Australian Government
Department of Infrastructure and Regional Development

WESTERN SYDNEY AIRPORT

DRAFT ENVIRONMENTAL IMPACT STATEMENT

VOLUME 3
LONG TERM DEVELOPMENT

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Western Sydney Airport Draft Environmental Impact Statement

Proponent	The Australian Government Department of Infrastructure and Regional Development.
EPBC Referral	The action was referred to the Commonwealth Minister for the Environment on 4 December 2014, referral 2014-7391.
Proposed action	The proposed Western Sydney Airport would be developed over a number of stages in response to increasing demand. The proposed action is the construction and operation of the first stage of development for the proposed Western Sydney Airport at Badgerys Creek. The draft environmental impact statement (EIS) provides a detailed consideration of likely environmental impacts arising from the Stage 1 development. The Stage 1 development includes a single runway with associated aviation facilities for up approximately 10 million passengers each year and is fully described in the draft Airport Plan. This is the level of passenger demand that is expected to occur in approximately 2030.
Airport Plan	The Stage 1 development would take place under an airport plan determined under Division 4A of Part 5 of the *Airports Act 1996.*
Airport site	The airport site covers about 1,700 hectares at Badgerys Creek. The Stage 1 development impacts about 1,065 hectares within this site. The airport site currently comprises the following properties owned by the Commonwealth: - Lot 1 on DP838361 - Lot 1 on DP851626 - Lot 2 Section C on DP1451 - Lot 17 on DP258581 - Lot 22 on DP258581 - Lot 23 on DP259698 - Lot 32 on DP259698 - Lot 33 on DP259698 - Lot 7 on DP3050 - Lot 8 on DP3050 - Lot 9 on DP226448 - Lot 3 on DP611519 - Lot 11 on DP226448 - Lot 1 on DP129674 - Lot 1 on DP129675 - Lot 1 on DP996420 - Lot 2 on DP996420 - Lot 28 on DP217001 - Lot 1 on DP996379 - Lot 2 on DP996379 It is also anticipated that one or more easements and a small amount of additional land would be acquired by the Commonwealth and incorporated into the airport site for operational and safety reasons.
Draft EIS	This draft EIS has been prepared by the Department of Infrastructure and Regional Development supported by GHD Pty Ltd, RPS Manidis Roberts Pty Ltd and various specialist sub-consultants. The draft EIS has been prepared in accordance with the *Guidelines for the content of a draft environmental impact statement* for the proposed airport issued on 29 January 2015. The draft EIS is divided into four volumes. **Volume 1** provides a description of the proposed Stage 1 development. Volume 1 also explains the approvals and community consultation process. **Volume 2** provides a detailed impact assessment of the Stage 1 development. **Volume 3** provides a strategic level assessment of environmental impacts of an indicative long term development of the airport site. The assessment has been undertaken to provide a broad understanding of the potential impacts facilitated by the Stage 1 development, given that development beyond Stage 1 would be the subject of future approvals processes. **Volume 4** contains detailed technical assessments that have informed the assessment of environmental impacts in Volume 2 and Volume 3. Volume 4 also contains the further information about the proponent, the EIS study team and the *Guidelines for the content of a draft environmental impact statement.*

