrivals Runway 27
Departures Runway 27



Source: APAM, 2020

E4.5.4
Single runway operations

Single runway modes of operation will, during most periods of the day, offer insufficient capacity to process traffic without significant delay and congestion. Therefore, these modes will only be used when the parallel north-south runways are unavailable. The single runway modes of operation are illustrated in **Figure E4.4**. Modelling showed runway capacity ranging up to between 48 and 50 aircraft movements an hour could be achieved, depending on the mode.

E4.5.5
Other modes

When weather conditions (particularly wind speed and direction) do not allow the above modes of operation, others may be required. These include arrivals and departures on the east-west runway (09/27). In such circumstances, pilots may prefer to depart and arrive using the existing north-south runway (16L/34R) due to its dimensions. These 'off-mode' flights would effectively result in an intersecting runway operation, limited in capacity due to the high crosswind component.

These other modes are expected to be used very infrequently.

E4.5.6
Noise abatement preferred modes of operations

E4.5.6.1
Day and evening period modes 6am–11pm

To deliver the capacity necessary for Melbourne Airport to meet the projected demand, M3R operating modes will need to prioritise mixed-mode parallel runway operations during the period 6am to 11pm.

During mixed mode operations, use of the runway 34 direction would be prioritised whenever available.

Departing aircraft make significantly more noise around the airport than arrivals (because their heavy fuel load means they need much more thrust). However, their noise on the ground fades faster because they take off at a steeper angle than arrivals generally use when landing. Taking this into account, the less-populated areas to the airport's north offer greater opportunities to design departure flight paths that avoid or minimise impacts on local populations.

Table E4.1 and **Figure E4.5** illustrate the proposed noise abatement preferred modes for the 6am to 11pm period, when demand requires mixed mode operations.

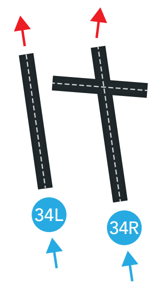
Table E4.1
Mixed mode day

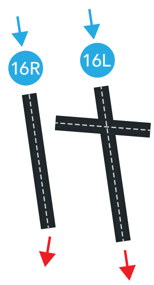
Priority	Arrivals	Departures	Notes
1	34L & 34R	34L & 34R	Mixed Mode
2	16L & 16R	16L & 16R	Mixed Mode

Source: APAM, SoundIN & Rehbein, 2020

Figure E4.5
Mixed mode day

Priority	Day (0600 – 2300)
1	**Mode Mixed Mode 34** Arrivals Runway 34R & 34L Departures Runway 34R & 34L
2	**Mode Mixed Mode 16** Arrivals Runway 16L & 16R Departures Runway 16L & 16R





Source: APAM, SoundIN & Rehbein, 2020

When demand is lower during the day and evening, the runway infrastructure, facilities, and airspace architecture proposed under M3R will allow a wider range of practical operating modes. These possibilities include:

- Option 1 – Segregated mode operations (when demand permits) that prioritise arrivals to the new north-south runway 16R or 34L, and departures from the existing north-south runway 16L or 34R. This operating mode is the most efficient because all aircraft (even ultra-long-haul departures) can operate from the existing runway, and all arrivals are able to land on the new runway. Departures to the north, and arrivals from the south, would be prioritised. Modelling has shown that this mode (in combination with mixed mode when demand requires) impacts the fewest number of dwellings with significant noise emissions. This operating strategy is illustrated in Table E4.2 and Figure E4.6.
- Option 2 – Segregated mode operations (when demand permits) that alternate runway priorities daily between the existing and new runways as explained below, again with priority for operations in a northerly direction (departures runway 34L/R). This operating strategy is illustrated in Table E4.3 and Figure E4.7.
    - Day 1 – Arrivals to the new north-south runway 16R or 34L and departures from the existing north-south runway 16L or 34R (as for Option 1)
    - Day 2 – Arrivals to the existing north-south runway 16L or 34R and departures from the new north-south runway 16R or 34L, with a few ultra-long-haul departures from the existing north-south runway 16L or 34R.

Modelling has shown that although Option 2 impacts more dwellings with significant noise emissions than Option 1, it does distribute noise impacts between existing and newly affected dwellings more evenly and with a predictable regime of respite.

Other segregated mode operating strategies were explored. However, modelling estimated they would result in even greater noise impacts than either of the two above.

Modelling undertaken for M3R has shown that using segregated modes between 11pm and 6am has the greatest potential to reduce noise impacts in the earlier years of M3R operation. However, by 2046 capacity requirements will demand the use of mixed mode for a large part of the day and evening period. Therefore, mitigation available from using segregated modes between 6am and 11pm is limited by 2046.

Table E4.2
Option 1 (day)

Priority	Arrivals	Departures	Notes
1	34L	34R	SM3
2	16R	16L	SM2
3	34L & 34R	34L & 34R	Mixed Mode
4	16L & 16R	16L & 16R	Mixed Mode

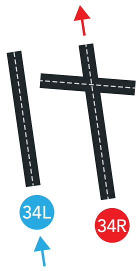
Source: APAM, 2020

Figure E4.6
Option 1 (day)

Priority	Day (0600 - 2300)

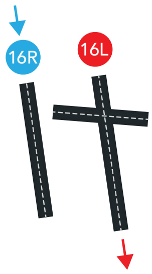
1

Mode SM3
Arrivals Runway 34L
Departures Runway 34R



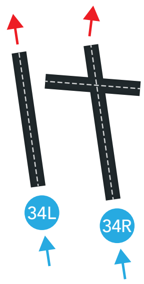
2

Mode SM2
Arrivals Runway 16R
Departures Runway 16L



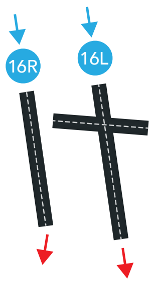
3

Mode Mixed Mode 34
Arrivals Runway 34R & 34L
Departures Runway 34R & 34L



4

Mode Mixed Mode 16
Arrivals Runway 16L & 16R
Departures Runway 16L & 16R



Source: APAM, 2020

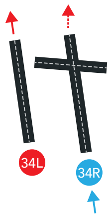
Table E4.3
Option 2 (day)

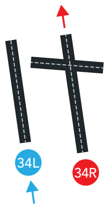
Priority	Arrivals	Departures	Notes	Day 1	Day 2
1	34L or 34R	34L or 34R		SM1*	SM3
2	16L or 16R	16L or 16R		SM2	SM4*
3	34L & 34R	34L & 34R	Mixed Mode		
4	16L & 16R	16L & 16R	Mixed Mode		

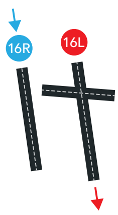
Source: APAM, SoundIN & Rehbein, 2020
**SM1 & SM4 will use existing NS runway for long haul departures when operationally required*

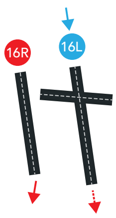
Figure E4.7
Option 2 (day)

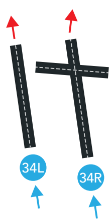
Priority	Day (0600 - 2300)	
1	**Day 1** **Mode SM1** Arrivals Runway 34R Departures Runway 34L Aircraft will use existing NS runway for long haul departures when operationally required.	**Day 2** **Mode SM3** Arrivals Runway 34L Departures Runway 34R
2	**Day 1** **Mode SM2** Arrivals Runway 16R Departures Runway 16L	**Day 2** **Mode SM4** Arrivals Runway 16L Departures Runway 16R Aircraft will use existing NS runway for long haul departures when operationally required.
3	**Mode Mixed Mode 34** Arrivals Runway 34R & 34L Departures Runway 34R & 34L	
4	**Mode Mixed Mode 16** Arrivals Runway 16L & 16R Departures Runway 16L & 16R	

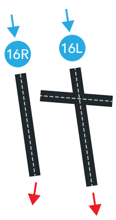












Source: APAM, 2020

E4.5.6.2
Night period modes 11pm–6am

When demand and weather conditions permit, SODPROPS is the preferred mode of operation for managing the impact of aircraft noise on residential areas during the period 11pm to 6am (as illustrated in **Figure E4.3**). The intent of SODPROPS is to direct flights over less populated areas to the north and west of the airport whenever possible, as shown in **Figure E4.8**.

This will concentrate flights over less populated areas during the most noise-sensitive period. By necessity, this will mean that people in some areas will experience a greater proportion of aircraft movements than is the case without M3R. The preliminary design of flight paths seeks to minimise the impacts for residential areas to the south and east of the airport (as discussed in **Chapter C2: Airspace Architecture and Capacity**). The majority of night-time departures would not overfly a built-up area within 30 kilometres of the airport.

When SODPROPS is not available, the next preferred mode in terms of managing nighttime noise impacts at night is segregated modes. Their options are similar to those for the day and evening (6am to 11pm) period, described above.

Combining SODPROPS with segregated-mode Option 1 results in the operating strategy illustrated in **Table E4.4** and **Figure E4.9**; combining SODPROPS with segregated mode Option 2 results in the operating strategy illustrated in **Table E4.5** and **Figure E4.10**.

Table E4.4
Option 1 (night)

Priority	Arrivals	Departures	Notes
1	16R	34R	SODPROPS
2	34L	34R	SM3
3	16R	16L	SM2
4	34L & 34R	34L & 34R	Mixed Mode**
5	16L & 16R	16L & 16R	Mixed Mode**

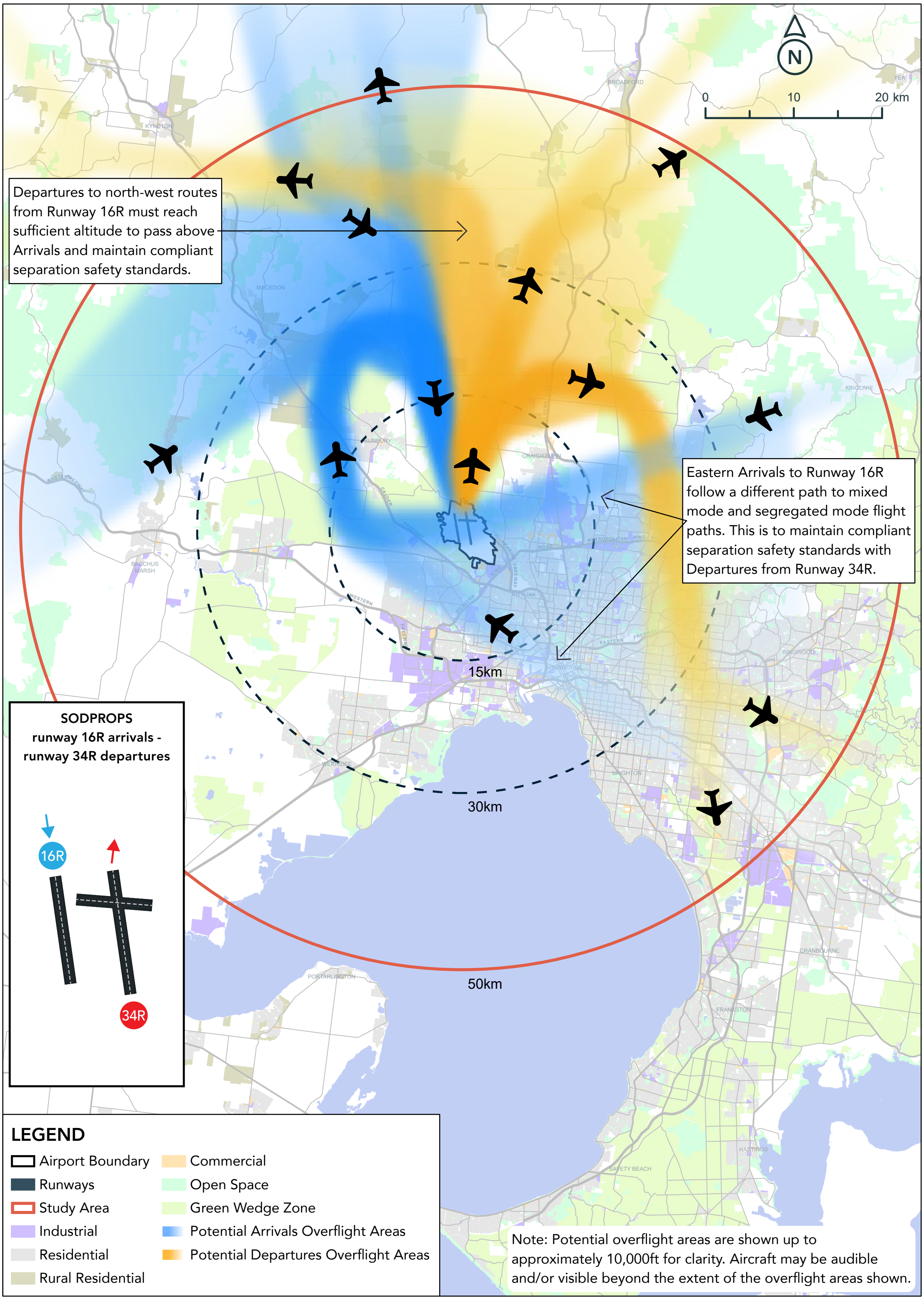
Source: APAM, SoundIN & Rehbein, 2020
*** When operationally required*

Table E4.5
Option 2 (night)

Priority	Arrivals	Departures	Notes	Day 1	Day 2
1	16R	34R	SODPROPS		
2	34L or 34R	34L or 34R		SM1*	SM3
3	16L or 16R	16L or 16R		SM2	SM4*
4	34L & 34R	34L & 34R	Mixed Mode**		
5	16L & 16R	16L & 16R	Mixed Mode**		

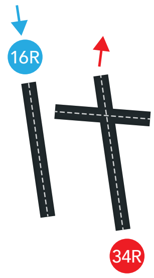
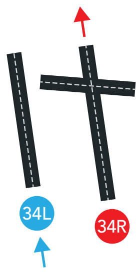
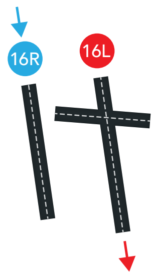
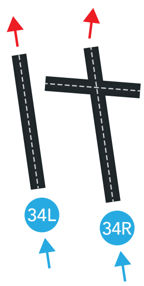
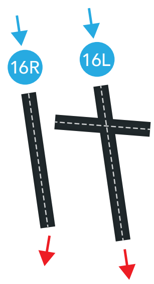
Source: APAM, 2020
** SM1 & SM4 will use existing NS runway for long haul departures when operationally required*
*** When operationally required*

Figure E4.8
Utilisation of Melbourne green wedges by the proposed SODPROPS mode at night



Source: APAM, 2020

Figure E4.9
Option 1 (night)

Priority	Night (2300 – 0600)	
1	**Mode SODPROPS** Arrivals Runway 16R Departures Runway 34R	
2	**Mode SM3** Arrivals Runway 34L Departures Runway 34R	
3	**Mode SM2** Arrivals Runway 16R Departures Runway 16L	
4	**Mode Mixed Mode 34** Arrivals Runway 34R & 34L Departures Runway 34R & 34L	
5	**Mode Mixed Mode 16** Arrivals Runway 16L & 16R Departures Runway 16L & 16R	

Source: APAM, 2020

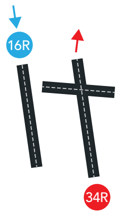
Figure E4.10
Option 2 (night)

Priority	Night (2300 – 0600)

1

Mode SODPROPS
Arrivals Runway 16R
Departures Runway 34R

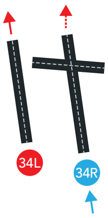
There are specific weather requirements that apply to this mode in terms of cloud base, visibility and wind strength and direction. These strict weather requirements mean that this mode is available for less than 30 per cent of the night (single-hour periods).



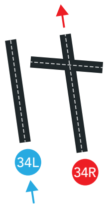
2

Day 1
Mode SM1
Arrivals Runway 34R
Departures Runway 34L

Aircraft will use existing NS runway for long haul departures when operationally required.

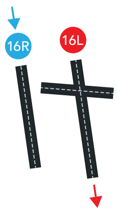


Day 2
Mode SM3
Arrivals Runway 34L
Departures Runway 34R



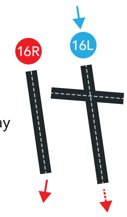
3

Day 1
Mode SM2
Arrivals Runway 16R
Departures Runway 16L



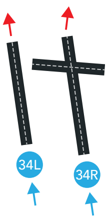
Day 2
Mode SM4
Arrivals Runway 16L
Departures Runway 16R

Aircraft will use existing NS runway for long haul departures when operationally required.



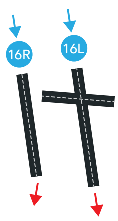
4

Mode Mixed Mode 34
Arrivals Runway 34R & 34L
Departures Runway 34R & 34L



5

Mode Mixed Mode 16
Arrivals Runway 16L & 16R
Departures Runway 16L & 16R



Source: APAM, 2020

E4.6
DRAFT RUNWAY OPERATING PLAN

The Draft Runway Operating Plan for Melbourne Airport following M3R's opening is presented in Table E4.6. It shows the preferred modes of operation recommended to optimise noise abatement where possible.

The proposed plan prioritises those operating modes during the day (defined as 6am to 11pm) that deliver the capacity Melbourne Airport needs to meet projected demand.

During the night period (11pm to 6am), when demand is lower, a wider range of operating modes is practically available. The draft operating plan proposes that priority is given to night operating modes that minimise the overflight of residential areas. These modes direct the majority of departures over less populated areas to the north of the airport.

To achieve this, SODPROPS would be the highest priority mode at night. When SODPROPS is unavailable due to weather conditions, the north-south runways would operate in a segregated mode option. The preferred option for segregated mode operations (of the two presented in this MDP) will be determined through further community consultation.

The use of the preferred segregated mode option will also be adopted whenever practicable (in terms of demand prevailing at the time) for day period operations outside peak periods.

Modelling presented by M3R to date has not included use of Runway 09/27. This strategy was adopted to avoid understating the potential impacts of the primary parallel north-south operating modes.

Runway 09/27 remains an important element of Melbourne Airport's operation following M3R. Feedback during the public exhibition clearly demonstrated community desire for its ongoing use for sharing noise, especially at night.

Melbourne Airport acknowledges that there is significant opportunity to introduce operating modes that promote use of Runway 09/27 with the objective of noise sharing. The process of detailed airspace design (pending approval of the M3R MDP) shall incorporate this objective and include updated noise modelling.

E4.6.1
Nominating duty runways and modes

'Duty runway' refers to the operating direction of the runway. For example, when landings are from the south and departures are to the north, the duty runway is runway 34.

During the day, when wind conditions allow, runways 34L and 34R are the preferred duty runways. They allow aircraft to take off to the north over largely unpopulated areas. (Runways 16R and 16L operate as the duty runways if wind conditions prevent use of the 34 direction.)