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Terms and abbreviations

Term	Definition
05/23	The proposed runway orientation. Refers to a generally north-east/south-west orientated runway at 50 degrees north-east and 230 degrees south-west.
1997-99 EIS	PPK 1997, Draft Environmental Impact Statement Second Sydney Airport Proposal, Commonwealth Department of Transport and Regional Development and PPK Environment and Infrastructure Pty Ltd 1999, Supplement to Environmental Impact Statement Second Sydney Airport Proposal, Volume 3 Supplement. Prepared on behalf of the Department of Transport and Regional Services, Prepared on behalf of the Department of Transport and Regional Services.
90^{th} Percentile N60	The N60 value that is exceeded on 10 per cent of nights.
90^{th} Percentile N70	The N70 value that is exceeded on 10 per cent of days.
ABS	Australian Bureau of Statistics
Acid sulfate soils	Naturally occurring soils or sediments containing iron sulfides, which produce sulfuric acid when exposed to air.
AHD	Australian height datum
Airport Plan	Draft plan developed in accordance with the requirements of the *Airports Act 1996*, setting out the Australian Government's requirements for the initial development of the proposed airport.
Airport site	The site for the proposed airport covering an area located at Badgerys Creek, Western Sydney.
Airports Act	*Airports Act 1996* (Commonwealth)
Airports Act amendment	Airports Amendment Bill 2015
ALC	Airport Lessee Company
ANEC	Australian noise exposure concept
ANEF	Australian noise exposure forecast
APU	Auxiliary power unit
ARI	Average recurrence interval – the average or expected value of the periods between exceedances of a given rainfall total accumulated over a given duration.
ATM	Air traffic movement
Australian Height Datum	A common reference level which is approximately equivalent to the height above sea level.
Australian Noise Exposure Concept	Scenario contours used to produce 'what if' contours, for example, in the process of examining flight path options around an airport.
Australian Noise Exposure Forecast	Official forecasts of future noise exposure patterns around an airport. They constitute the contours on which land use planning authorities base their controls.
BoM	Bureau of Meteorology
Bulk earthworks	The removal, moving or adding of large quantities of soil or rock from a particular area to another.
Bund	A constructed retaining wall designed to prevent inundation or breaches from a known source.

Term	Definition
BWSEA	Broader Western Sydney Employment Area
CASA	Civil Aviation Safety Authority
Catchment	The area drained by a stream, lake or other body of water.
CO	Carbon monoxide
Construction impact zone	The area that would be directly impacted by construction of the Stage 1 development.
Continuous descent approaches	A method by which aircraft approach airports prior to landing. Designed to reduce fuel consumption and noise compared to other conventional descents.
Controlled airspace	Airspace of defined dimensions within which air traffic control services are provided.
Criteria pollutants	Air pollutants that have been regulated and are used as indicators of air quality.
Datum	A level surface used as a reference in measuring elevations.
dB(A)	A weighted noise level – an expression of the relative loudness of sounds in air as perceived by the human ear.
DEC	NSW Department of Environment and Conservation (now Office of Environment and Heritage)
DECC	NSW Department of Environment and Climate Change (now Office of Environment and Heritage)
DECCW	NSW Department of the Environment Climate Change and Water (now Office of Environment and Heritage)
Decibel (dB)	A unit of sound.
Direct impact	Direct impacts are caused by an action and occur at the same time and place.
DP&E	NSW Department of Planning and Environment
DPI	NSW Department of Primary Industries
EEC	Endangered ecological community
EIS	Environmental Impact Statement
EIS guidelines	Guidelines for the Content of a Draft Environmental Impact Statement – Western Sydney Airport.
EMS	Environmental management system
Environmental assessment	A formal process of evaluating significant short-term and long-term effects or impacts a project will have on the environment.
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW)
EPA	NSW Environmental Protection Agency
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
FTE	Full time equivalent
Fugitive emissions	Dust derived from a mixture of sources (non-point source) or not easily defined sources. Examples of fugitive dust include dust from vehicular traffic on unpaved roads, materials transport and handling, and un-vegetated soils and surfaces.
GBAS	Ground based augmentation system
GBMWHA	Greater Blue Mountains World Heritage Area

Term	Definition
GDE	Groundwater dependent ecosystem
GDP	Gross domestic product
General aviation	Name given to the aviation industry that is non-military (both fixed wing and helicopter) and that excludes the larger airlines operating scheduled passenger services. General aviation sector undertakes a diverse range of passenger and freight activities including charter operations, flight training, aerial agriculture, aerial work, private and business flying and sports related activities.
GPS	Global positioning system
Greenfield airport	A new airport on land which was not previously used for aviation purposes.
Grey water	Wastewater stream from all domestic wastewater sources other than the toilet (such as baths, sinks, washing machines, etc.).
Groundwater	Water found below the surface, usually in porous rock, soil or in underground aquifers.
GRP	Gross regional product
GSE	Ground support equipment
Hazard	The potential or capacity of a known or potential risk to cause adverse effects.
Hazardous material	Any item or agent that has the potential to cause harm to humans, animals or the environment.
Hazardous waste	Any waste that is classified as hazardous in accordance with the Waste Classification Guidelines (NSW EPA, 2014). Hazardous waste cannot be disposed of to landfill unless it is treated to remove or immobilise the contaminants. – including waste batteries, fertilisers, fuels, herbicides, oils pesticides, paints, solvents, cleaners, clinical and pharmaceutical waste, and waste tyres.
Heavy metal	Any metal or metalloid of environmental concern.
HIAL	High intensity approach lighting
HIPAP	NSW Hazardous Industry Planning Advisory Papers
IAP2	International Association of Public Participation
ICAO	International Civil Aviation Organisation – A specialised agency of the United Nations which codifies the principles and techniques of international air navigation and fosters the planning and development of international air transport to ensure safe and orderly growth.
ICAO Standards	Standards and recommended practices concerning air navigation, its infrastructure, flight inspection, prevention of unlawful interference and facilitation of border-crossing procedures for international civil aviation.
Impact	A change in the physical, natural or cultural environment brought about by an action. Impacts can be direct or indirect.
Impervious	Impervious surfaces are surfaces non-permeable to water.
Indirect impact	As defined in the EPBC Act *Significant impact guidelines 1.2*, indirect impacts are downstream or downwind impacts, such as impacts on wetlands or ocean reef; upstream impacts, such as those associated with the extraction of raw materials; or facilitated impacts, such as urban or commercial development of an area made possible by a project.
Km/h	Kilometres per hour
L_{A90}	The L_{A90} level is the A-weighted noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the L_{A90} level for 10% of the time. This measure is commonly referred to as the background noise level.

Term	Definition
L_{Aeq}	The equivalent continuous sound level (L_{Aeq}) is the energy average of the A-weighted noise level over a sample period, and is equivalent to the level of a constant noise which contains the same energy as the varying noise environment. This measure is sometimes used to describe aircraft noise, in which case it refers to the noise level that is due to aircraft only, excluding other noise. Variants of this measure have been defined that cover specific time periods, such as $L_{Aeq,9am\text{-}3pm}$, which is used to describe noise affecting school classrooms.
$L_{Aeq,9am\text{-}3pm}$	The impact of noise on school students and teachers.
Leachate	The liquid that passes through, or is released by, waste.
LEP	Local environmental plan
LGA	Local Government Area
$L_{night,outside}$	The equivalent-continuous noise level between 11pm and 7am, or $L_{Aeq,11pm\text{-}7am}$ (it is used to describe night time noise exposure and assess chronic health impacts associated with exposure).
Long term development	The long term development of the airport, including parallel runways and facilities for up to 82 million passengers annually (nominally occurring in 2063).
LOS	Level of service
m^2	Square metres
Manual of Standards	Standard procedures for the operation of airports issued by the Civil Aviation Safety Authority.
MAP	Million annual passengers
Master plan	Non-statutory document that outlines a vision to guide the growth and development of a place.
Maximum noise level (LA_{max})	LA_{max} over a sample period is the maximum A-weighted noise level measured during the period. In the context of aircraft noise, LA_{max} generally means the maximum A-weighted noise level recorded during a specific overflight, measured using "Slow" speed, and can therefore also be written LAS_{max}. In this report, LAmax denotes the maximum level attained during a single overflight.
MDP	Major development plan in accordance with the Airports Act.
mg/m^3	Milligrams per cubic metre
MIKE21 modelling	MIKE21 is a two dimensional hydraulic modelling software program used to simulate surface flow and estimate flood levels and flow velocities.
Minister for Infrastructure and Regional Development	Hon. Warren Truss MP
Minister for the Environment	Hon. Greg Hunt MP
Mitigation	The action of reducing the severity, seriousness, or painfulness of something.
MNES	Matters of national environmental significance
MOS	Manual of standards
MUSIC modelling	MUSIC is a software program used to estimate the performance of stormwater quality management systems.