When wind conditions allow neither 16 nor 34 direction operations, either runway 09 or 27 would be required as the duty runway. During these occasions, despite the east-west runway being nominated as the duty runway, pilots may prefer to depart and arrive using the existing north-south runway (16L/34R) due to its larger dimensions. These off-mode flights effectively result in a crossing mode operation, which has limited capacity and is expected to be used very infrequently.

E4.6.2
Rules for mode selection

When more than one of the operating modes listed in Table E4.6 is available (given meteorological and capacity constraints) the mode used is determined by the table's order of priority.

A change of operating mode is implemented by ATC, and the time taken to implement it dependent on the current volume of air traffic. However, during the day a change to a higher priority mode will generally be made as soon as practicable once the higher priority mode becomes available (taking into account the flow of traffic).

During night-time, when a higher priority mode becomes available a change to that mode is made as soon as safety and other operational considerations allow.

Table E4.6
Proposed Draft Runway Operating Plan

Time	Priority	Landing	Take-off	Notes
Day (6am-11pm)	1	Runway 34L and 34R	Runway 34L/R	Runways will be operated in mixed mode when demand requires between 6am and 11pm. Where demand permits, segregated mode options may be operated in the 'day mode' period
	2	Runway 16L and 16R	Runway 16L/R	
	3	Runway 09 or 27	Runway 09 or 27	-
Night (11pm – 6am)	1	Runway 16R	Runway 34R	SODPROPS
	2	Runway 34L or 34R	Runway 34R or Runway 34L	Runways will be normally be operated in segregated mode between 11pm and 6am. Use of Runway 34L for arrivals and Runway 34R for departures results in the fewest impacted dwellings (Option 1). Alternating the arrival and departure runways daily distributes the noise impacts between existing and newly affected dwellings more evenly and with a predictable regime of respite (Option 2).
	3	Runway 16 R or 16L	Runway 16L or 16R	Runways will be normally be operated in segregated mode between 11pm and 6am. Use of Runway 16R for arrivals and Runway 16L for departures results in the fewest impacted dwellings (Option 1). Alternating the arrival and departure runways daily distributes the noise impacts between existing and newly affected dwellings more evenly and with a predictable regime of respite (Option 2).
	4	Runway 27	Runway 27	-
	5	Runway 09	Runway 09	-

Source: APAM, SoundIN, Rehbein & Airservices, 2020


القطرية
QATAR

Appendix E4A
Future Use of 09/27 (East-West Runway)

APPENDIX E4A CONTENTS

APPENDIX E4A FIGURES

APPENDIX E4A TABLES

E4A.1
INTRODUCTION

Melbourne Airport's M3R project includes several necessary changes to existing infrastructure and operations – importantly among these is shortening of the current east-west Runway (09/27).

Physical change to Runway 09/27, coupled with the context of a parallel north-south runway system, has implications for its ongoing capability and operation.

This section collects and presents the various elements of M3R that specifically relate to future use of runway 09/27, including:

- Historical infrastructure planning
- Existing operational use
- Topography and configuration
- Operational capability of reduced length
- Procedures and utility in M3R system.

Runway 09/27 has been in operation with its current length (2,286 metres) since Melbourne Airport opened in 1970. Subsequent plans have varied its interim and 'ultimate' length - the M3R project proposes to reduce its overall length by 346 meters to 1,940 metres for reasons detailed herein.

Future plans for Runway 09/27, as detailed in Master Plan 2022, include its eventual extension within the 'ultimate' four-runway airport layout.

Figure E4A.1
Evolution of the runway layout from the 1960s to 1990s

A 1960s
Master Plan

B 1989
Melbourne Airport Strategy

C 1990
Supplement to the Melbourne Airport Strategy
Draft Environmental Impact Statement

E4A.2 HISTORIC PLANNING

E4A.2.1 Prior to the 1998 Master Plan

Planning for the long-term configuration of Melbourne Airport has been evolving since the 1960s through successive runway layouts. This has included substantial modifications to the configuration of Runway 09/27 as shown in Figure E4A.1.

Figure E4A.1 image A: In the 1960s (prior to the airport's official opening) a total Runway 09/27 runway length of 3,000 metres was envisaged, to be achieved by strategic extension of pavement to the west.

Figure E4A.1 image B: The 1989 Melbourne Airport Strategy (1989 MAS) further proposed extensions to both west and east, enabling total runway length 3,500 metres. The 1989 MAS also notably changed plans for a future parallel north-south runway - to parallel with the existing and separated by 400 metres, located entirely south of existing Runway 09/27.

Figure E4A.1 image C: The subsequent 1990 Supplement to the Melbourne Airport Strategy Draft Environment Impact Statement (1990 Supplement Report) updated the north-south runway proposal to 1,311 metre spacing and shifted 1,900m to the north following recommendations during the public exhibition period. In this location, the north-south runway crossed the alignment of extended Runway 09/27.

E4A.2.2 1998-2008 Master Plans

The 1998 Master Plan retained the runway layout of the 1990 Supplement Report. The 20-year airport development drawing showed construction of a north-south parallel runway and 714 metre western extension to Runway 09/27 (to total 3,000 metres), however was careful to explain that the sequence of the third and fourth runways had not been decided:

> *"Although this plan highlights runway 16R/34L, it serves only to illustrate that one new runway is anticipated to be constructed by 2018/19 and there is an option for it to be either 16R/34L or 09R/27L."*

The long-term concept of extending Runway 09/27 to 3,000 metres was retained in the 2003 and 2008 Master Plans, though without further detail of sequence or timing.

E4A.2.3 2013-2018 Master Plans

The 2013 Master Plan nominated orientation of the third runway east-west. This plan included extension of the existing Runway 09/27 by 714 metres to the west within the next five years (by 2018) to correlate with planned operation for the parallel east-west between 2018 and 2022.

The 2018 Master Plan included the extension of existing Runway 09/27 in the scope of the Runway Development Program (RDP) project. This scope included western extension of 714 metres and eastern extension of 378 metres to provide a total runway length of 3,378 metres. Eventual full extension to 3,500 metres was projected in the 2018 Master Plan.

E4A.2.4
2022 Master Plan

Master Plan 2022 introduces the concept design for M3R MDP, which includes shortening Runway 09/27 at the western end by 346 metres to total runway length of 1,940 metres (refer to Master Plan 2022 **Figure 9-1**).

This plan also continues to safeguard the long-term layout of runways at Melbourne Airport (i.e. beyond 2042) that further modifies Runway 09/27 by extending its length to 3,500 metres via extensions to the east and west.

E4A.3
HISTORIC (2019) USAGE OF RUNWAY 09/27

E4A.3.1
Current runway characteristics

The utility of Runway 09/27 is dependent on several factors including weather conditions (wet/dry, temperature, etc.) and aircraft performance (particularly payload effects upon landing/departure requirements) as balanced against available pavement length. These characteristics directly influence the aircraft types and flight routes that are able to operate on Runway 09/27.

The existing total runway length for Runway 09/27 is 2,286 metres. Layout and associated entry/exit taxiway locations are shown in **Figure E4A.2.**

Current declared distances for Runway 09/27 [Source: Airservices AIP, RDS YMML -1, 01 Dec 2022]:

- Take-off Run Available (TORA): 2,286 metres
- Take-off Distance Available (TODA): 2,436 metres (includes clearway 150 metres)
- Accelerate Stop Distance Available (ASDA): 2,346 metres (includes stopway 60 metres)
- Landing Distance Available (LDA): 2,286 metres

Landing Exit Distances (LED) [Source: Airservices AIP, MMLNA04-151_01DEC2022]:

- Runway 27
  - Taxiway N: 1,630 metres (Rapid Exit Taxiway – preferred exit)
  - Taxiway M: 2,286 metres (full length)
- Runway 09
  - Taxiway A: 1,658 metres (preferred exit for turboprops)
  - Taxiway P: 2,286 metres (preferred exit for other aircraft)
  - Taxiway Q: 2,286 metres

E4A.3.2
Noise Abatement Procedures and total annual use

Current Noise Abatement Procedures (NAP) for Melbourne Airport are shown in **Figure E4A.3** and **Figure E4A.4.** Runway 09/27 is prioritised within the top three noise abatement procedures for day (6am to 11pm – including high capacity operations) and night (11pm to 6am). These modes include crossing runway operations and Single Runway Operations (SRO) on Runway 27.

- The NAP priorities directly influence and are reflected by utilisation of Runway 09/27 - 40 percent of all aircraft movements in 2019 (based on NFPMS data), of which runway 39 percent used Runway 27.
- There is substantial difference in Runway 09/27 usage between day and night. Despite being nominated in the top three priority modes during the night period, usage drops to 28 percent.

E4A.3.3
USE BY AIRCRAFT TYPE AND DESTINATION

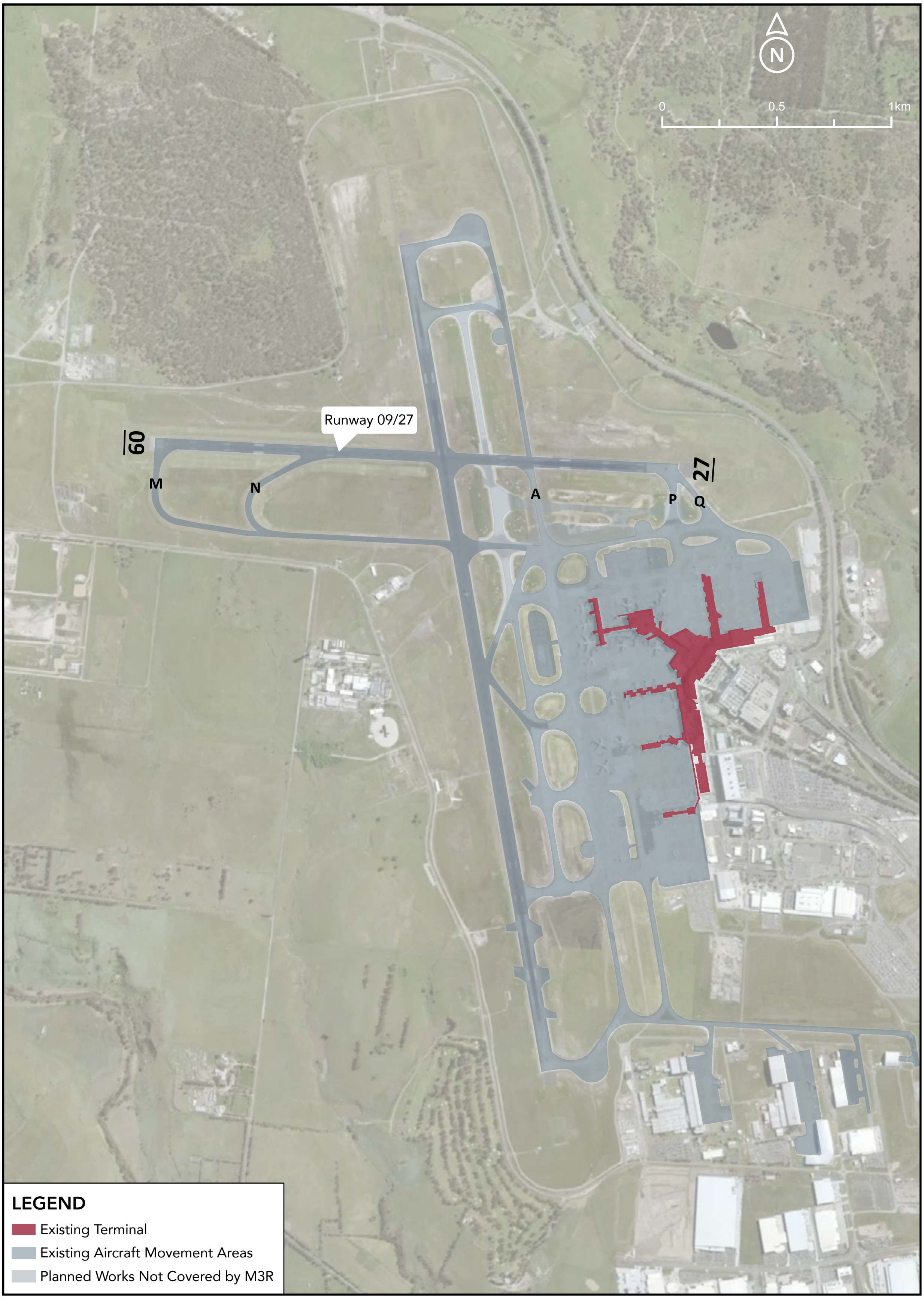
Runway 09/27 is not used frequently by all aircraft types or for all destinations. Analysis of 2019 NFPMS data demonstrates that the majority of aircraft movements on Runway 09/27 are narrow-body jets and turboprops (87%):

- For departures Runway 09/27 was predominantly used by narrow-body jets (average 125 per day). There were also some small wide-body jets (11 per day) and turboprop aircraft (average 8 per day).
- For arrivals, Runway 09/27 was typically used by narrow-body jets (average 72 per day). There were also some turboprop aircraft (average 16 per day) and small wide-body aircraft arrivals (six per day).

Of total airport traffic, Runway 09/27 was used for:

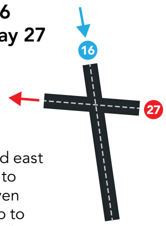
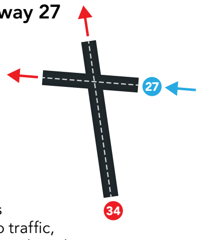
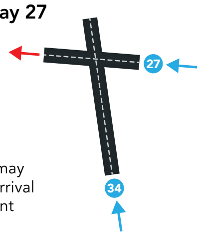
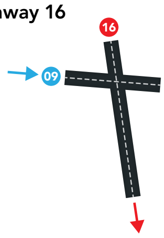
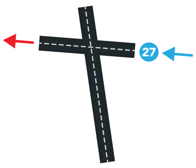
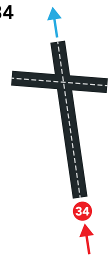
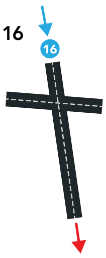
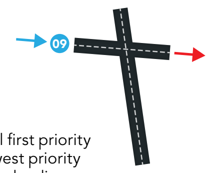
- Approximately 12% of movements by very-large and large wide-body aircraft (e.g. A380, B747, B777, A350). The rate of use was consistent across day and night periods.
- 23% of movements by other wide-body aircraft (e.g. B787, A330). The rate of use was slightly lower at night (19%).
- Narrow-body jets (e.g. B737-8, A320) and turboprop aircraft (e.g. Saab 340, Q400) make more equitable use of the runways, however preference remains for Runway 16/34 (09/27 has 45% of movements through full day, reducing to 31% at night).
- Domestic freighters (e.g. B737-400, BAe 146) which predominantly operate during the night for 40% of movements.

Figure E4A.2
Existing runway 09/27 layout



Source: APAM, 2023

Figure E4A.3
Existing note abatement preferred runway modes day (6am to 11pm)

Priority	Day (0600 – 2300)		Day (0600 – 2300) High Capacity Landing Modes
1	**Arrivals Runway 16** **Departures Runway 27**  Runway 16 departure permitted for south and east bound routes. Subject to traffic by propeller driven aircraft or jet aircraft up to B737 / A320 size, but only when there is significant ground delay for a departure from runway 27.	**Arrivals Runway 27** **Departures Runway 27** **& Runway 34**  Runway 34 landing is permitted, subject to traffic, for arrivals from the south and south-west.	**Arrivals Runway 27** **Runway 34** **Departures Runway 27**  High capacity modes may be used during peak arrival periods when significant airborne delays would otherwise occur.
2	**Arrivals Runway 09** **Departures Runway 16**  Not available between 2300-0600 local time.		
3	**Arrivals Runway 27** **Departures Runway 27**  		
4	**Arrivals Runway 34** **Departures Runway 34**  	**Arrivals Runway 16** **Departures Runway 16**  	
5	**Arrivals Runway 09** **Departures Runway 09**  Runway 09 is equal first priority for landing but lowest priority for take-off. Ad-hoc landings on runway 09 may be available when suitable with overall traffic management.		

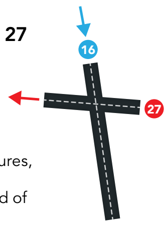
Source: Information from Airservices Australia (figure by APAM)

Figure E4A.4
Existing note abatement preferred runway modes night (11pm to 6am)

Priority	Night (2300 – 0600)

1

Arrivals Runway 16
Departures Runway 27

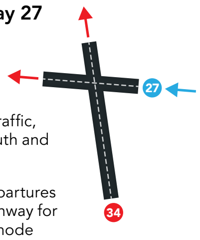


Where there are jet departures requiring the longer runway for departures, priority 2 mode may be nominated by ATC instead of priority 1.

Runway 34 landing is permitted, subject to traffic, for arrivals from the south-west.

2

Arrivals Runway 27
Departures Runway 27 & Runway 34

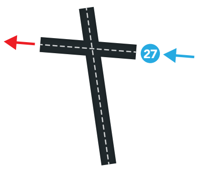


Runway 34 landing is permitted, subject to traffic, for arrivals from the south and south-west.

Where there are jet departures requiring the longer runway for departures, priority 2 mode may be nominated by ATC instead of priority 1.

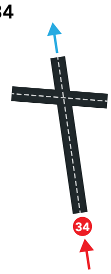
3

Arrivals Runway 27
Departures Runway 27

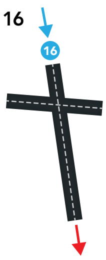


4

Arrivals Runway 34
Departures Runway 34

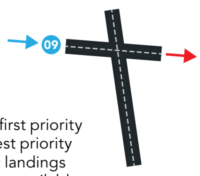


Arrivals Runway 16
Departures Runway 16



5

Arrivals Runway 09
Departures Runway 09

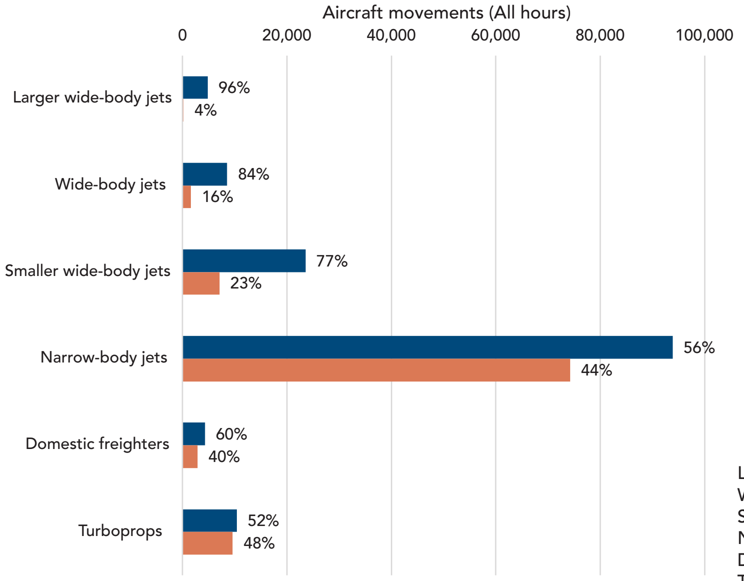


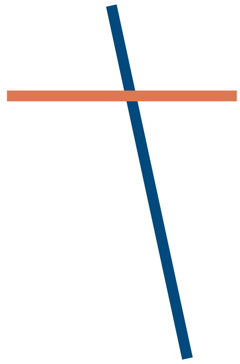
Runway 09 is equal first priority for landing but lowest priority for take-off. Ad-hoc landings on runway 09 may be available when suitable with overall traffic management.