Term	Definition
N60	N60 is a measure of noise exposure defined exactly as for N70, but representing the average number of aircraft overflights per day exceeding 60 dBA. However, N60 is generally used to describe night time noise exposure. In this report, unless otherwise noted, N60 values represent the average number of aircraft overflights per day exceeding 60 dBA during the period 10pm to 7am.
N70	N70 is a measure of noise exposure that indicates the average number of times per day (or other specified time period) that an aircraft overflight will have L_{Amax} greater than 70 dBA respectively. The numbers of overflights are graded in contour lines on a map. N70 contours can be calculated for different time periods, indicating the average number of over flights experienced per day in that period.
NASF	National Airports Safeguarding Framework
National environmental protection measure	Broad framework-setting statutory instruments which outline agreed national objectives for protecting or managing particular aspects of the environment. NEPMs are similar to environmental protection policies and may consist of any combination of goals, standards, protocols, and guidelines.
Nautical mile	A unit of distance. One nautical mile equals 1.852 kilometres.
NEPM	National Environmental Protection Measure
NGER Regulations	*National Greenhouse and Energy Reporting Regulations 2008* (Cth)
Nitrogen	Nitrogen is a colourless element that has no smell and is usually found as a gas. It forms about 78% of the earth's atmosphere, and is found in all living things.
NO_2	Nitrogen dioxide
NO_x	Nitrogen oxide
Non-putrescible	General solid waste including waste cardboard, glass, green waste, metals, paper, plastics, wood and electronic waste.
NPWS Act	*National Parks and Wildlife Act 1974* (NSW)
Nuisance dust	Dust which reduces environmental amenity without necessarily resulting in material harm. Nuisance dust comprises particles with diameters nominally from about one millimetre to 50 micrometres (microns).
O_3	Ozone
Offset measure	A conservation action that is intended to compensate for the negative environmental impacts of an action, such as a development. Offsets can include protecting at-risk environmental assets, restoring or extending habitat for threatened species, or improving the values of a heritage place.
OLS	Obstacle limitation surface – a series of surfaces that define the limits to which structures or objects may project into the airspace to ensure the safety of aircraft.
Organic	An organic compound is any member of a large class of gaseous, liquid, or solid chemical compounds whose molecules contain carbon.
PAH	Polycyclic aromatic hydrocarbon
PANS-OPS	Procedures for air navigation services – aircraft operations
Particulate	A complex mixture of extremely small particles and liquid droplets.
Pathogen	A bacterium, virus, or other microorganism that can cause disease.
Permissible use	A land use which may receive development consent under the *Environmental Planning and Assessment Act 1979* (NSW).
PM	Airborne particulate matter

Term	Definition
PM_{10}	Airborne particulate matter with an aerodynamic diameter of less than 10 µm
$PM_{2.5}$	Airborne particulate matter with an aerodynamic diameter of less than 2.5 µm
POEO Act	*Protection of the Environment and Operations Act 1997* (NSW)
Point merge system	This is a way of synchronising arriving aircraft and directing them to the runway in a structured manner through a single final approach track. By directing aircraft though a series of predictable routes, the vertical and lateral path taken on approach is more accurate and can result in a reduction in the number of level flight segments required at a low altitude.
ppb	Parts per billion
ppm	Parts per million
Proposed airport	The proposed airport at Badgerys Creek and assessed in the Western Sydney Airport Environmental Impact Statement.
PSZ	Public safety zone
Putrescible	In relation to waste, material that may decay or putrefy.
RAAF	Royal Australian Air force
Ramsar Convention	An intergovernmental treaty that provides the framework for national action and international cooperation in wetland conservation. The treaty is named after the city of Ramsar in Iran, where it was signed.
Receivers	See sensitive receiver.
Receptors	See sensitive receiver.
Residual risk	Residual risk is the level of risk that remains after proposed mitigation and management measures are implemented.
Restricted airspace	Restricted airspace includes all airspace that has restrictions placed on its use. This is generally associated with military installations or other situations where safety is an issue, for example explosives storage facilities such as the Defence Establishment Orchard Hills.
Reticulated	In relation to water or another utility, transferred from one place to another.
Reverse thrust	A temporary redirection of aircraft engines so that the direction of exhaust is reversed, usually to provide a breaking effect during landings. Reverse thrusting generally produces an increase in noise during landing.
SACL	Sydney Airport Corporation Limited
SEIFA	Socioeconomic Indexes for Areas
Sensitive receiver	A place occupied by people that is sensitive to impacts. This term is usually used in air and noise studies to refer to dwellings, businesses, schools and the like. Also termed sensitive receptor.
SEPP	NSW State Environmental Planning Policy
Significant impact	As defined in the EPBC Act *Significant impact guidelines 1.2*, a ‘significant impact’ is an impact which is important, notable, or of consequence, having regard to its context or intensity. Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment which is impacted, and upon the intensity, duration, magnitude and geographic extent of the impacts.
SO_2	Sulphur dioxide
SO_x	Sulfur oxides
Stage 1 development	The initial stage in the development of the proposed airport, including a single runway and 10 million annual passengers (nominally occurring in 2030).

Term	Definition
STM3	Strategic Travel Model (Version 3)
SWRL	South West Rail Link
Sydney Airport	Sydney (Kingsford Smith) Airport
Sydney Basin	The Sydney Basin extends over approximately 350 kilometres of coastline from Newcastle in the north, to Durras Lake in the south. To the west the boundary runs in a line through Lithgow along the Liverpool Range to about 80 kilometres north of Muswellbrook and back to the coast at Newcastle. The total land area of the basin is approximately 44,000 square kilometres and the centre lies about 30 kilometres west of the Sydney CBD at Fairfield.
Sydney CBD	Sydney Central Business District
TAPM	The Air Pollution Model
Taxiways	Defined paved areas provided for the surface movement of aircraft between runways and aprons.
The Department	Australian Government Department of Infrastructure and Regional Development
The Proponent	The proponent for the development and operation of the airport is the Australian Government Department of Infrastructure and Regional Development.
The proposed airport	The proposed Western Sydney Airport.
Threatened species	Species of animals or plants that are at risk of extinction, or becoming endangered within the next 25 years ('vulnerable species'), defined by the *Threatened Species Conservation Act 1995* and the *Environment Protection and Biodiversity Conservation Act 1999*.
TSC Act	*Threatened Species Conservation Act 1995* (NSW)
TSP	Total suspended particulates
ug/m^3	Micrograms per cubic metre
UNESCO	United Nations Educational, Scientific and Cultural Organisation
USEPA	United States Environmental Protection Agency
VOC	Volatile organic compounds
Western Sydney Airport	The proposed airport. The airport is referred to as Sydney West Airport under the *Airports Act 1996* (Commonwealth).
Western Sydney Region	Western Sydney is a major region of Sydney, New South Wales. Defined by the Western Sydney Regional Organisation of Councils (WSROC) as ranging from Auburn to the Blue Mountains and from Liverpool to Hawkesbury, with a total land area of about 5,400 square kilometres.
WHS	Work health and safety
WM Act	*Water Management Act 2000* (NSW)
WSEA	Western Sydney Employment Area
WSIP	Western Sydney Infrastructure Plan
WSU	Western Sydney Unit, Australian Government Department of Infrastructure and Regional Development

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PART G:
Assessment of Long Term Development

30. Introduction

30.1. Background

The Department of Infrastructure and Regional Development (the Department) is proposing the design, construction and operation of the proposed Western Sydney Airport (proposed airport) to cater for ongoing growth in demand for aviation services within the Sydney region and to support economic and employment growth in Western Sydney. This draft Environmental Impact Statement (EIS) has been prepared in accordance with the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) to support the determination of an Airport Plan under the *Airports Act 1996* (Airports Act).