Source: Information from Airservices Australia (figure by APAM)

Figure E4A.5
Runway usage by aircraft group (all hours)

Runway 16/34
Runway 09/27



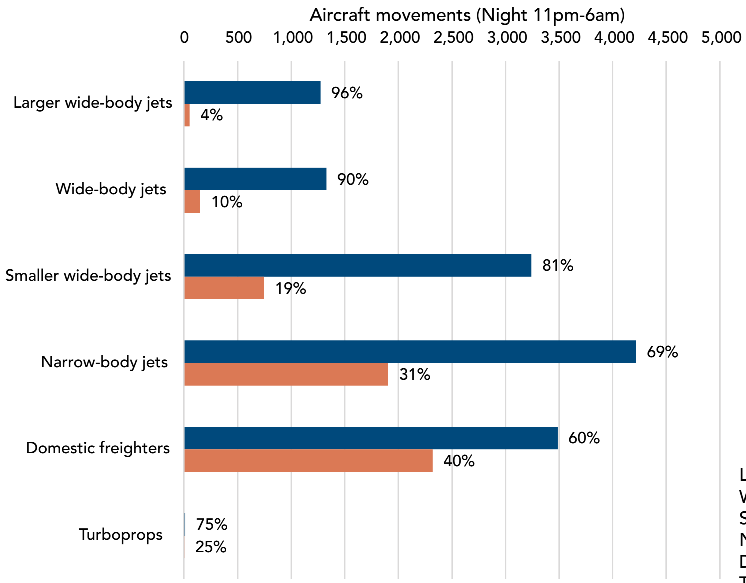


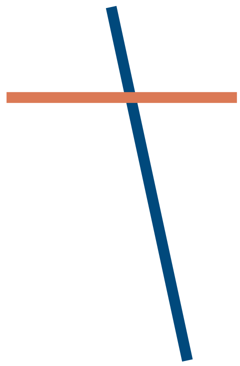
Large Wide-body Aircraft: Airbus A380s, Boeing 747s etc.
Wide-body Aircraft: Airbus A350s, Boeing 777s etc.
Smaller Wide-body Aircraft: Airbus A330s, Boeing 787s etc.
Narrow-body Jets: Airbus A320s, Boeing 737s etc.
Domestic Freighters: Boeing 737s, BAe 146s etc.
Turboprop Aircraft: Dash-8 Q400s, Saab 340s

Source: APAM analysis of 2019 NFPMS data

Figure E4A.6
Runway usage by aircraft group (night hours 11pm to 6am)

Runway 16/34
Runway 09/27

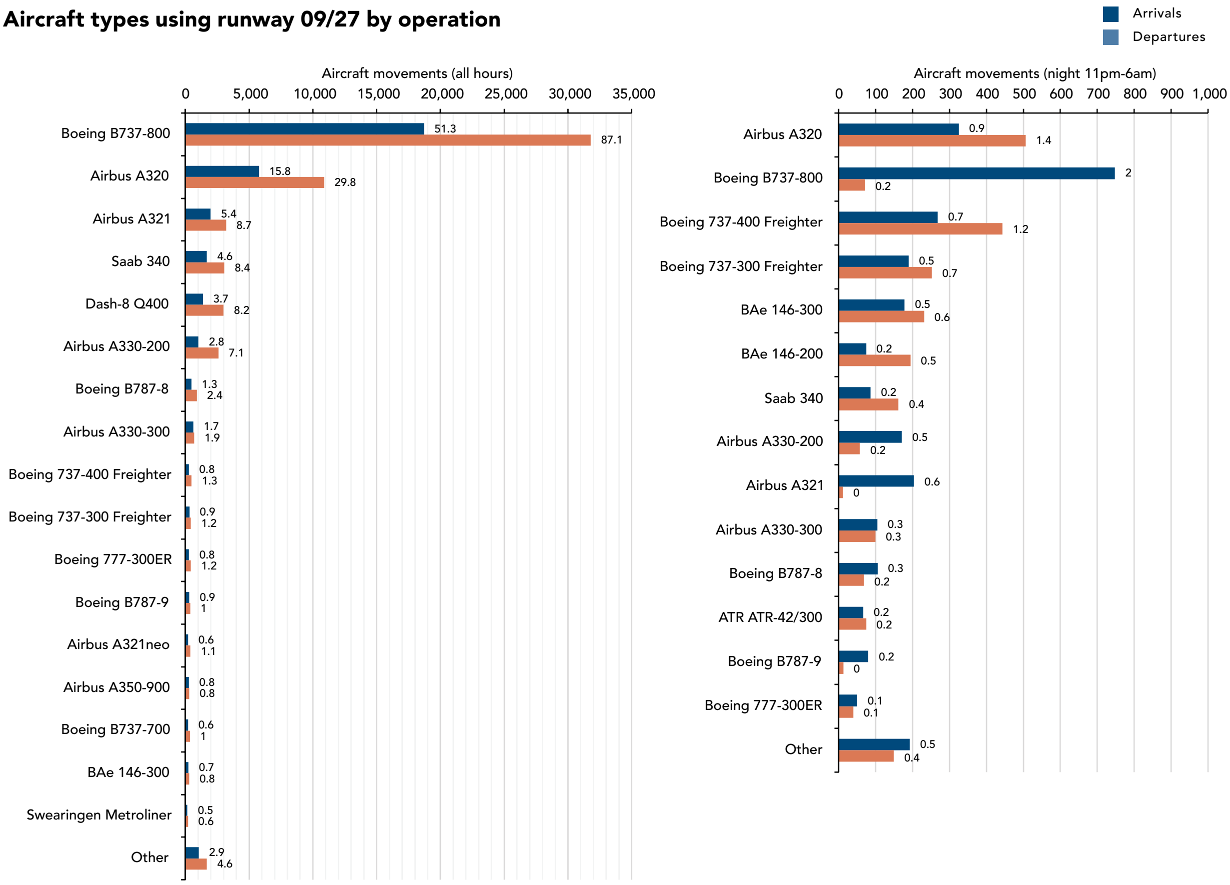




Large Wide-body Aircraft: Airbus A380s, Boeing 747s etc.
Wide-body Aircraft: Airbus A350s, Boeing 777s etc.
Smaller Wide-body Aircraft: Airbus A330s, Boeing 787s etc.
Narrow-body Jets: Airbus A320s, Boeing 737s etc.
Domestic Freighters: Boeing 737s, BAe 146s etc.
Turboprop Aircraft: Dash-8 Q400s, Saab 340s

Source: APAM analysis of 2019 NFPMS data

Figure E4A.7
Aircraft types using runway 09/27 by operation



Source: APAM analysis of 2019 NFPMS data

Figure E4A.5 and **Figure E4A.6** demonstrate runway use rates by aircraft group - for total operations, and overnight (11pm to 6am only).

Figure E4A.7 details use of Runway 09/27 in 2019 by arrival/departure for dominant aircraft types. Over 63% of these movements are departures.

An important factor in take-off performance (therefore pavement length required) is balance between aircraft weight and power and flight length. It is thus useful to understand the distribution of flight routes that are typically served by movements using Runway 09/27.

Departures from Runway 09/27:

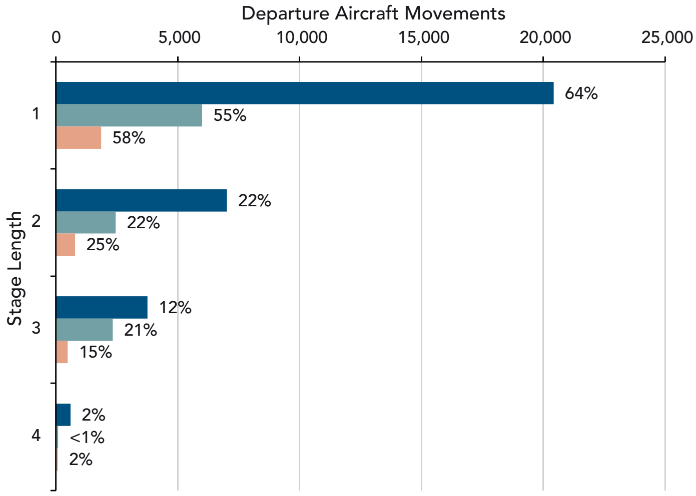
- For narrow-body fleet (refer to **Figure E4A.8**), over 84% of the departures using Runway 09/27 are within Stage Length 2 (within 1,000 nautical miles) and over 98% are within Stage Length 3 (within 1,500 nautical miles). These encompass all domestic ports (except Darwin and Broome) and New Zealand.
- For turboprops, all departures using Runway 09/27 (average 16 per day) are within Stage Length 1 (within 500 nautical miles) which covers regional Victoria, northern Tasmania and some regional New South Wales and South Australia destinations.
- For smaller wide-body jets (refer to **Figure E4A.9**), over 63% of departures using Runway 09/27 are within Stage Length 3 (within 1,500 nautical miles). The most prominent operations in this category (over 84%) are A330-200 servicing high-capacity demand for Perth and Sydney.

  Around 29% of wide-body departures from 09/27 are to destinations within Stage Lengths 4 and 5 (between 2,500 and 3,500 nautical miles). Prevalent destinations include Bali, Singapore, Manila and Kuala Lumpur.

Arrivals to Runway 09/27:

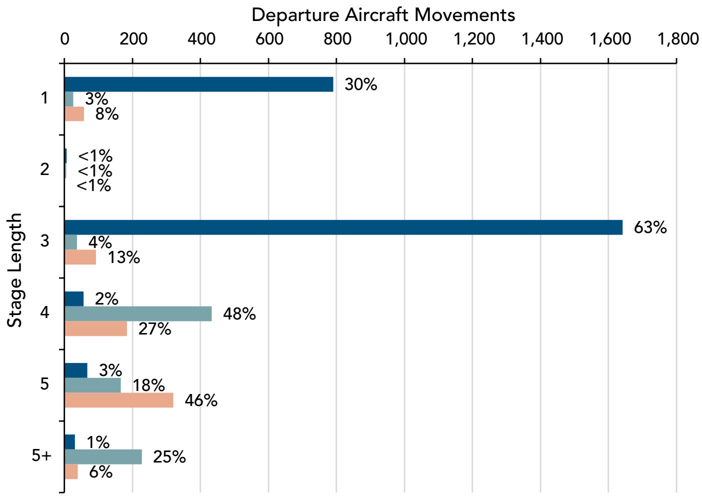
- For narrow-body fleet (refer to **Figure E4A.10**), over 84% of the arrivals using Runway 09/27 are within a Stage Length 2 (within 1,000 nautical miles) and over 97% are within Stage Length 3 (within 1,500 nautical miles). There were nine arrivals by A320 aircraft from Singapore (Stage Length 5) in 2019.
- For turboprops, all arrivals using Runway 09/27 (average eight per day) are within Stage Length 1 (within 500 nautical miles). There was one exception, which came from Brisbane (Stage Length 2).

Figure E4A.8
Runway 09/27 narrow-body aircraft departures usage by Stage Length



Source: APAM using 2019 NFPMS data

Figure E4A.9
Runway 09/27 wide-body aircraft departures usage by Stage Length



Source: APAM using 2019 NFPMS data

- For smaller wide-body jets (refer to **Figure E4A.11**), over 41% of arrivals using Runway 09/27 are within Stage Length 3 (within 1,500 nautical miles). The most prominent operations in this category (over 79%) are A330-200 servicing high-capacity demand for Sydney and Perth.

  Around 29% of wide-body arrivals to 09/27 are from airports within Stage Lengths 4 and 5 (between 2,500 and 3,500 nautical miles). Prevalent routes include Bali and Manila. Arrivals from ports in Stage Length 5 (over 3,500 nautical miles) also feature - predominantly Tokyo and Hong Kong. These routes are enabled for arrivals because landings generally require less runway (largely because aircraft land at lower weight having used fuel load during departure/flight).

E4A.4
RATIONALE FOR REDUCTION IN LENGTH

E4A.4.1
Interaction of Runway 09/27 and M3R

There are several important factors that influence and constrain the design of M3R, and consequently Runway 09/27. Safety, operability and resilience are key criteria for the project and have thus been carefully built into the infrastructure design.

Runway design compliance is primarily governed in Australia by the CASA Manual of Standards (MoS) Part 139 and related instruments, which include regulations for the design and protection of airspace and flight procedures.

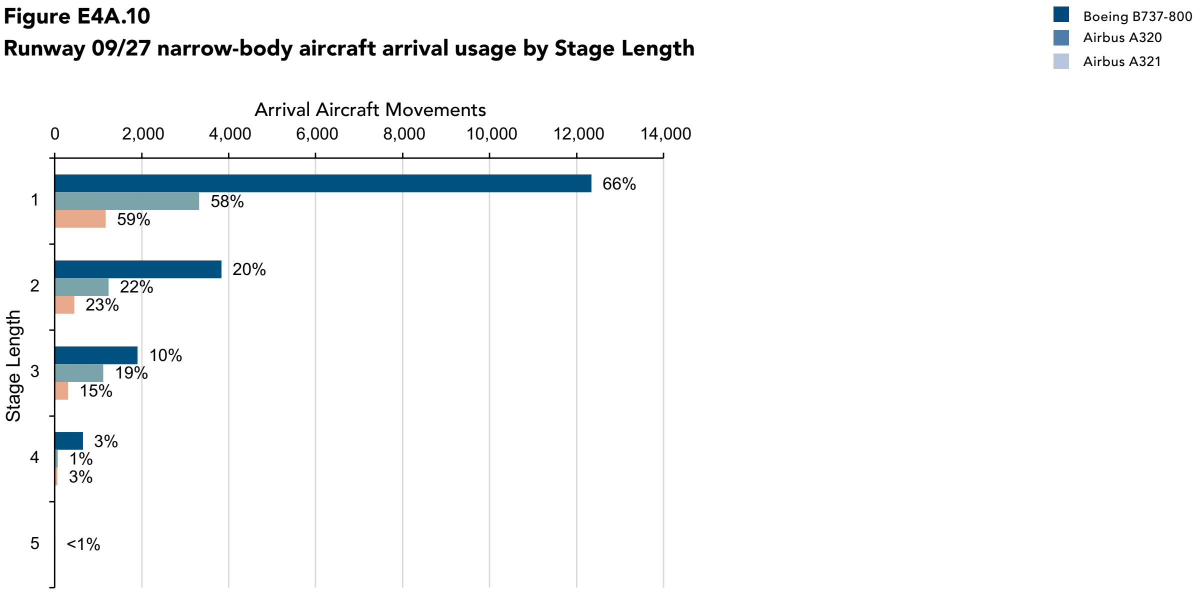
Design Constraints

Proposed Runway 16R/34L was carefully located and aligned (as highlighted in **Section C6.2**) in the 1990s through the Melbourne Airport Strategy process. Separation of the runway alignments by at least 1,310 metres enables them to be operated independently, which optimises the airport's flexibility, capacity and resilience. M3R places the new runway 1,311 metres to the west of the existing north-south runway.

The topography of the Tullamarine site along (and beyond) the 3,000-metre alignment of Runway 16R/34L significantly influences its physical design. The site elevates from south to north with a varied landscape and geology (detailed information is available in Chapters A5: Construction and B3: Soils, Groundwater and Waste). M3R design compliance criteria include regulatory specifications for longitudinal and lateral runway slopes.

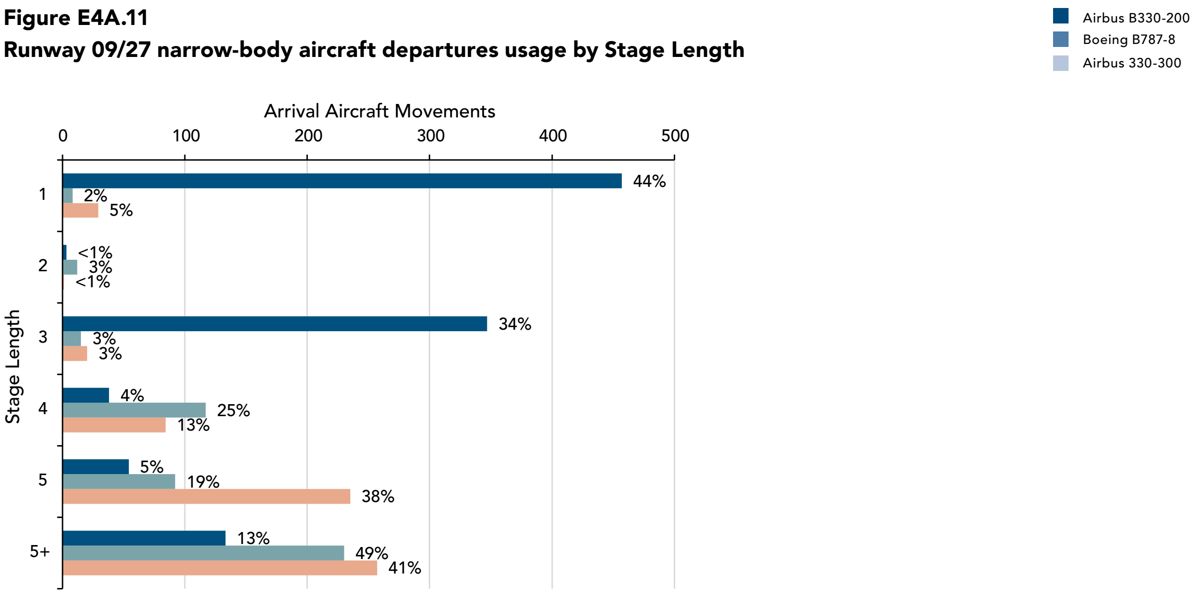
The elevation of the runway is also partially limited by obstacles outside the airport's boundary that must be incorporated into the design of the runway via Obstacle Limitation Surfaces (OLS) which function to safeguard the critical arrival and departure flight paths close to the airport. The most critical of these applicable to M3R is clearance above vehicles using Sunbury Road to the north, which affects the OLS approach and take-off climb surfaces.