A draft Airport Plan has been developed to provide the strategic direction for the development of the proposed airport and includes a specific proposal for the Stage 1 development and an indicative concept for the long term development. Volume 2 of the draft EIS provides a detailed consideration of the potential environmental impacts arising from the Stage 1 development.

However it is recognised that approval of the proposed Stage 1 airport infrastructure would facilitate future growth in aviation capacity and consequently, additional impacts beyond the level assessed for the Stage 1 development would be expected. While the long term airport development described in this document would not be authorised by the Airport Plan, a strategic level assessment of the potential implications has been undertaken to support consideration of the Stage 1 development and long term planning and land use strategies.

This volume (Volume 3) provides a strategic level assessment that considers these potential issues and implications based upon the indicative design concepts presented in the draft Airport Plan.

30.2. The long term development

30.2.1. Progressive development and approvals

The long term development of the proposed airport would incrementally build upon the Stage 1 development as demand increases beyond 10 million annual passengers. Additional aviation infrastructure and support services such as taxiways, aprons, terminal buildings, fuel pipeline, rail and other support facilities will be provided to service the growing demand.

The need for a second runway would be triggered when the operational capacity approaches 37 million annual passengers which is equivalent to approximately 164,000 air traffic movements per year. Based on current projections, a second runway is forecast to be required by around 2050 and is proposed to be located parallel to the first runway with a separation distance of approximately 1,900 metres. The long term airport is forecast to service approximately 82 million passengers, which is equivalent to approximately 370,000 air traffic movements per year. Indicative configurations of the progressive development of the proposed airport are presented in Figure 30-1.