Figure E4A.10
Runway 09/27 narrow-body aircraft arrival usage by Stage Length



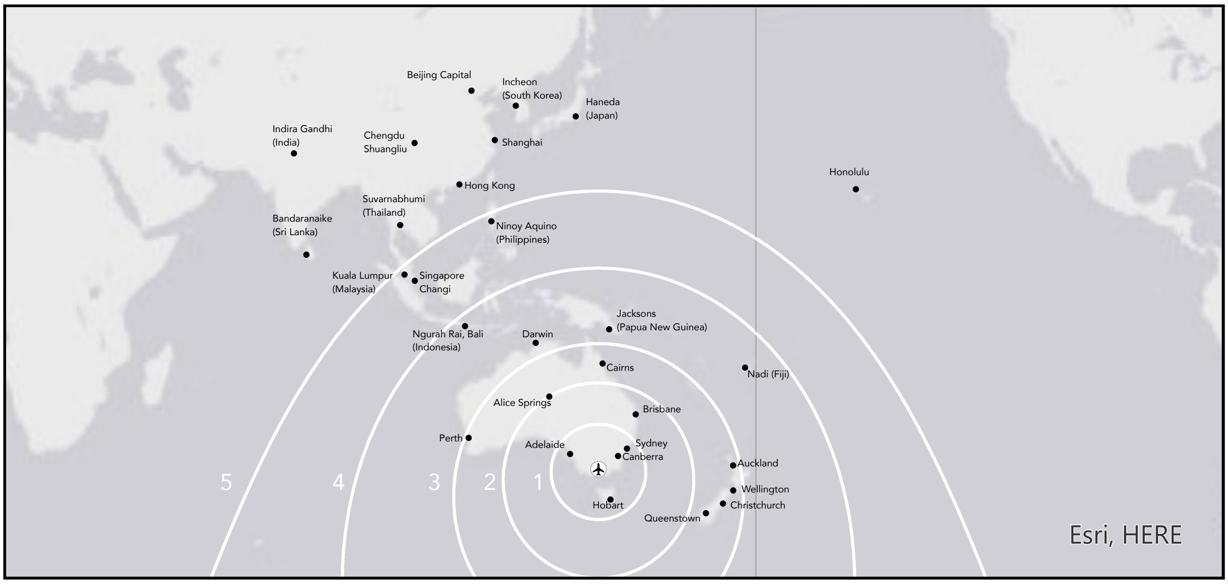
Source: APAM using 2019 NFPMS data, 2023

Figure E4A.11
Runway 09/27 narrow-body aircraft departures usage by Stage Length



Source: APAM using 2019 NFPMS data, 2023

Figure E4A.12
Stage Length map with destinations



Source: APAM, 2023

M3R (16R/34L) and 09/27

Figure E4A.13 shows the alignment of Runway 16R/34L (including the associated runway strip) overlaid on the western end of existing Runway 09/27 (including associated stopway, runway strip and Runway End Safety Area) and Taxiway Mike.

Figure E4A.14 demonstrates that the elevations of Runway 16R/34L and Runway 09/27 are approximately two meters apart at their intersection. This configuration presents a range of design challenges - particularly regarding the 09/27 Runway End Safety Area (RESA) of Runway 09/27.

E4A.4.2
Relevant standards and design practice

RESA are important elements of runway infrastructure, with related compliance requirements defined by MoS Part 139:

> *"6.26(1) Subject to subsections (2) and (3), a runway end safety area (RESA) must be:*
> *…*
> *(b)(ii) ensure an aeroplane encounters no hazards if it runs off the runway*
> *…*
> *(9) No portion of a RESA may project above the approach or take-off climb surfaces of the runway*
> *(10) A RESA must be free of fixed objects or structures, other than visual or navigational aids for the guidance of aircraft of vehicles.*
> *(11) Any fixed object or structure permitted to be on a RESA must be of low mass and frangibly mounted"*

MoS Part 139 does not specify criteria for runways that converge at their end/s, however related industry guidance is available from the United States Department of Transportation Federal Aviation Administration (FAA). FAA Advisory Circular AC 150/5300-13B (31st March 2022) section 3.7.5 addresses overlapping RSAs (Runway Safety Area):

> *"3.7.5.1 Standards*
> *1. Configure runway ends, taxiways and holding positions to allow taxiing and holding aircraft to remain clear of all RSAs.*
> *…*
> *3.7.5.2 Recommended Practices*
> *1. For multiple runways that converge but do not intersect, configure runway ends for the optimum condition of independent RSAs."*

E4A.4.3
Options considered

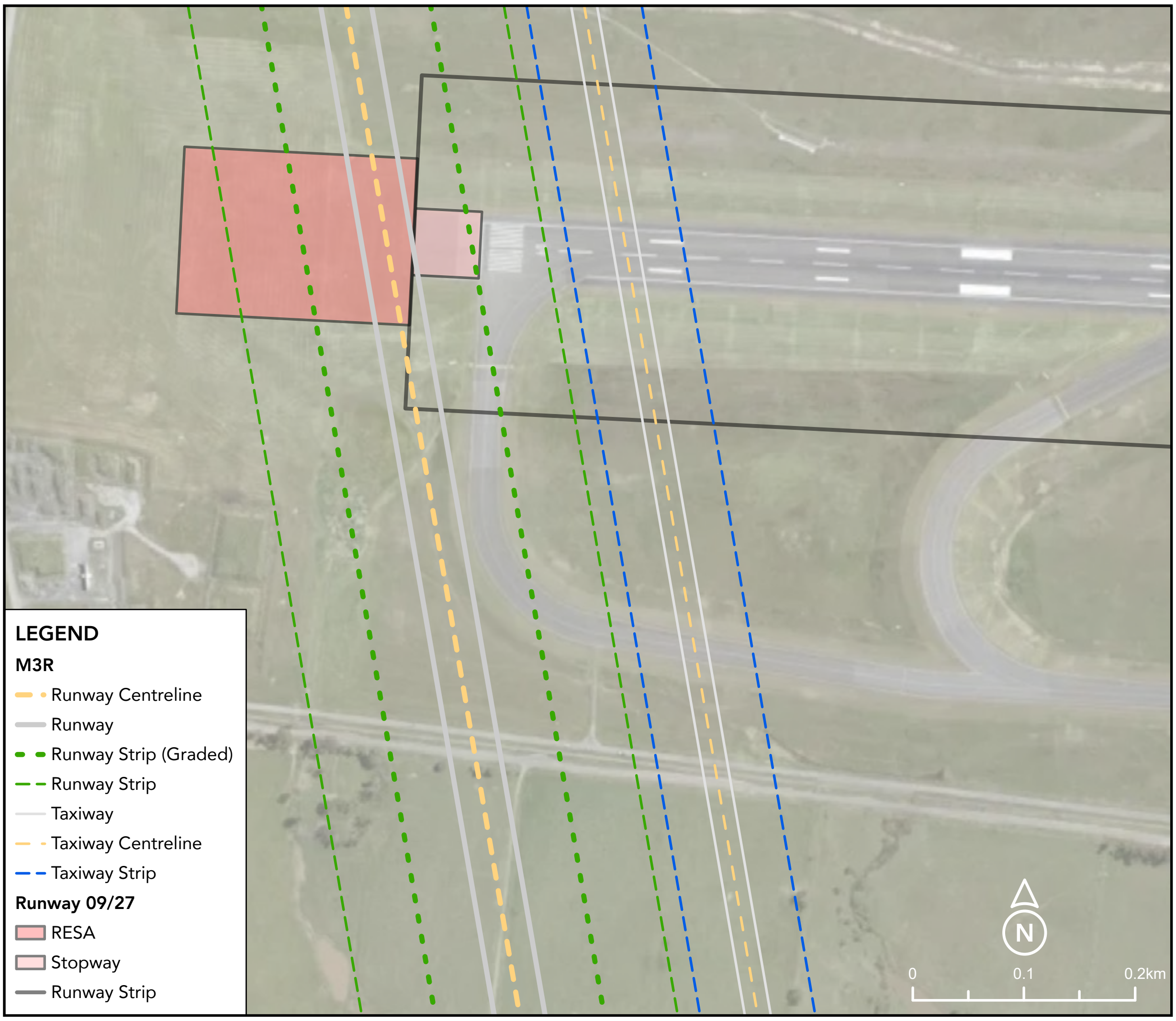
M3R design concluded that Runway 09/27 must be modified after considering a range of options to address the conflict between alignment/elevations, including (illustrated in Figure E4A.15):

- Relocating Runway 09 threshold east to clear Runway 27 RESA of the M3R parallel taxiway. Runway 09/27 length reduced by approximately 516 metres.

  Reduction of Runway 09/27 to approximately 1,770 metres significantly impacts its utility for most aircraft, including the domestic narrow-body jet fleet. This option has not been pursued as it unacceptably constricts the ongoing utility of Runway 09/27.

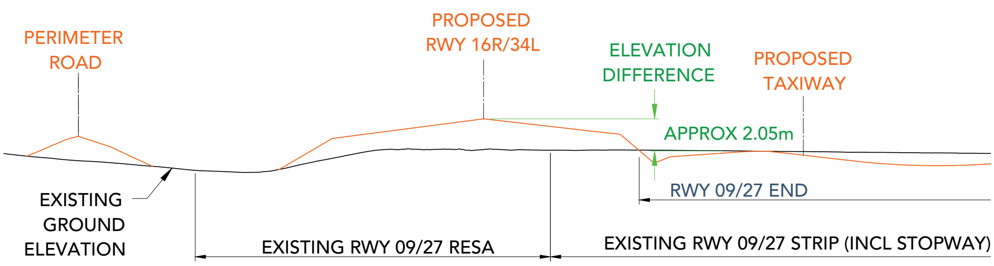
- Relocating Runway 09 threshold east to clear Runway

Figure E4A.13
Alignment of runway 16R/34L and the western end of runway 09/27



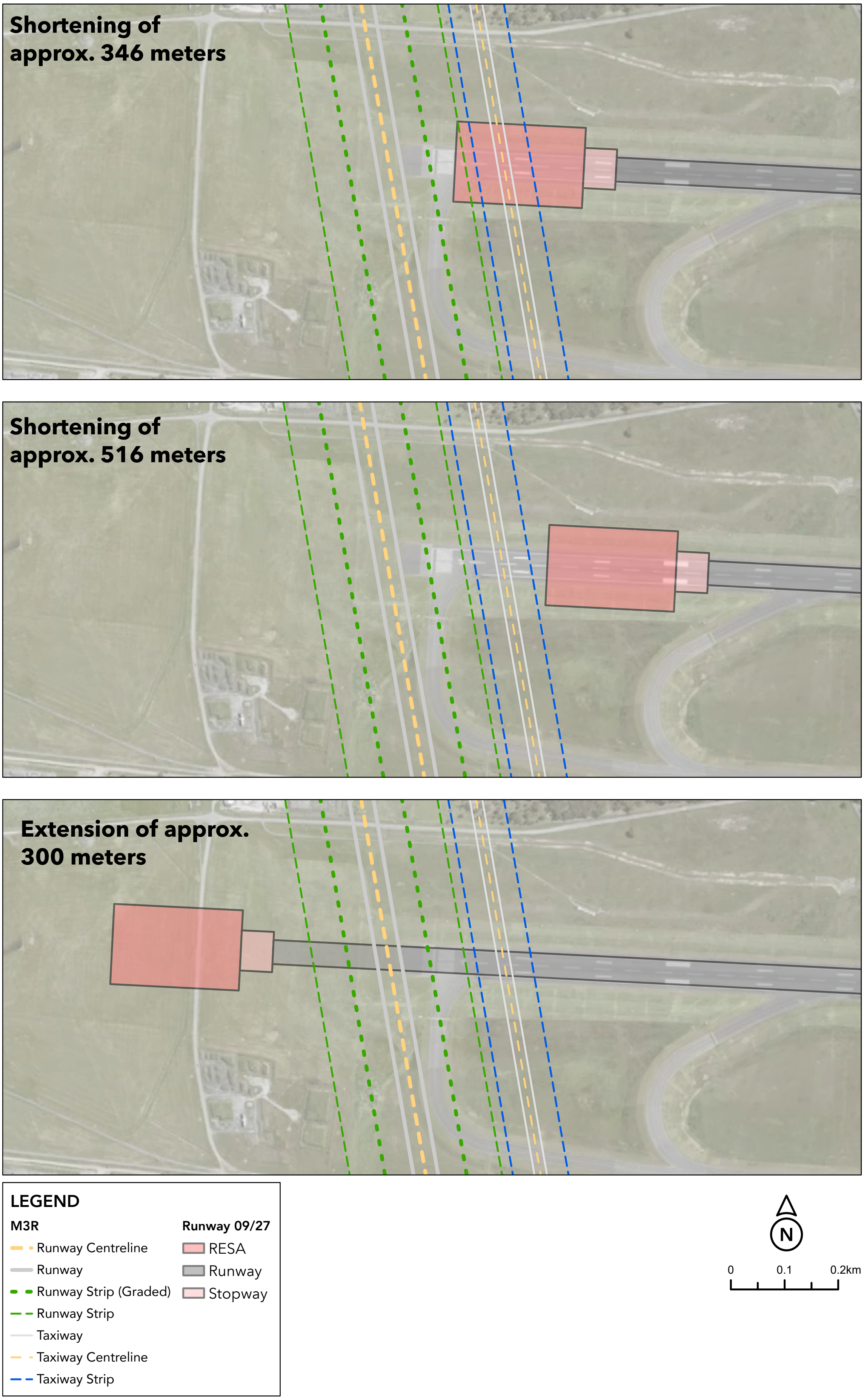
Source: APAM, 2023

Figure E4A.14
Cross section of runway 09/27 and proposed runway 16R/34L



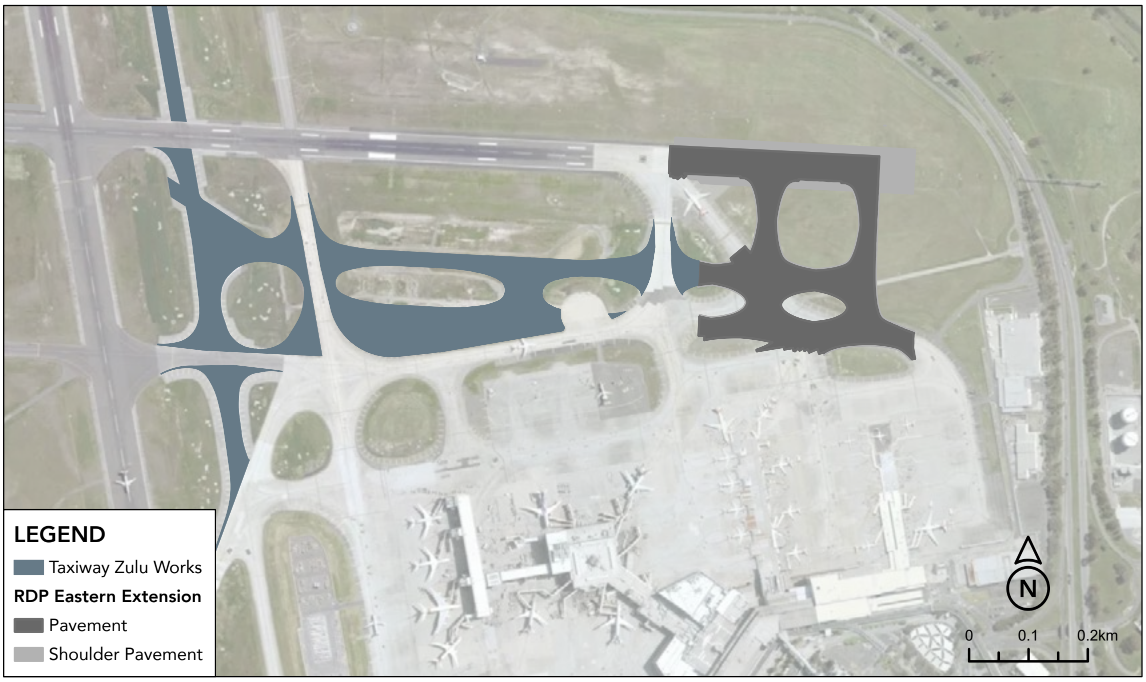
Source: APAM, 2023

Figure E4A.15
Runway 09/27 options considered



Source: APAM, 2023

Figure E4A.16
Runway 09/27 eastern extension



Source: APAM, 2023

27 RESA of the M3R graded strip. Runway 09/27 length reduced by approximately 346 metres.

Reduction of Runway 09/27 to approximately 1,940 metres impacts its utility for some wide-body fleet. This option retains current narrow-body capability to ports such as Brisbane and Sydney.

- Extension of Runway 09/27 east (Figure E4A.16). This option was considered in combination with above options in order to maintain existing runway length.

  Extending Runway 09/27 to the east would require a significant construction project, involving extended closure of the runway. To pursue this option prior to M3R would restrict all operations to Runway 16/34, rendering the airport vulnerable to complete closures for weather, maintenance and incidents.

- Relocating Runway 09/27 threshold west to clear Runway 09 threshold beyond M3R runway strip - supporting taxiway entry/exit separation from M3R runway compliant. Runway 09/27 length increased by approximately 300 metres.

  Extending Runway 09/27 to intersect Runway 16R/34L would require resolving the elevation variance by raising Runway 09/27 through a significant demolition and reconstruction project. To pursue this option would incur extended closure of the runway – if undertaken prior to M3R this would restrict all operations to Runway

Though Melbourne Airport's master plans continue to safeguard extensions of Runway 09/27, the benefits afforded by pursuing these prior to M3R do not justify correlating costs and impacts to resilience.

E4A.5 RUNWAY CAPABILITY (EXISTING, POST-M3R, LONG TERM)

Table E4A.1 details operational 'declared distances' for Runway 09/27 – current, and at total length 1,940 metres as proposed by M3R:

Table E4A.1 Comparison of runway lengths for Runway 09/27 (existing and M3R scenario) - metres

A review of take-off and landing requirements for the future domestic fleet (covering A321neo and Boeing B737 MAX8) was completed using aircraft manufacturers manuals for standard day conditions. The outcomes are summarised below:

- Airbus A321LR and Boeing B737 MAX8 aircraft can take-off using a runway length of 1,940 metres and reach Sydney and Brisbane
- Airbus A321LR and Boeing 737 MAX8 aircraft can land at maximum landing weight on a runway length of 1,940 metres in dry conditions

Additional analysis was completed on landing capability for larger aircraft (Airbus A330-200, Airbus A330-300 and Boeing 787-8). According to aircraft manuals these aircraft can land at maximum landing weight on a dry runway of 1,940 metres. It is worth noting that the preferred exit for runway 27 (Taxiway N) does not change with the proposed shortening.

As noted within the manufacturer manuals, it is important to engage with airline operators for specific operating procedures. Melbourne Airport will continue to consult with airline operators through the detailed airspace

Table E4A.1
Comparison of runway lengths for Runway 09/27 (existing and M3R scenario) - metres

	Runway 27		Runway 09	
	Existing	Proposed with M3R	Existing	Proposed with M3R
Runway Length	2,286	1,940	2,286	1,940
Stopway	60	60	60	60
Clearway	150	60	150	150
TORA	2,286	1,940	2,286	1,940
TODA	2,436	2,000	2,436	2,090
ASDA	2,346	1,940	2,346	2,000
LDA	2,286	1,940	2,286	1,940
LED	TWY N – 1,630 TWY M – 2,286	TWY N – 1,630 TWY M – 1,940	TWY A – 1,630 TWY P – 2,286 TWY Q – 2,286	TWY A – 1,294 TWY P – 1,940 TWY Q – 1,940

Source: Existing Airservices AIP and as proposed by APAM, 2022

design process and exploration of Runway 09/27 modes to ensure their specific operating procedures are appropriately incorporated.

E4A.6 ONGOING USE OF RUNWAY 09/27

Runway 09/27 remains an important element of Melbourne Airport's operation following M3R. Feedback during the public exhibition clearly demonstrated community desire for its ongoing use for sharing noise, especially at night.

Noise modelling presented by M3R to date has not included use of Runway 09/27. This strategy was adopted to avoid understating the potential impacts of the primary parallel north-south operating modes.

Melbourne Airport acknowledges that there is significant opportunity to introduce operating modes that promote use of Runway 09/27 with the objective of noise sharing. The process of detailed airspace design (pending approval of the M3R MDP) shall incorporate this objective and include updated noise modelling.

E4A.7 CONCLUSION

Melbourne Airport has concluded, through a process of assessing options and alternatives, that Runway 09/27 must be shortened by approximately 346 metres. This change to infrastructure is proposed as an early element of M3R.

At revised total length of 1,940 metres Runway 09/27 remains capable of supporting very similar operations to its current use.

Significant disruption, costs and risks to airport resilience outweigh any benefits to extending Runway 09/27 to the east and/or west with M3R.

The 2022 Master Plan safeguards future extension of Runway 09/27. Need and timing for these developments will continue to be reviewed through the Master Planning process.

Melbourne Airport undertakes to incorporate exploration of additional operating modes and noise modelling into the continuing design of M3R. The objective of this process shall remain to deliver optimal outcomes for the community.

FINAL MDP CONTEXTUAL ADDITION: EASTERN EXTENSION PROJECT

*In her approval of the Master Plan 2022 the Minister raised concerns relating to the shortening of Runway 09/27, including in relation to noise sharing arrangements. To address these concerns APAM has committed to returning Runway 09/27 to its current length by extending by ~345 metres to the east (**Eastern Extension Project or EEP**).*

Before the EEP could occur, the Minister would first need to consider and approve both:

a) a minor variation to the Master Plan 2022, or a new Master Plan, specifying the EEP as a proposed development; and

b) a major development plan detailing the EEP (which would itself be a major airport development under s 89(1)(b) or (ba) of the Act).

APAM intends to progress the necessary statutory steps and provides the following information in that regard. As soon as practicable, upon approval of the M3R MDP, APAM will begin to prepare documents for consideration by the Minister, with respect to the EEP. This will involve preparation of:

- *either:*
  - *a draft minor variation to the Master Plan 2022, which APAM will give to the Minister under s 84(1)(b) of the Act, or*
  - *a new Master Plan, which APAM would give to the Minister under s 78(1) of the Act;*

and

- *a draft major development plan, which APAM will give to the Minister under s 94(1) of the Act (having first met the public comment and consultation requirements under ss 92 and 93 of the Act).*

The Minister would then need to consider these on their merits, and that the Minister cannot form any view about the merits of those documents until they have been prepared and given to the Minister in accordance with the Act.

Indicative Timeline for Approval and Delivery of the EEP

EEP draft major development plan and Approvals	
Scope / Development	*Q3/Q4 2024*
Public Exhibition	*Q2/Q3 2026*
Submit Draft to Minister	*Q4 2026*
***Delivery** (if the draft major development plan were approved by the Minister)*	
Construction Completion	*Q2 2029*
Eastern Extension Opening	*Q2 2029*

Public Exhibition of the EEP preliminary draft major development plan is likely to occur in Q2/Q3 2026. APAM's current objective is that it will coordinate the public consultation of the EEP preliminary draft major development plan with required exhibitions for the variation (or new) Master Plan.

The proposed scope of the project is to install ~345m pavement to the eastern end of Runway 09/27. If the M3R dMDP is approved, and the requisite approvals for the EEP were subsequently given, the effect would be to return Runway 09/27 to its current length.

APAM's future intended use of Runway 09/27, on the assumption that any approvals are granted, would be to use it in off-peak periods when demand and weather permit.

Chapter E5
Risk Management

CHAPTER E5 CONTENTS

CHAPTER E5 FIGURES

E5.1 INTRODUCTION

Melbourne Airport has completed a comprehensive risk assessment of the potential impacts associated with Melbourne Airport's Third Runway (M3R). This chapter is an overview of the Risk Management Framework (RMF) applied to the construction and operation of M3R. The RMF's three categories are:

- Corporate and business risks
- Airport operational risks
- Project risks.

E5.2 RISK MANAGEMENT FRAMEWORK

The framework is illustrated in Figure E5.1. It defines both the risk categories and the tools to manage them.

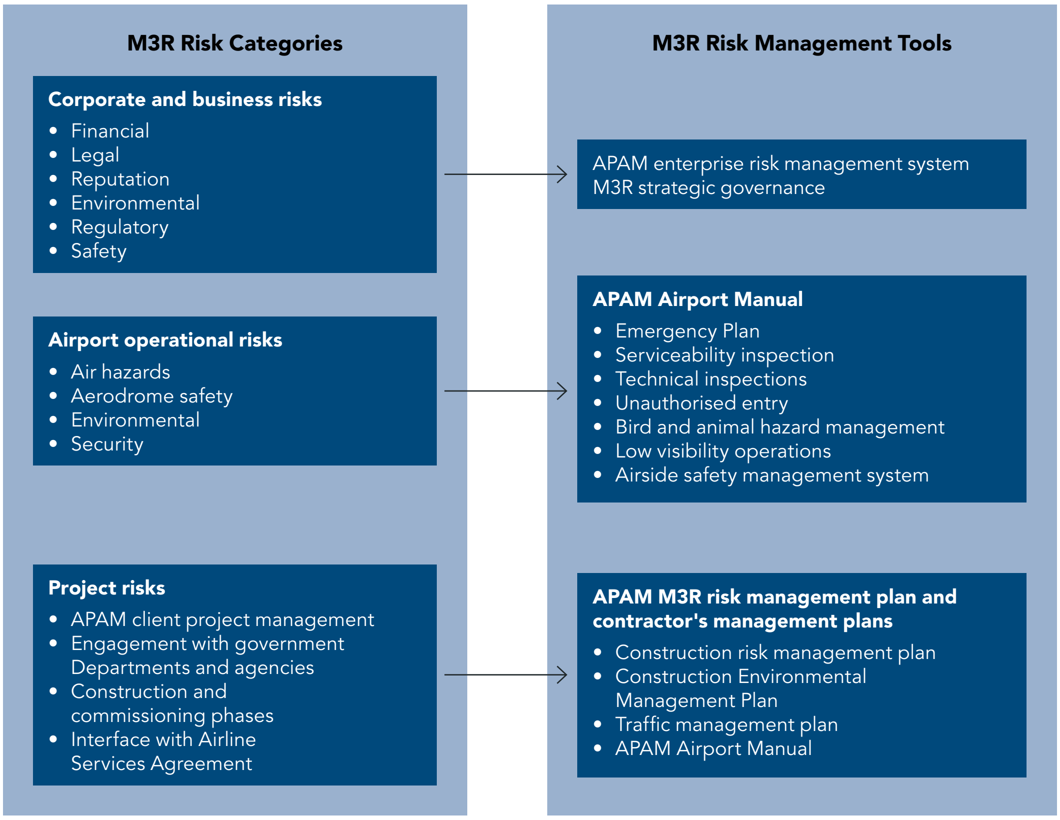
E5.3 RISK CATEGORIES

The RMF's three risk categories are:

- Corporate and business risks: these could have a business or commercial impact on Melbourne Airport or APAM stakeholders.
- Operational risks: these risks to the business as usual (BAU) operations of Melbourne Airport could occur because of M3R construction activities. They have been identified and recorded by the M3R team and will be actively managed for the duration of M3R by rigorous adherence to Melbourne Airport's risk management policies and procedures. Descriptions of these operational risks and mitigation measures during construction are included in Chapter C5: Airspace Hazards and Risks. Operational risk management includes the Environmental Management Framework and Construction Environmental Management Plan as discussed in Chapter E2: Environmental Management Framework.
- Project risks: also relate to the delivery of M3R during the construction phase. The time, cost and functional performance objectives of stakeholders involved in and impacted by M3R have been identified. They include the following:
  - The interfaces and interdependencies between M3R and other Melbourne Airport projects
  - The interdependencies between Melbourne Airport and Airservices Australia for the design and delivery of the latter's on-airfield infrastructure (which would be consistent with regulatory requirements and could potentially require Public Works Committee approval), and the design and approval of the revised airspace and flight procedures.
  - The contractors' management of M3R design, commissioning, and construction activities.

Descriptions of these project risks and management are included in Chapter A5: Project Construction. While Chapter E2: Environmental Management Framework describes the systematic governance structures proposed and in place to manage environmental impacts during construction (compliance-based processes are already in place relating to noise, contaminated land and groundwater, and potential hazardous materials).

Figure E5.1
M3R Risk Management Framework



E5.4
RISK CONTROLS

Comprehensive risk assessments have been undertaken since the inception of M3R and will continue through to project completion. Potential risks at the corporate, operational and project levels have been identified and quantified, and are recorded in a central risk register. This register is the principal functional control resource for delivery of M3R. It tracks action items and risk performance in real time.

Risks generated by M3R which could have an impact on the overall management of Melbourne Airport are also incorporated into ATOM: the Melbourne Airport enterprise risk-management system (internal Melbourne Airport Risk Management System).

Consultative and collaborative working groups have been established to actively manage risk and to communicate risk-mitigation strategies to stakeholders. This includes a Program Control Group (PCG), an Executive Steering Group, a Program Working Group (PWG) and the routine production of progress reports. All critical risks are actively managed by Melbourne Airport senior management and its board.

E5.5
RISK OWNERSHIP

The comprehensive risk assessments of M3R and controls have been developed and allocated to responsible parties, as outlined below. However, Melbourne Airport recognises that while risk management and mitigation functions are shared across several parties, ownership of M3R risk is ultimately with Melbourne Airport.

The key risk-management and mitigation responsibilities are outlined as follows:

- Melbourne Airport's responsibilities for safety and operational risk management are set out in the Melbourne Airport Manual. This manual includes policies and risk management procedures covering all airport operations, and compliance standards for Melbourne Airport and its customers. It also includes the airport's emergency plan and the Airside Safety Management System, both of which will be updated to incorporate M3R
- Airservices' responsibilities for operational risk management include air traffic control policies, procedures and systems. These will be revised to enable configuration of the new flight paths and to comply with CASA's regulatory requirements. In addition, Airservices is responsible for the operation, and therefore sound risk management, of the Aviation Rescue and Fire Fighting Services (ARFFS) at Melbourne Airport

- Airservices' responsibilities also include management of noise complaints in accordance with the Air Services Regulations (2019). This function is provided by the Noise Complaint and Information Service (NCIS).
- CASA's primary responsibility is to monitor and enforce the safety regulation of civil air operations in Australia. As such, it is responsible for assessing safety cases proposed by Melbourne Airport and Airservices for the operation of the airport with M3R. This is to ensure continuous compliance with the *Civil Aviation Regulations 1988* and the *Civil Aviation Safety Regulations 1998*
- M3R risks relating to design, construction and commissioning are the responsibility of Melbourne Airport. Many workshops have been conducted to identify potential M3R risks and their quantum, and to allocate risk control to the appropriate party (these details are recorded in the centralised risk register). The main contractor for M3R is responsible for defining, implementing, and communicating risk management plans; as well as reporting and escalation mechanisms relating to:
  - Construction progress risks
  - Site safety (workplace health and safety) risks
  - Environmental risks
  - Traffic risks.
- The contractor will also be responsible for complying with Melbourne Airport's Airside Works Safety Policy
- To manage the interface between Melbourne Airport and Airservices, both parties have agreed to jointly develop a plan for managing potential safety risks during M3R design and construction including:
  - The principles of cooperation, collaboration and communication that will be agreed and adopted by all the parties as a foundation for successful implementation of M3R
  - The definition of the governance structures and processes for monitoring progress, mitigating emerging risks, resolving issues and managing change.

E5.6 RISK PROFILE

M3R construction activities (temporary) and operations (permanent) will impact the overall risk profile of Melbourne Airport. Although the risk profile will evolve throughout M3R construction and commissioning, the overarching objective of M3R is to mitigate the risk of airport congestion by accommodating airlines' anticipated growth requirements.

M3R construction works will temporarily affect the risk profile of the operational airport - noise, dust, vibration, traffic management and security will be proactively managed to acceptable levels of safety and health. Certain stages of work will require particularly careful coordination with the existing airfield to manage operational hazards. This will be particularly evident for construction works to shorten the existing east-west runway (09/27) and construct the interfaces between the new taxiways linking the new north-south runway (16R/34L) with the existing north-south runway (16L/34R). The risk profile during such activities will be managed down to as low as is reasonably practicable through implementation of the risk management tools and a collaborative approach to risk control with all stakeholders.


australia
BUS
LANE
ONLY

Chapter E6
Summary Commitments and Conclusion

CHAPTER E6 CONTENTS

CHAPTER E6 TABLES

E6.1 INTRODUCTION

Melbourne Airport has prepared this Major Development Plan (MDP) to meet the requirements of the *Airports Act 1996* (Cth) (Airports Act), and the whole-of-environment requirements as defined in *Actions on, or impacting upon Commonwealth land, and actions by Commonwealth agencies, Significant impact guidelines 1.2 Environment, Protection and Biodiversity Conservation Act 1999* (Significant impact guidelines 1.2). It represents a comprehensive assessment of the potential impacts and benefits associated with the construction and operation of Melbourne Airport's Third Runway (M3R) in accordance with the methodology described in **Chapter A8: Assessment and Approvals Process**.

This chapter documents the numerous benefits of M3R identified throughout the MDP. It then provides a summary of those adverse impacts assessed as significant and explains why Melbourne Airport considers these impacts acceptable in the overall context of the project.

This chapter also documents where each assessment has considered the interaction with other projects forecast to be in construction or operation at the same time as M3R, to consider the cumulative impact of M3R. M3R will necessitate changes to the Melbourne Basin airspace, which in turn has implications for the operations of other airports. This facilitated impact is described within the chapter.

E6.2
M3R BENEFITS

Table E6.1 details the benefits of M3R associated with the land use and planning, surface water and erosion, economic, health and social aspects of M3R.

The benefits of M3R are significant. Without M3R (or if M3R is delayed) air transport growth will be inhibited, reducing potential benefits to the Victorian economy and impacting national productivity:

- New jobs will not be realised
- The On-Time Performance (OTP) of Melbourne Airport and the Australian aviation network will deteriorate until airline services are constrained and demand cannot be met effectively
- Competition will be negatively impacted
- The cost of air travel will rise, impacting affordability and choice for passengers
- With limited availability, new services will not be attracted or able to come to Melbourne Airport.

E6.3
M3R IMPACTS

E6.3.1
Overview

This MDP, prepared in accordance with the Airports Act, has been accredited as the assessment process under section 160 of the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). It demonstrates how M3R is expected to impact the 'whole of the environment' (as defined in the Significant impact guidelines 1.2).

The assessment framework defined in **Chapter A8: Assessment and Approvals Process** was developed to align with the Significant impact guidelines 1.2 definition of significance, which requires assessment of the severity of an impact. The assessment framework applied to M3R also includes consideration of the likelihood of the impact occurring.

For each impact, the combination of severity and likelihood provided an initial means of determining the significance of the impact, with those assessed as having a residual rating of high or extreme considered

Table E6.1
Beneficial assessment

Aspect of the MDP	Description		
	Summary	Mitigation inherent in design and practice	Significance
B2: Land Use and Planning			
On-airport: airside land use	Direct – airside land use composition to intensify/ change.	Design has been undertaken in accordance with airport Master Plan land use framework.	Beneficial
On-airport: rural areas	Direct – conversion to airside land use.	Design has been undertaken in accordance with airport Master Plan land use framework.	Beneficial
B4: Surface Water and Erosion			
Post construction water quality conditions – non-PFAS	Existing waterways both within project area and the receiving waters show some exceedances of water quality objectives including physico-chemical, nutrients, and toxicants.	Surface runoff from M3R will increase flow in Arundel Creek. Design and construction of stormwater assets for M3R will provide improvements to current stormwater network, particulary in Arundel Creek. This includes use of swales, bio-retention swales, buffer strips and off-line bioretention and sedimentation basins, to mitigate increases in pollutant loads.	Medium adverse
D2: Economic Impact Assessment			
Construction: Employment	Positive impact – direct and indirect construction jobs creation (expected 650+).	N/A	Beneficial
Construction: Gross state product	Positive impact – increased economic activity associated with construction/production.	N/A	Beneficial
Operation: Employment	Positive impact for airport/operational jobs (direct) and diffuse (Victorian) related industries (initially 500 p/a increasing to 2000+ p/a).	N/A	Beneficial

'significant'. These are identified in the final column 'significance of residual impact' in Table E6.2.

The climate change assessment identifies some significant long term climate change risks. The key risks that are foreseen to become significant in the longer term relate to emissions reporting obligations, climate-related regulation and changing customer behaviour. However, these are not impacts generated by the project, but instead have the potential to impact on the operation and asset management of Melbourne Airport. They are therefore not included in the Table E6.2. Further details can be found in Chapter B13: Climate Change and Natural Hazard Risk.

A summary assessment against the Significant impact guidelines 1.2 criteria (drawing from relevant M3R MDP chapters) is provided in Appendix E6.A.

E6.3.2
Acceptability of impacts

The following provides an explanation as to why Melbourne Airport believes the significant impacts identified during M3R MDP assessment are acceptable.

E6.3.2.1
Significance of impact

In relation to the assessment of the severity of the impact combined with the likelihood of it occurring (Table E6.2) there are five impacts with a residual significance of high. In terms of the high impacts, one relates to Indigenous Cultural heritage, one to European heritage, one to greenhouse gas emissions, and two are associated with social impacts.

'Significant' impacts

For Aboriginal cultural heritage there is the potential for a number of cultural heritage places to be impacted by the M3R development. Impacts will result from excavation and filling to prepare runways, airside areas, access roads, service facilities and other infrastructure. One site (Granite Hill Cultural Landscape) has been confirmed as unavoidably impacted by the development – despite mitigation (through salvage of values) the impact to this site remains high.

A CHMP has been approved in relation to impacts on the cultural heritage values within the M3R development area and associated management requirements.

Additional mitigation, management, avoidance and offset measures	Significance of residual impact
B2: Land Use and Planning (cont.)	
Beneficial, no further mitigation required.	Beneficial
Beneficial, no further mitigation required.	Beneficial
B4: Surface Water and Erosion (cont.)	
Refinement of the model during detailed design phase to address existing modelling assumptions to ensure an optimised outcome that is fit for purpose. Residual impact: Sufficient space exists to include additional stormwater treatment to ameliorate impacts under normal operations. A residual risk will remain for extenuating circumstances (major disaster/emergency, force majeure etc) that are not part of general operational activities.	Beneficial
D2: Economic Impact Assessment (cont.)	
Beneficial, no further mitigation required.	Beneficial
Beneficial, no further mitigation required.	Beneficial
Beneficial, not further mitigation required	Beneficial

Aspect of the MDP (cont.)	Description (cont.)		
	Summary	Mitigation inherent in design and practice	Significance
Operation: Gross state product	Positive economic activity impact - increased economic activity associated with increased aviation business opportunity (direct) and diffuse Victorian related industries (indirect).	N/A	Beneficial
Operation: Freight trade			Beneficial
Operation: Tourism			Beneficial
D3: Health Impact			
Employment	Individual, family and community health benefits.	See **Chapter D2: Economic Impact Assessment**.	Beneficial
	Indirect effect on deaths avoided.		Beneficial
D4: Social Impact			
Construction: Employment	Direct creation of construction jobs and further indirect jobs. Employment opportunities and flow-on health and social benefits.	N/A	Beneficial
Construction: Local economic activity	Indirect business stimulus in local area related to increased airport activity (e.g. cafes, retail, construction supplies)		Beneficial
Construction: Community Initiatives	Opportunity to build on community engagement, and enjoyable activities.	N/A	Beneficial
Operations: Access for people and goods	Increased aviation capacity to meet demand. Melbourne Airport will avoid the delays, cancellations and unavailability of flights that it otherwise faces.	N/A	Beneficial
Operations: Employment	650 direct construction jobs, airport and operational jobs (direct) and diffuse (Victorian) related industries (initially 500 p/a increasing to 2000+ p/a). Beneficial economic and social outcomes for communities near the airport and beyond, including Victoria in general.	N/A	Beneficial
Operations: Infrastructure and services	Support for Victorian economy and enabler of economic growth. Positive impact - increased economic activity for aviation business (direct) and diffuse Victorian related industries and general economy (indirect).	N/A	Beneficial
Operations: Community initiatives	Melbourne Airport already has a range of community programs and will look for new initiatives. Builds social cohesion, and community support.	N/A	Beneficial

Beneficial, no further mitigation required.	Beneficial Beneficial Beneficial

Additional mitigation, management, avoidance and offset measures (cont.)	Significance of residual impact (cont.)
D3: Health Impact (cont.)	
Beneficial, no further mitigation required.	Beneficial
Beneficial, no further mitigation required.	Beneficial
D4: Social Impact (cont.)	
Beneficial, no further mitigation required.	Beneficial
Beneficial, no further mitigation required.	Beneficial
Beneficial, no further mitigation required.	Beneficial
Beneficial, no further mitigation required.	Beneficial
Beneficial, no further mitigation required.	Beneficial
Beneficial, no further mitigation required.	Beneficial
Beneficial, no further mitigation required.	Beneficial

Table E6.2
Extreme and high (i.e. 'significant') adverse assessment summary

Aspect of M3R	Description of impact		
	Summary	Mitigation inherent in design and practice	Significance
B6: Indigenous Cultural heritage			
Granite Hill Cultural Landscape (VAHR TBD)	Direct impacts from runway footprint.	Minimal options to reduce impacts due to topographic locations.	High adverse
B7: European heritage			
Coghill's Boiling Down Works (High state significance)	Direct impacts from construction	Minimal options to reduce impacts due to topographic locations	Extreme adverse
B11: Greenhouse gas Emissions			
Fuel consumption from aircraft movements – GHG emissions	Without mitigation management measures and controls, indirect (scope 3) impacts associated with aircraft fuel use during LTO cycle up to 3,000 feet AGL, and whilst on stand.	Airfield planning: airfield layout to minimise impact on ground-based aspects (i.e. avoid unnecessary fuel burn during taxi and handling) and to seek opportunities for enhancement. Connection to electric renewable energy ground power and preconditioned air to reduce APU use. Airline carbon offset mitigation programs.	High adverse
D4: Social Impact Assessment			
Cultural heritage (community value)	Some heritage sites will be affected but will be monitored, recorded, and managed.	Careful planning with indigenous community, and thorough research and planning with expert input.	High adverse
Aircraft noise (day)	Increased and new daytime populations affected by aircraft noise, overall reduction in night noise but newly affected populations. While there are benefits for some communities the response will be dominated by the significant numbers receiving new or more noise.	Flight paths designed to minimise impacts on residential areas where possible. Engagement with community to identify preferred operating modes, information sharing, ongoing community engagement.	Extreme adverse

Consultations continue between Wurundjeri and APAM for M3R beyond the requirements of the CHMP's pre and post-approval actions.

In relation to European heritage, 'Coghill's Boiling Down Works' is considered a unique surviving example of early Victorian industry and has been assessed as being of State Significance. The potential impact to the site is rated as extreme. Following salvage, recording and documenting the site, the residual impact is still considered to be high due to its significance. This impact is considered acceptable given the site's inaccessible and degraded location and the greater value that salvage, recording and documenting the site will have for the broader understanding of European settlement in the area.

In relation to greenhouse gas emissions, there is a high residual high impact associated with emissions from the landing and take-off cycle. This impact is considered acceptable as there are potential mitigation measures that could reduce the level of impact, however these emissions are associated with the airlines. Melbourne Airport will continue to support state, national and international commitments to reduce and offset aviation emissions and move to lower carbon fuels..

A necessary outcome of parallel north-south runways is that areas to the north and south of the airport will receive more frequent noise, while areas to the east and west of the airport will experience dramatic reductions in aircraft noise. During the night, implementation of night NAPs will place the noisiest operations over the least populated land to the north of the airport whenever possible.

The social impacts reflect careful optimisation of impacts through the preliminary airspace design and are considered acceptable. Impacts have been balanced with the benefits associated with M3R. These benefits include:

- More capacity more often to meet demand including during unfavourable weather
- Capturing the economic growth opportunity for Victoria from the Australian aviation network and international passenger demand

Mitigation, management, avoidance and offset measures	Significance of residual impact
Removal of surface artefacts, archaeological deposits and scarred trees from footprint.	High adverse
Archaeological salvage.	High adverse
Support ongoing state, national and international commitments to reduce and offset aviation emissions and transition to low carbon fuels. These emissions are outside the scope of Melbourne Airport to directly control and therefore the residual impact remains.	High adverse
Monitoring during construction to manage any unforeseen heritage sites/issues	High adverse
Responsiveness to community engagement where possible, ongoing information sharing, engagement with community facilities affected. Melbourne Airport will continue to work proactively with stakeholders to develop a Noise Monitoring and Management Plan based on the ICAO 'Balanced Approach' to managing aircraft noise. Advocate for implementation of NASF guidelines. Opportunity during detailed airspace design (and post-operation) to identify further mitigation opportunities and further reduce noise impacts. Community engagement feedback on segregated mode options to be considered in final detailed airspace design.	High adverse

- Open access for all services providing more destinations and greater frequency of services
- Enhanced passenger choices
- Competition and affordable air travel
- Better on-time performance, less cancellations, better service and significantly reduced runway delay and airline costs.

In the context of benefits, the social impact assessment identifies the importance of Melbourne Airport in connecting communities. In providing significant additional runway capacity, M3R will ensure Melbourne Airport continues to play this important community role over coming decades. The social impact assessment also identifies the benefit associated with the generation of over 500 additional jobs during each year during construction, and a further 37,000 jobs generated throughout Victoria from M3R by 2046. Employment is a key contributor to individual and community health, and given the extent of employment generated, the social impact assessment considers this to be a benefit.

Melbourne Airport genuinely endeavours to minimise adverse outcomes of its business. APAM works proactively with governments, airlines, Airservices Australia, industry partners and local communities to manage its impacts. As part of the work to develop the detailed airspace design (post-MDP), APAM will continue to work proactively with stakeholders to develop a noise monitoring and management plan based on the ICAO 'Balanced Approach' to managing aircraft noise. The Balanced Approach includes principles such as reducing the noise at the source (e.g. quieter aircraft engines), enhancing land use planning controls to prevent inappropriate development in noise-sensitive areas, and operational procedures which can be designed to reduce noise impacts for local communities.

The ecology assessment identifies several impacts initially rated extreme adverse, which are expected to reduce to medium through careful mitigation. Melbourne Airport has sought to minimise the impact to ecological values through ongoing refinement of the development footprint, as described in **Chapter A3: Options and Alternatives**.

For residual impacts on significant ecological values that cannot be eliminated through avoidance, minimisation and management, appropriate offsets will be secured in accordance with the Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy. While this will be primarily used to compensate for significant impacts to EPBC Act listed threatened species and ecological communities, it is anticipated that impacts on state significant ecological values will also be mitigated concurrently using this process.

E6.3.3
Whole-of-environment assessment

The 'whole of the environment' assessment contained in Appendix E6.A identifies M3R will have a range of impacts in accordance with the criteria in the Significance impact guidelines 1.2. The following describes why Melbourne Airport considers these impacts acceptable.

Channelise, divert or impound rivers or creeks or substantially alter drainage patterns:

Arundel Creek runs through the airport and parts will be impacted by M3R. A culvert will be constructed to maintain creek flow under M3R infrastructure, and there is no alternative to this option. As described in Appendix E6.A and Chapter B4: Surface Water and Erosion, the design of Arundel Creek and the wider stormwater network has minimised flooding and water quality impacts downstream and upstream.

Construction works on northern part of Arundel Creek will impact on the EPBC Act listed Growling Grass Frog. Compensatory offset measures for Growling Grass Frog will improve the ecological value of an off-site wetland for significant species. In this context the impact is considered acceptable.

Increase atmospheric concentrations of gases which will contribute to the greenhouse effect

Construction and operation of M3R requires energy, which in turn will result directly and indirectly in emission of gases which contribute to the greenhouse effect. Chapter B11: Greenhouse Gas Emissions quantifies the estimated emissions attributable to M3R during construction and operation. It identifies that the vast majority of these emissions are associated with aircraft (in the landing and take-off cycle) and surface access (employees and passengers accessing the airport using the current road network). These are 'scope 3' emissions and, while Melbourne Airport can influence them, the implementation of mitigation rests with other organisations.

Melbourne Airport will continue to support state, national and international commitments to reduce and offset aviation emissions. This impact is considered acceptable to Melbourne Airport within the overall context of its operation.

Substantially disturb contaminated soil

Chapter B3: Soils, Groundwater and Waste identifies the potential for disturbance of asbestos-containing materials and PFAS-impacted soils and sediments during construction of M3R. To address the potential impact associated with disturbance of these contaminants, specific mitigation measures are identified and have been incorporated into the Environmental Management Framework described in Chapter E2: Environmental Management Framework. The EMF forms the basis of the Construction Environmental Management Plan to be developed by the contractor for construction of M3R. In this context the anticipated impacts related to contaminated soil are considered acceptable.

Involve medium or large-scale native vegetation clearance and substantially reduce or fragment available habitat for native species

Chapter B5: Ecology identifies that development of M3R will require clearance of native vegetation. This collective impact is considered acceptable on the basis that Melbourne Airport has minimised the extent of the development footprint (through design iterations) and has applied the Commonwealth legislative framework to offset remaining impacts.

In addition, to address potential impacts associated with fragmentation of available habitat, Chapter B5: Ecology describes post-construction rehabilitation that will be undertaken. Chapter E2: Environmental Management Framework defines appropriate measures to minimise impacts to fauna associated with habitat removal. It is concluded that resulting ecological impacts are acceptable.

Affect the health, safety, welfare or quality of life of the members of a community, through factors such as noise, odours, fumes, smoke, or other pollutants

As previously described, the evaluated social and health impacts are considered acceptable and balanced by the numerous benefits associated with M3R (achieved through considerable focus on reducing impacts through the preliminary and detailed airspace design processes).

Melbourne Airport works proactively with governments, airlines, Airservices Australia, industry partners and local communities to manage health and social impacts. As part of the work to develop the detailed airspace design (post-MDP), APAM will continue to work proactively with stakeholders to develop a noise monitoring and management plan based on the ICAO 'Balanced Approach' to managing aircraft noise.

Health and social assessments have considered a range of adverse impacts credibly associated with M3R. Medium-rated residual impacts (after mitigation) relating to communication interference, annoyance and sleep disturbance remain for some communities, however these are considered acceptable in balance with the community benefits afforded by the project (most notably related to employment).

Permanently destroy, remove or substantially alter the fabric (physical material including structural elements and other components, fixtures, contents, and objects) of a heritage place

While there will be impacts to both Cultural and European heritage places as part of M3R, the development footprint has sought to minimise these effects as described in **Chapter A3: Options and Alternatives**. Where the impact is significant and unavoidable (one Cultural and one European site), artefacts will be salvaged in consultation with the relevant stakeholders.

In relation to Cultural heritage impacts, Melbourne Airport has prepared a voluntary Cultural Heritage Management Plan (CHMP) which has been approved under the Victorian Aboriginal Heritage Act 2006. This impact is considered acceptable.

E6.4 CUMULATIVE IMPACTS

Assessment of cumulative impacts requires consideration of how other projects in construction or operation at the same time as M3R may interact with this project's impacts. Cumulative assessments have:

- Included planned airside and landside improvements (per the Master Plan) in the Build and No Build schedules that have informed modelling used in this MDP
- Identified and included (where possible) relevant off-airport projects in chapter assessments
- Collaborated with other Melbourne Airport projects expected to be in construction within the same period as M3R.

The projects that have been considered in specific chapters of M3R are listed in **Table E6.3**. A separate list (**Table E6.4**) demonstrates the cumulative impacts of transport projects which are expected to present significant cumulative impacts when combined with M3R.

Melbourne Airport is constantly planning and delivering a range of projects - generally focused on enhancing capacity and improving passengers' experience of the airport journey. During the anticipated M3R construction period, Melbourne Airport expects approximately 70 other terminal, landside and airside projects will be delivered.

Table E6.5 to **Table E6.7** list projects across the terminals, landside and airside areas with a capital value of at least 50 million dollars, and their potential interactions with M3R. The impact of these projects, combined with the impacts of M3R, have the potential to cause cumulative impacts as described.

E6.5 FACILITATED IMPACTS

'Facilitated impacts' refers to actions which are induced by the M3R project.

The key facilitated impact associated with M3R is change to the Melbourne Basin airspace - specifically impacts on other aerodromes' operations (particularly Essendon Fields Airport), as described in **Chapter C2: Airspace Architecture and Capacity**.

There is a comprehensive set of air traffic control procedures, designed and maintained by Airservices Australia, that facilitate the current safe and efficient coordination of operations between Melbourne and Essendon Fields airports. Melbourne Airport and Essendon Fields Airport have been collaborating with Airservices Australia to develop the future airspace design and to manage the airports' operational dependencies when M3R is commissioned.

Design of the airports' interactions continue to develop, and will be confirmed during the detailed airspace design process. Detailed airspace design will also consider interactions with other Melbourne Basin airports (Avalon Airport, RAAF Base Point Cook and Moorabbin Airport). Refer to **Chapter C2: Airspace Architecture and Capacity** for further details.

E6.6 MITIGATION MEASURES AND COMMITMENTS

Within each assessment chapter, Melbourne Airport has identified the mitigation measures that have been included in design, and additional measures that will be undertaken to mitigate impact during M3R construction and operation.

Specific mitigation measures for construction have been described in **Chapter E2: Environmental Management Framework** and will be implemented through the Construction Environmental Management Plan.

Operational impact mitigations will either be implemented through the Airport Environment Strategy (per the Master Plan) or, for operational airspace-related mitigations, as described in **Chapter E4: Draft Runway Operating Plan**.

E6.7 CONCLUSION

Melbourne Airport is Australia's second busiest passenger airport and plays a critical role as the main aviation hub for southern Australia.

APAM is obliged under the Commonwealth lease to develop the airport - having regard to actual and anticipated future growth in air traffic and demand - to the standard reasonably expected of a major international airport and good business practice.

M3R, consisting of the development of a new parallel north-south runway, will enable runway capacity essential to facilitate projected demand for air travel to and from Melbourne, Victoria and Australia. Improved resilience and reliability will also support the Australian aviation network's efficient operation.

Supporting growth demands will enable Melbourne Airport to assure passenger choice from a variety of airlines (through competition), increase reliability and reduce delays, stabilise airline costs and enable economic growth in Victoria and Australia.

As detailed in **Chapter A1: Introduction**, though

COVID-19 has impacted the aviation industry, Melbourne Airport is confident that demand will recover and grow, and therefore that the additional capacity afforded by M3R remains necessary. The extensive timeframes associated with securing approvals, detailed design and construction for this important infrastructure project are likely to extend beyond the temporary impacts of COVID-19. Melbourne Airport is therefore progressing the approvals component of the project to secure its future as a key asset for Melbourne, Victoria and Australia.

Table E6.3
Cumulative impacts with projects and developments

Chapter	Other projects / developments	Cumulative impact with M3R
B2: Land Use and Planning	Strategic land developments	External land use and planning impacts have been assessed based on consistency with the range of published state/local government land use plans and strategies. These plans and strategies are outlined in Chapter B2: Land Use and Planning, **Sections B2.2 Methodology and assumptions**, and **B2.5 Existing conditions**.
B5: Ecology	Taxiway Zulu and Northern Access project	**Chapter B5: Ecology** discusses significant construction works underway airside (major earthworks for the construction of the Taxiway Zulu and Northern Access projects). See **Table E6.7** for further information.
B8: Surface Transport	Addressed in **Table E6.4**.	N/A
B10: Air Quality	Existing sources of air quality emissions	Cumulative air quality impact assessments were undertaken for M3R by adding estimates for existing air pollutant concentrations to the emissions from Melbourne Airport. This was undertaken in accordance with procedures set out in Victoria's State Environment Project Policy (Air Quality Management). These parameters included the effects of existing particulate emissions (e.g. road traffic, earthworks projects in the vicinity of the airport and other industrial and 'natural' sources of dust and particles). Additionally, for assessment of the operational scenarios, road traffic emissions were included in the modelling for all major roadways surrounding the airport. Apart from road vehicle traffic surrounding the airport, all other air pollutant emissions immediately surrounding the airport were assumed to be insignificant in relation to the airport operation.
B11: Greenhouse Gas Emissions	Electricity grid	In calculating future emissions associated with M3R, a level of decrease in the carbon intensity of the Victorian electricity grid has been assumed.
	Manufacture of construction materials	Includes the emissions associated with the extraction, manufacture and transport of construction materials to site.

Table E6.4
Cumulative impacts with relevant off-airport transport projects (specific impacts only)

Project	Timeframe	Cumulative impact with M3R	
		M3R construction	M3R operations
Melbourne Airport Rail (MAR)	2022–2029	Construction of MAR on airport land is planned to begin in 2023 with a target completion date of 2029 subject to relevant Victorian and Federal planning, environmental and other government approvals. Construction of M3R and MAR could overlap (dependent on final construction schedules for each project). An overlap could result in greater than expected construction traffic on arterial roads south of the airport (such as Keilor Park Drive and Sharps Road). As a key stakeholder in each project, Melbourne Airport would be able to coordinate to minimise any potential negative impacts from construction traffic of both projects.	MAR will have a positive impact on public transport mode share (reducing the share of vehicle traffic to/from the airport – in parallel with increasing volumes of passengers). Correlation between M3R and MAR has not been specifically analysed in this MDP. MAR is subject to a separate MDP – in which applicable cumulative impacts relating to M3R shall be considered.
Sunbury Road Upgrade (Powlett Street to Bulla-Diggers Rest Road)	2020–2025	Construction of M3R and Sunbury Road Upgrade is likely to overlap, which could result in cumulative travel time delays for traffic travelling on Sunbury Road during peak construction periods. Melbourne Airport will seek to minimise the extent of any such impacts by coordinating with Department of Transport and Planning's planned disruptions team.	Delivery of the Sunbury Road Upgrade will have a positive impact by improving travel time reliability along this road segment. The strategic traffic assessment in Chapter B8: Surface Transport incorporates upgrade of the Sunbury Road corridor.

Table E6.5
Other Melbourne Airport projects – terminal

Melbourne Airport project	Construction period	Interaction with M3R
Terminal 2 – Pier D Expansion	2025-2028	The terminal projects will occur inside existing building envelopes or within the existing terminal precinct. They therefore have minimal interaction with the construction or operational processes of M3R. The most likely impact correlation is congestion of the surface transport network, which has been considered in this MDP
Terminal 2 – Satellite Expansion	2025-2028	
Terminal 2 – Check-in expansion	2023-2026	
Terminal 1 – Check-in, retail	2026-2027	
Terminal 2 – Reclaim expansion	2028-2029	

Table E6.6
Other Melbourne Airport projects – landside

Melbourne Airport project	Construction period	Interaction with M3R
Elevated Roads Project (Stage 1 and 2) A new exit from the Tullamarine Freeway provides a continuous grade-separated road link into Terminal 4 and Terminal 1/2/3 multi-storey car parks. The project includes expanded pick-up and drop-off facilities for Terminals 1/2/3. The project increases capacity for pick-up and drop-off traffic at the terminals. By diverting this traffic onto the elevated road network, it also improves capacity on the existing surface network.	Commencing early to mid-2020s	The Elevated Roads Project has been incorporated into the traffic assessment reported in Chapter B8: Surface Transport. Overall, it has a positive impact on the airport road network, ensuring that the network performs acceptably even with the increased traffic generated by M3R.

Table E6.7
Other Melbourne Airport projects – airside

Melbourne Airport project	Description	Construction period	Interaction with M3R
Taxiway Zulu	The scope of works (over 3 phases) includes the following major deliveries: • Improved and expanded taxiway network in the northern terminal precinct totalling 270,000 m² of paved area • Associated services and utilities necessary to support development (including drainage and power).	2019 -2025	Final stages of construction are likely to overlap with the commencement of M3R construction. Construction planning for M3R shall carefully avoid conflict between the projects and, in doing so, minimise cumulative adverse impacts in the airside environment.

E6.7.1
The importance of Melbourne Airport

- Melbourne Airport is a major international gateway to Australia and is the primary domestic airport in Victoria.
- Between 2000 and 2019, the number of passengers passing through Melbourne Airport more than doubled from 16 million to over 37 million.
- Melbourne Airport plays an important role in the Australian aviation network - partnering in six of the 10 busiest flight routes.
- Typically, approximately 60 per cent of all aircraft operating Australian domestic, and narrow-body short-haul international, routes cycle through Melbourne Airport every weekday.
- Demand for domestic travel, particularly in busy periods, is forecast to recover post-COVID and continue growing - supported by Melbourne's growing population.

E6.7.2
Capacity, reliability and resilience – impacts on passengers and airlines

- In 2019 Melbourne Airport was reaching capacity, and by 2026 will have exceeded effective and efficient capacity. Flight cancellations, delays and schedule restrictions will become increasingly frequent, and recovery from delays will be problematic.
- The existing two-runway system is not resilient in Melbourne's wind patterns. Severe cross-wind induced capacity constraints occur on average 30 percent of the time (up to 50 percent of the time in some months).
- Melbourne Airport's on-time performance deteriorated to 74.9 per cent in 2019 - the second-worst of the five major Australian airports.
- On busy days morning delays cannot be recovered until midday, and progressively impact the performance of the Australian aviation network through the whole day. On busy days, average evening delays are more than 15 minutes.
- Melbourne Airport is one of the busiest airports in the world without a parallel runway system. It is forecast to process 47 million passengers by 2026.
- A Runway Demand Management System (RDMS) could assist on-time performance in the short-term but is not capable of providing the total required capacity.

E6.7.3
Situation without M3R (No Build)

- Without M3R (or if it is delayed) growth will be inhibited, reducing potential benefits to the Victorian economy and impacting national productivity:
  - New jobs will not be realised
  - The on-time performance of Melbourne Airport and the Australian aviation network will deteriorate until airline services are constrained and demand cannot be met effectively
  - Competition will be negatively impacted
  - The cost of air travel will rise, impacting affordability and choice for passengers
- With limited availability, new services will not be attracted or able to come to Melbourne Airport.

E6.7.4
Situation with M3R (Build)

- M3R will provide 37,000 additional jobs in Victoria and contribute and additional 4.6 billion dollars per annum to gross state product by 2046.
- By 2046, the new runway capacity will enable an additional 23 million passengers per annum and additional 136,500 aircraft movements each year, representing 40 per cent more passengers and 43 percent more aircraft movements compared to a No Build scenario.
- M3R will provide the required capacity and access at Melbourne Airport and improve the reliability of the network in all weather conditions.

E6.7.5
Impact Assessments

This MDP is Melbourne Airport's primary exposition for M3R - prepared to meet the requirements of the Airports Act and the EPBC Act in relation to this major project. The MDP details a wide range of assessments for construction and operational impacts of M3R - beneficial and adverse.

E6.7.5.1
Beneficial impacts

Section E6.2 describes the benefits expected to result from the development of M3R. Broadly these result from the function of Melbourne Airport as economic infrastructure – through direct and indirect employment, community connection and economic activity and growth (direct and throughout various industries around Melbourne, Victoria and Australia).

In particular, employment is a key contributor to individual and community health and wellbeing - the health and social impact assessments consider it a significant beneficial aspect of the project.

E6.7.5.2
Adverse impacts

Potential adverse impacts resulting from M3R have been assessed across a wide range of subjects, including:

- Land use and planning (Chapter B2)
- Soils, groundwater and waste (Chapter B3)
- Surface water and erosion (Chapter B4)
- Ecology (Chapter B5)
- Indigenous cultural and European heritage (Chapters B6 and B7)
- Surface transport (Chapter B8)
- Ground-based noise and vibration (Chapter B9)
- Air quality and greenhouse gas emissions (Chapters B10 and B11)
- Landscape and visual amenity (Chapter B12)
- Climate change and natural hazard risks (Chapter B13)
- Airspace architecture - including flight path, and hence noise, distribution (Chapters C2 to C5)
- Human health and social effects (Chapters D3 and D4)

Each of these assessments has considered likely impacts during each of the construction (temporary) and operational (permanent) phases of M3R. Construction impacts are generally associated with disturbance to the environment and heritage attributes of the land required for infrastructure development. Adverse operational impacts are related to the change in aircraft activity that M3R will facilitate. The detailed outcomes of these assessments are contained in the respective assessment chapter.

Residual impacts identified as 'significant' (per *Actions on, or impacting upon Commonwealth land, and actions by Commonwealth agencies, Significant impact guidelines 1.2 Environment, Protection and Biodiversity Conservation Act 1999*) are described in Section E6.3 and listed in Table E6.2.

E6.7.5.3
Adverse impact mitigation

The preliminary airspace design incorporates a number of considerations to minimise the impacts of aircraft noise on sensitive areas. These include features of the proposed runway infrastructure, adjustment of flight paths to improve noise outcomes, as well as maximising the opportunities for runway modes of operation which give priority to noise preferred runway modes of operation during the night-time period

The health impact assessment concludes that an adverse risk of impact from daytime aircraft noise is projected to occur for communication interference in community buildings and annoyance of people. However, overall, from a health outcome perspective, the beneficial health outcomes which affect mortality (increased employment) greatly outweigh the less serious negative health outcomes of sleep disturbance, annoyance and communication interference.

Health and social impacts of M3R will vary for different people and communities and may change over time. Although the project will deliver significant economic, and positive social benefits, these will not be directly or evenly shared by all individuals across all communities. Likewise, some of the negative impacts (such as aircraft noise) will reduce in some areas and increase in other areas. The degree of impact (positive and negative) will depend heavily on individual circumstances.

Although the negative effects and the benefits of the new runway will not fall evenly over communities, the parallel runways provide greater flexibility to allow alternative flight paths that can distribute aircraft noise differently. Through thorough community engagement, Melbourne Airport will give affected communities the opportunity to review and provide feedback on plans so that the best outcome can be achieved for the airport and the community.

Significantly, modelling has identified a substantial number of homes that will be newly affected by aircraft noise, but also a substantial (albeit smaller) number of homes that will experience less noise. It is also important to note that without M3R there will still be a significant increase in aircraft noise as the airport reaches capacity, but without any flexibility in how that noise is managed.

Night noise for currently impacted homes and community facilities will be minimised by accessing the increased capacity for flexible operating modes provided by M3R. Nevertheless, there will also be homes newly affected by aircraft noise at night. The options available for alternative flight paths provide distinctly different noise outcomes and the affected communities will be able to consider which is the preferred option.

In general terms those to the east and west will see and hear reduced impacts from the airport while those to the north and south will see increases.

On opening of the new runway there will be no immediate increase in the number of aircraft using the airport but the shift in impacts from the east-west runway to the north-south runways would occur immediately on opening. Those newly affected will be much more likely to notice the negative impacts, than those that are likely to benefit from a decrease in aircraft noise. This change effect will be exacerbated by the increase in operations from its current low level as aviation recovers from the impact of COVID-19.

The No Build scenario would result in some negative social impacts through the growth in traffic up to the capacity limits of two runways, with increased impacts from delays for incoming and departing aircraft, resulting in additional noise and emissions and significant economic costs.

Additionally, the No Build scenario prevents the opportunity to implement significantly beneficial noise mitigation modes of operation such as Simultaneous Opposite Direction Parallel Runway Operations (SODPROPS) which seeks to direct all arriving and departure traffic to the north over the 'green wedge' at times of low traffic (between 11pm and 6 am) and when suitable weather conditions occur.

E6.7.6 Managing impacts

Melbourne Airport responsibly manages impacts associated with its operation and project, and works proactively with governments, industry partners and local communities to achieve this objective.

Within each assessment chapter of this MDP, Melbourne Airport has explored mitigation measures achievable through design, and additional measures that can be undertaken to appropriately manage impact during M3R construction and operation.

Through the detailed airspace design (post-MDP), APAM will continue to work proactively with stakeholders to develop a noise monitoring and management plan based on the ICAO 'Balanced Approach' to managing aircraft noise. The Balanced Approach includes principles such as reducing the noise at the source (e.g. quieter aircraft engines), enhancing land use planning controls (to prevent inappropriate development in noise-sensitive areas), and designing operational procedures to minimise noise impacts for communities.

Ongoing information sharing by Melbourne Airport will include continued publication of material about both the impacts of the airport and opportunities for mitigation. Appropriate information will help individuals to make informed lifestyle decisions. It will also assist them to understand, discuss and engage in the development of possible mitigation actions that individuals, the airport, Airservices Australia or other agencies might be able to undertake.

In addition to mitigation actions that have been included in the infrastructure and airspace design to reduce noise as much as possible, Melbourne Airport will continue to work with the Victorian Government and local councils to implement the relevant principles and guidelines presented in the NASF to safeguard airport operations and protect the community from undue noise exposure. This includes advocating for appropriate land use planning in the vicinity of the airport, using appropriate metrics to identify noise-sensitive areas and actively discouraging development in noise-sensitive areas. The NASF, including N contours, must be considered in all planning decisions.

APPENDIX E6.A
WHOLE-OF-ENVIRONMENT ASSESSMENT

Environmental element	M3R MDP assessment
Impacts on landscapes and soils Is there a real chance or possibility that the action will substantially alter natural landscape features; cause subsidence, instability or substantial erosion; or involve medium or large-scale excavation of soil or minerals?	B12: Landscape and Visual Amenity Development of M3R will not substantially alter natural landscape features of M3R development footprint as demonstrated by **Chapter B12: Landscape and Visual**, which states: • Melbourne Airport has been operating since the early 1970s, so is well established within the landscape. The proposed development is generally consistent with the airport planning framework enacted with the 1990 EIS by the [then] Commonwealth Government. The community has been informed of proposed developments and impacts through subsequent statutory Master Plans which have been approved since 1997. • Construction of M3R has the potential to impact on the landscape values of the site due to the removal of vegetation, and earthworks which will alter the landform. The impacts caused by partial removal of the Grey Box Woodland and earthworks would be permanent, however, the visual impacts caused by other construction activity will be short-term. These impacts will be seen in the context of the existing airport and are not likely to be significant. • During operation, there will be a moderate impact on the views from rural landscapes as views are opened to M3R and existing areas of the airport. B4: Surface Water and Erosion M3R will not result in subsidence, instability or substantial erosion as described in **Chapter B4: Surface Water and Erosion**: • The baseline site and soil conditions within the M3R study area indicate a relatively low potential for erosion. Significant rainfall and wind conditions are offset by cohesive soils and established vegetation with generally flat or undulating topography throughout most of the M3R study area. Localised areas of minor instability and potential erosion risk were identified within Arundel Creek. • The potential for increased erosion risk will be primarily associated with construction activities, including soil and vegetation stripping, bulk earthworks and development of temporary staging platforms. Effective mitigation measures to be implemented throughout the construction phase are considered capable of minimising erosion risk to acceptable levels. Specific strategies to control localised risks will be developed within the CEMP, which will reduce erosion potential in the central area of M3R to a negligible residual impact risk. • During the post-construction and operation phases of M3R, ongoing erosion risks are expected to be low based on implementation of suitable management and maintenance, including inspections of drains and maintaining vegetation and media along drains.
Impacts on coastal landscapes and processes Is there a real chance or possibility that the action will alter coastal processes, including wave action, sediment movement or accretion, or water circulation patterns; permanently alter tidal patterns, water flows or water quality in estuaries; reduce biological diversity or change species composition in estuaries; or extract large volumes of sand or substantially destabilise sand dunes?	Not applicable as M3R is approximately 25 kilometres from the coast.
Impacts on ocean forms, ocean processes and ocean life Is there a real chance or possibility that the action will reduce biological diversity or change species composition on reefs, seamounts or in other sensitive marine environments; alter water circulation patterns by modification of existing landforms or the addition of artificial reefs or other large structures; substantially damage or modify large areas of the seafloor or ocean habitat, such as sea grass; release oil, fuel or other toxic substances into the marine environment in sufficient quantity to kill larger marine animals or alter ecosystem processes; or release large quantities of sewage or other waste into the marine environment?	Not applicable as M3R is approximately 25 kilometres from the coast.

Environmental element (cont.)	M3R MDP assessment (cont.)
Impacts on water resources Is there a real chance or possibility that the action will measurably reduce the quantity, quality or availability of surface or groundwater; channelise, divert or impound rivers or creeks or substantially alter drainage patterns; or measurably alter water table levels?	M3R will not substantially reduce the quantity, quality or availability of surface or groundwater within or outside the M3R development footprint. Chapter B4: Surface Water and Erosion The expected impact to the quantity of surface water arising from the MDP is detailed in Chapter B4: Surface Water and Erosion, which states: • Arundel Creek runs through the airport and parts will be impacted by M3R. A culvert will be constructed to maintain the creek flows under associated infrastructure. • Water sensitive urban design measures have been incorporated into the design of M3R to improve the quality of water discharging into Arundel Creek and from the airport estate. • Modelling has demonstrated that the proposed treatment train will effectively remove the increased pollutants the project will generate. • Infilling of the parts of the creek valley and the addition of culverts will result in minor flood level increases on the upstream side of the culvert within the airport. Modelling shows this will not impact land downstream from the airport. • Mitigation of PFAS impacts in surface water and appropriate controls will be outlined in the proposed PFAS Management Strategy. The PFAS Management Strategy will incorporate a whole-of-project approach to PFAS management from source management to mitigation of surface water impacts discharging off-site. • Mitigation measures will be incorporated into the Construction Environmental Management Plan to protect waterways and minimise erosion. Chapter B3: Soils, Groundwater and Waste Impacts to groundwater are not expected to be amplified due to the development of M3R. This is detailed in Chapter B3: Soils, Groundwater and Waste, which states: • There are some areas of the M3R footprint where soil and groundwater has been contaminated as a result of past activities. Assessment of soil and groundwater has been undertaken to identify potentially contaminated areas so that they can be managed appropriately during M3R construction. • The key contamination issue that requires management in the M3R footprint is PFAS (both source and diffuse impacts). A project-specific PFAS management strategy is proposed. Confirmation of management and remediation options, including detailed feasibility, will be completed as part of detailed design works. A project-specific human health and ecological risk assessment will also be prepared to support the management and remediation options assessment and PFAS management strategy. • Minor occurrences of asbestos-containing material, isolated occurrences of metals and hydrocarbons, and other potential impacts from historic landfilling activities have been identified in discrete areas of the project footprint. A Construction Environmental Management Plan (CEMP) will be developed to provide specific details as to how these impacts will be mitigated and managed in accordance with applicable regulations. • Waste generated during the construction and operation of M3R will be managed proactively to limit potential environmental impacts. The CEMP will be developed to include specific details on waste management controls to be applied to mitigate potential risks to the environment from these wastes.

Environmental element (cont.)	M3R MDP assessment (cont.)
Pollutants, chemicals, and toxic substances Is there a real chance or possibility that the action will generate smoke, fumes, chemicals, nutrients, or other pollutants which will substantially reduce local air quality or water quality; result in the release, leakage, spillage, or explosion of flammable, explosive, toxic, radioactive, carcinogenic, or mutagenic substances, through use, storage, transport, or disposal; increase atmospheric concentrations of gases which will contribute to the greenhouse effect or ozone damage; or substantially disturb contaminated or acid-sulphate soils?	**Chapter B10: Air Quality** Chapter B10: Air Quality details that M3R will not substantially reduce local air quality at and around the airport. Chapter B10 states: • Construction dust impacts were assessed for PM_{10}, $PM_{2.5}$ and Total Suspended Particles (TSP) at the airport during the construction phase. Sources of dust emissions were quantified based on a worst-case scenario. Modelling was undertaken using Victoria's regulatory air dispersion model AERMOD, and demonstrated predicted peak concentrations of $PM_{2.5}$ and TSP excluding background were below their respective criteria at sensitive receptors (residences) to the north and south of the airport boundary, and predicted peak concentrations of PM_{10} (excluding background) were above criteria at residences to the north of the airport. While modelling is considered conservative and impacts are likely to be lower, Melbourne Airport will apply additional dust suppression measures, such as avoiding the confluence of worst-case conditions during specific construction activities) to achieve compliance with the standards. • The USA Federal Aviation Administration's regulatory model the Aviation Environmental Design Tool (AEDT) was used to quantify emissions from operating sources at the airport, and COPERT was used to quantify emissions sources from road vehicles immediately surrounding the airport. The two models were approved for use by EPA Victoria. • AERMOD was also used to assess the dispersion of air pollutants against nominated criteria, which were applied from the airport boundary and at the nearest identified sensitive receptors. • Results of the modelling of airport operations demonstrated compliance with all air quality criteria for all scenarios beyond the airport boundary, except for one scenario (NO_2 in 2046). For this scenario, concentrations above the ambient air quality criteria were observed beyond the airport boundary to the south of the proposed new runway, however no sensitive receptors were affected. • Compliance with relevant criteria was observed for $PM_{2.5}$, VOC (benzene and formaldehyde), CO and SO_2. **Chapter B4: Surface Water and Erosion** M3R includes provision for the attenuation of flows from the airport due to the increased impermeable area. The modelling undertaken to date demonstrates that the Build peak flow discharges to the Moonee Ponds Creek, Arundel Creek and Maribyrnong River are all lower than the No Build levels. Furthermore, the modelling of Arundel Creek demonstrates that the infilling of the creek valley and addition of culverts to replace the conveyance of the creek at the alignment of the runway only results in minor flood level increases on the upstream side of the culvert, within the boundary of the airport land. The modelling has demonstrated that there is no flood level increase in the one per cent AEP flood event downstream of the proposed culvert underneath the proposed runway (16R/34L) located on Arundel Creek. The impact risk for surface water is considered low. The proposed design will be checked against additional modelling requirements as part of later design phases. Melbourne Airport is located on Commonwealth land but ultimately discharges stormwater to waterways outside the airport which falls within the jurisdiction of the Victorian Government. It is important to consider these waterways as part of a holistic approach to environmental management. The environmental operations of the airport are regulated under the Airports Act and the Airport Regulations. Desired environmental conditions of receiving waterways are stipulated under Victorian legislation including the SEPP (Waters). Water quality discharging from the airport does not currently meet all Airport Regulations and SEPP Water quality objectives. This is not an uncommon issue with many of the quality objectives also not met in the broader catchment areas. M3R presents an opportunity to improve surface water discharge quality. In particular, from Arundel Creek which is the main discharge point for the Airport. In addition to improvements to the drainage network and the proposed end of line treatment train for Arundel Creek, additional measures will be developed as part of the proposed PFAS Management Strategy. The PFAS Management Strategy will incorporate a whole of project approach to PFAS management from source management to mitigation of surface water impacts discharging off-site.

Environmental element (cont.)	M3R MDP assessment (cont.)
Pollutants, chemicals, and toxic substances (cont.) Is there a real chance or possibility that the action will generate smoke, fumes, chemicals, nutrients, or other pollutants which will substantially reduce local air quality or water quality; result in the release, leakage, spillage, or explosion of flammable, explosive, toxic, radioactive, carcinogenic, or mutagenic substances, through use, storage, transport, or disposal; increase atmospheric concentrations of gases which will contribute to the greenhouse effect or ozone damage; or substantially disturb contaminated or acid-sulphate soils?	Chapter B3: Soils, Groundwater and Waste *Groundwater quality* Although groundwater is unlikely to be intersected during project works, there is the potential to intersect perched groundwater systems that may be impacted by PFAS and other contaminants. The expected volumes and potential to intersect groundwater are considered low, but if encountered will require management. If groundwater is encountered and is required to be extracted as part of works, existing water treatment facilities both on-site and off-site are available to treat water to remove contaminants of concern. This is the preferred option rather than seeking permits for trade waste or to disposing off site to a licenced facility for disposal. *Soil and sediment* There are some areas of the M3R footprint where soil and groundwater has been contaminated as a result of past activities. Assessment of soil and groundwater has been undertaken to identify potentially contaminated areas so that they can be managed appropriately during M3R construction. The key contamination issue that requires management in the M3R footprint is PFAS (both source and diffuse impacts). A project-specific PFAS management strategy is proposed. Confirmation of management and remediation options, including detailed feasibility, will be completed as part of detailed design works. A project-specific human health and ecological risk assessment will also be prepared to support the management and remediation options assessment and PFAS management strategy. Minor occurrences of asbestos-containing material, isolated occurrences of metals and hydrocarbons, and other potential impacts from historic landfilling activities have been identified in discrete areas of the project footprint. A Construction Environmental Management Plan (CEMP) will be developed to provide specific details as to how these impacts will be mitigated and managed in accordance with applicable regulations. Chapter B11: Greenhouse Gas Emissions Chapter B11: Greenhouse Gas Emissions assesses potential emissions to atmosphere from construction and operation of M3R. In summary, the key findings of this assessment are: • A detailed greenhouse gas emissions inventory has been prepared for the construction and operation of M3R • This assessment identified a difference in predicted greenhouse gas emissions between the Build and No Build scenarios of 348 kilotonnes CO2-e per year by 2046. • The biggest source of emissions is from aircraft during the landing and take-off cycle. • Melbourne Airport has limited ability to implement measures to reduce these emissions, but will continue to work with the airlines to reduce greenhouse gas emissions wherever possible. Chapter B10: Air Quality Chapter B10: Air Quality details how M3R will not increase atmospheric concentrations of gases which will contribute to the ozone damage.
Impacts on plants Is there a real chance or possibility that the action will: involve medium or large-scale native vegetation clearance; involve any clearance of any vegetation containing a listed threatened species which is likely to result in a long-term decline in a population or which threatens the viability of the species; introduce potentially invasive species; involve the use of chemicals which substantially stunt the growth of native vegetation; or involve large-scale controlled burning or any controlled burning in sensitive areas, including areas which contain listed threatened species?	Chapter B5: Ecology Ecological impacts resulting from the proposed construction of M3R have been assessed for the disturbance/removal of native vegetation and habitat. It is considered highly likely that the project will result in significant impact to the environment on Commonwealth land due to large-scale clearing of native vegetation, the removal of threatened ecological communities and species habitat, loss of habitat for local wildlife populations and substantial alteration to landscape features through substantial modifications to Arundel Creek and the Grey Box Woodland. The project will have impacts on: • 78.74 hectares of Grey Box Woodland (intact woodland and derived grassland) • 97.89 hectares of Natural Temperate Grassland of the Victorian Volcanic Plain • 9.75 hectares of Golden Sun Moth habitat • 64.34 hectares of Growling Grass Frog habitat • 68.02 hectares of Swift Parrot habitat. Whilst other EPBC Act listed threatened species and migratory species may use the project area on occasion and in some cases will do so regularly (e.g. Grey-headed Flying Fox), significant impacts are not expected to occur to these species as a result of the project. Mitigation measures will be implemented through the Construction Environmental Management Plan to reduce impacts where possible. An offset management strategy has been prepared, identifying offsets to compensate for the residual significant impact on threatened species and ecological communities in accordance with the EPBC Act Offsets Policy.

Environmental element (cont.)	M3R MDP assessment (cont.)
Impacts on animals Is there a real chance or possibility that the action will cause a long-term decrease in, or threaten the viability of, a native animal population or populations, through death, injury or other harm to individuals; displace or substantially limit the movement or dispersal of native animal populations; substantially reduce or fragment available habitat for native species; reduce or fragment available habitat for listed threatened species which is likely to displace a population, result in a long-term decline in a population, or threaten the viability of the species; introduce exotic species which will substantially reduce habitat or resources for native species; or undertake large-scale controlled burning or any controlled burning in areas containing listed threatened species?	Chapter B5: Ecology The project will impact: • 9.75 hectares of Golden Sun Moth habitat • 64.34 hectares of Growling Grass Frog habitat • 68.02 hectares of Swift Parrot habitat. Whilst other EPBC Act listed threatened species, migratory species and state listed species may use the project areas on occasion and in some cases will do so regularly (e.g. Grey-headed Flying Fox), significant impacts are not expected to occur to these species as a result of the project. Mitigation measures will be implemented through the Construction Environmental Management Plan to reduce impacts where possible. An offset management strategy has been prepared, identifying offsets to compensate for the residual significant impact on threatened species and ecological communities in accordance with the EPBC Act Offsets Policy.
Impacts on people and communities Is there a real chance or possibility that the action will substantially increase demand for, or reduce the availability of, community services or infrastructure which have direct or indirect impacts on the environment, including water supply, power supply, roads, waste disposal, and housing; affect the health, safety, welfare or quality of life of the members of a community, through factors such as noise, odours, fumes, smoke, or other pollutants; cause physical dislocation of individuals or communities; or substantially change or diminish cultural identity, social organisation or community resources?	Chapter B8: Surface Transport Evaluation has been conducted of the impact that increased transport activity will have on the performance of internal and external road networks that serve Melbourne Airport (the assessment considers both construction and operational phases of M3R). Commonwealth-leased airports are required to meet the infrastructure development and upgrades needs within the commonwealth land, and also contribute to upgrades required on interfacing infrastructure. The development of infrastructure (e.g. roads, rail and paths) outside of the Melbourne Airport estate are the responsibility of the State and local governments. The assessment found that the overall difference between the Build and No Build scenarios is generally moderate (i.e. reduced performance of between five and 20 per cent), with conditions becoming increasingly congested as years progress – although this varies depending on location and mode. Without mitigation, the impact of the Build scenario on some elements of the transport network may be greater, with demands exceeding capacities more regularly than under the No Build scenario. A range of mitigation measures were identified and assessed, including a need for further analysis of the proposed Melbourne Airport Rail link (to be undertaken independently of this Major Development Plan) and its potential to alleviate operational challenges. Chapter B9: Ground Based Noise and Vibration The construction and operation of M3R will create different ground-based noise emissions. A detailed assessment has predicted the likely impacts, using a worst-case scenario approach. Mitigation measures for the construction phase will be incorporated into the Construction Environmental Management Plan (CEMP) to minimise construction noise impacts. A small exceedance of operational noise objectives is predicted in the opening day scenario, with similar noise levels predicted into the future scenarios. The impact of this small exceedance is considered negligible. Chapter D3: Health Impact Negative health effects from daytime aircraft noise are projected to occur, particularly for communication interference within affected community buildings and for annoyance of people. Dwellings are projected to be affected by aircraft night-time noise, particularly for sleep disturbance of people. However, the introduction of a parallel runway system enables optionality for noise sharing and/or concentration, reduces noise exposure for some communities (east and west of the airport) and strategies for concentrating noise over low-population areas north of the airport at night. Health risk from air quality arising from aircraft operation is negligible for all air quality indicators studied. Employment is a key determinant of health. Beneficial effects on health are projected to result from jobs created by M3R.

Environmental element (cont.)	M3R MDP assessment (cont.)
Impacts on people and communities (cont.) Is there a real chance or possibility that the action will substantially increase demand for, or reduce the availability of, community services or infrastructure which have direct or indirect impacts on the environment, including water supply, power supply, roads, waste disposal, and housing; affect the health, safety, welfare or quality of life of the members of a community, through factors such as noise, odours, fumes, smoke, or other pollutants; cause physical dislocation of individuals or communities; or substantially change or diminish cultural identity, social organisation or community resources?	Chapter D4: Social Impact Melbourne Airport is a key economic generator and social connector for the Greater Melbourne area, the state of Victoria, and nationally. Melbourne Airport is a major contributor to Victoria's (and Australia's) economy and is forecast to provide a 4.6 billion dollar boost to Victoria's Gross State Product by 2046 with the building of M3R. When M3R is built 3,200 more jobs will be created on site, and 37,000 more jobs state-wide by 2046. The social impacts of M3R will vary for different people and communities and may change over time. Although the project will deliver significant economic and positive social benefits, these will not be directly or evenly shared by all individuals across all communities. Likewise, some of the negative impacts (such as aircraft noise) will reduce in some areas and increase in other areas. The degree of impact (positive and negative) will depend heavily on individual circumstances. Although the negative effects and the benefits of the new runway will not fall evenly over society, the parallel runways provide greater flexibility to allow alternative flight paths that can distribute the aircraft noise differently. Through thorough community engagement, Melbourne Airport will give affected communities the opportunity to collaborate towards achieving the best outcome. Significantly, modelling has identified a substantial number of homes that will be newly affected by aircraft noise, but also a substantial (albeit smaller) number of homes that will experience less noise. It is also important to note that without M3R there will still be a significant increase in aircraft noise as the airport reaches capacity, but without any flexibility in how that noise is managed. Night noise for currently impacted homes and community facilities will be reduced by accessing the increased capacity for flexible operating modes provided by M3R. Nevertheless, there will also be homes newly affected by aircraft noise at night. The options available for alternative flight paths provide distinctly different noise outcomes and the affected communities will be able to consider which is the preferred option. In general terms those to the east and west will see and hear reduced impacts from the airport while those to the north and south will see increases. On opening of the new runway there will be no immediate increase in the number of aircraft using the airport but the shift in impacts from the east/west runway to the north/south runways would occur immediately on opening. Those newly affected will be much more likely to notice the negative impacts, than those that are likely to benefit from a decrease in aircraft noise. This change effect will be exacerbated by the increase in operations from its current low level as aviation recovers from the impact of COVID-19. The No Build scenario would also result in some negative social impacts through the growth in traffic up to the capacity limits of two runways, with increased impacts from delays for incoming and departing aircraft, resulting in additional noise and emissions and significant economic costs. Additionally, the No Build scenario prevents the opportunity to implement significantly beneficial noise mitigation modes of operation such as Simultaneous Opposite Direction Parallel Runway Operations (SODPROPS) which seeks to direct all arriving and departure traffic to the north over the 'green wedge' at times of low traffic (between 11pm and 6 am) and when the right weather conditions occur.

Environmental element (cont.)	M3R MDP assessment (cont.)
Impacts on heritage Is there a real chance or possibility that the action will permanently destroy, remove or substantially alter the fabric (physical material including structural elements and other components, fixtures, contents, and objects) of a heritage place; involve extension, renovation, or substantial alteration of a heritage place in a manner which is inconsistent with the heritage values of the place; involve the erection of buildings or other structures adjacent to, or within important sight lines of, a heritage place which are inconsistent with the heritage values of the place; substantially diminish the heritage value of a heritage place for a community or group for which it is significant; substantially alter the setting of a heritage place in a manner which is inconsistent with the heritage values of the place; or substantially restrict or inhibit the existing use of a heritage place as a cultural or ceremonial site?	Chapter B6: Cultural Heritage A detailed assessment of Indigenous Cultural Heritage values within the M3R project study area and immediate surrounds has been completed. This assessment was undertaken in accordance with the requirements of Commonwealth and Victorian governments. The key findings are: • The assessment has identified 33 Aboriginal cultural heritage places within the study area, consisting of artefact scatters, low density artefact distributions and scarred trees. • Melbourne Airport is currently preparing Cultural Heritage Management Plan (CHMP) 16792 in consultation with Wurundjeri Woi-wurrung Cultural Heritage Aboriginal Corporation (Wurundjeri). Wurundjeri is the Registered Aboriginal Party (RAP) for the region that includes Melbourne Airport. The CHMP will detail the findings of the assessment and the specific heritage management requirements to be implemented to mitigate impacts to heritage values. These measures are likely to include cultural inductions for people working on M3R and procedures for the archaeological salvage and reburial of cultural material. • The CHMP will be evaluated by Wurundjeri as part of the project's stakeholder consultation and following best practice under the Victorian state heritage legislation. Chapter B7: European Heritage A detailed assessment of European heritage has been completed to understand the heritage values located in M3R development area and immediate surrounds. The key findings are: • The assessment involved a process of background research to identify existing and previously-unassessed heritage sites. This was achieved through: consultation with historical societies, experts and Heritage Victoria (HV), field surveys and excavation. The historical significance of each site has been assessed using National Heritage Criteria, and HV criteria and thresholds. • The study identified 16 existing and potential historical sites with heritage value within the footprint. Of these 16 sites, 10 were determined to require further assessment in the form of targeted excavations. These sites primarily relate to early European settlement in the Tullamarine area in the mid- to late-19th century and consist of early residential homesteads, farms and early industrial development. Only one homestead, Aucholzie, was found to have surviving built structures. The remaining sites were either ruins, building foundations with remnant occupational and demolition deposits, and more modern and ephemeral archaeological deposits. • Of the sites identified, two were determined to have no remaining significant archaeological deposits or features, due to modern earthworks related to construction of the existing east-west runway (09/27) (Glen Alice outbuildings) and reconstruction of the dam on Glenara Creek (Glenara sheep dam). • The proposed impacts to these sites prior to mitigation are assessed as being minor, moderate or high due to the sites' being of local or regional significance, with the exception of 'Coghill's Boiling Down Works' which was assessed as extreme. Salvage and recording of all sites will occur prior to any impact so the heritage value of the sites is documented and retained. In this way harm will be mitigated and the potential impact reduced. 'Coghill's Boiling Down Works' is considered a unique surviving example of early Victorian industry and has been assessed as being of State Significance. The potential impact to the site is rated as extreme. Following salvage, recording and documenting the site, the residual impact is still considered to be high due to its significance.

MELBOURNE AIRPORT

Level 1, T4, Departure Drive, Melbourne Airport, VIC 3045 Australia
Locked Bag 16, Tullamarine, VIC 3043 Australia | +61 3 9297 1600
Australia Pacific Airports (Melbourne) Pty Ltd | A.C.N. 076 999 114