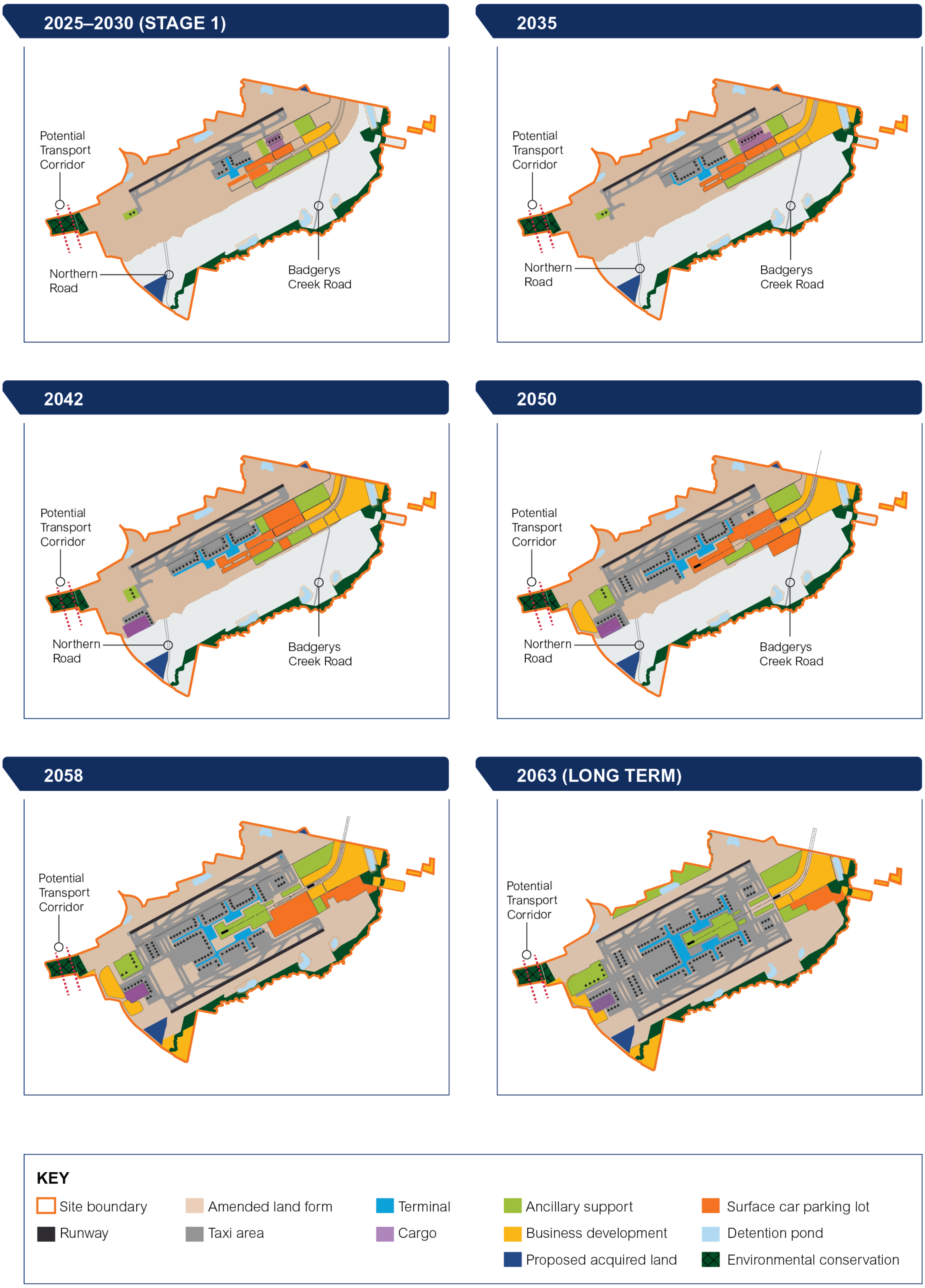


Figure 30-1 – Indicative configurations and sequencing of the progressive development of the proposed airport

The proposed airport is anticipated to be developed and operated by an Airport Lessee Company (ALC). The Airport Plan will provide the strategic direction for the airport site from the date of its determination until the first master plan is in place. As required under the Airports Act, within five years of an airport lease being granted to the ALC, or in a longer period as approved by the Minister for Infrastructure and Regional Development, the ALC will be required to submit a draft master plan for approval. The master plan would, among other purposes, set the strategic direction for the airport site for a period of 20 years. Under the Airports Act, the ALC will be required to prepare new master plans every five years. Once an airport lease is granted, the ALC would also be required to prepare major development plans and seek building approvals in accordance with the provisions of Part 5 of the Airports Act for all future development at the airport site.

The final concept for the long term airport development will be developed by the ALC as part of the master planning process. All future development would be subject to further assessment and approval requirements in accordance with the Airports Act. It is anticipated that assessment of each development stage will be considered in the context of the rapidly changing regional land use setting and will be reflective of technological advances in the aviation industry.

30.2.2. Preliminary airspace design

Airservices Australia provided a preliminary assessment of air traffic management arrangements for airspace in the Sydney region associated with the introduction of flights to and from the proposed airport (Airservices Australia 2015). The preliminary airspace assessment was limited to a conceptual proof-of-concept design to establish whether safe and efficient operations could be introduced at the proposed airport.

In the long term, the operation of parallel runways at the proposed airport could potentially achieve around 100 aircraft movements per hour (one landing or one arrival constitutes an aircraft movement), with Sydney Airport maintaining a movement rate of 80 per hour. The preliminary analysis also suggests that the following issues would need to be assessed in detail as part of the future airspace design process prior to the commencement of parallel runway operations at the proposed airport:

- changes to Sydney Airport flight paths to maintain independent operations at the proposed airport and Sydney Airport, and to achieve the anticipated capacity;
- changes to flight paths serving Bankstown Airport, in particular instrument flight rules operations, in order to maintain independent operations at the proposed airport and Bankstown Airport, and to achieve the anticipated capacity;
- resolution of a potential constraint associated with the restricted airspace area over the Defence Establishment Orchard Hills; and
- further consideration of noise and visually sensitive receivers, such as residential areas and tourism attractions within the Greater Blue Mountains World Heritage Area.

The conceptual airspace design presented in this draft EIS has not been developed to a level of detail necessary for implementation. A separate regulated airspace design process would be required to develop actual flight paths suitable for implementation.

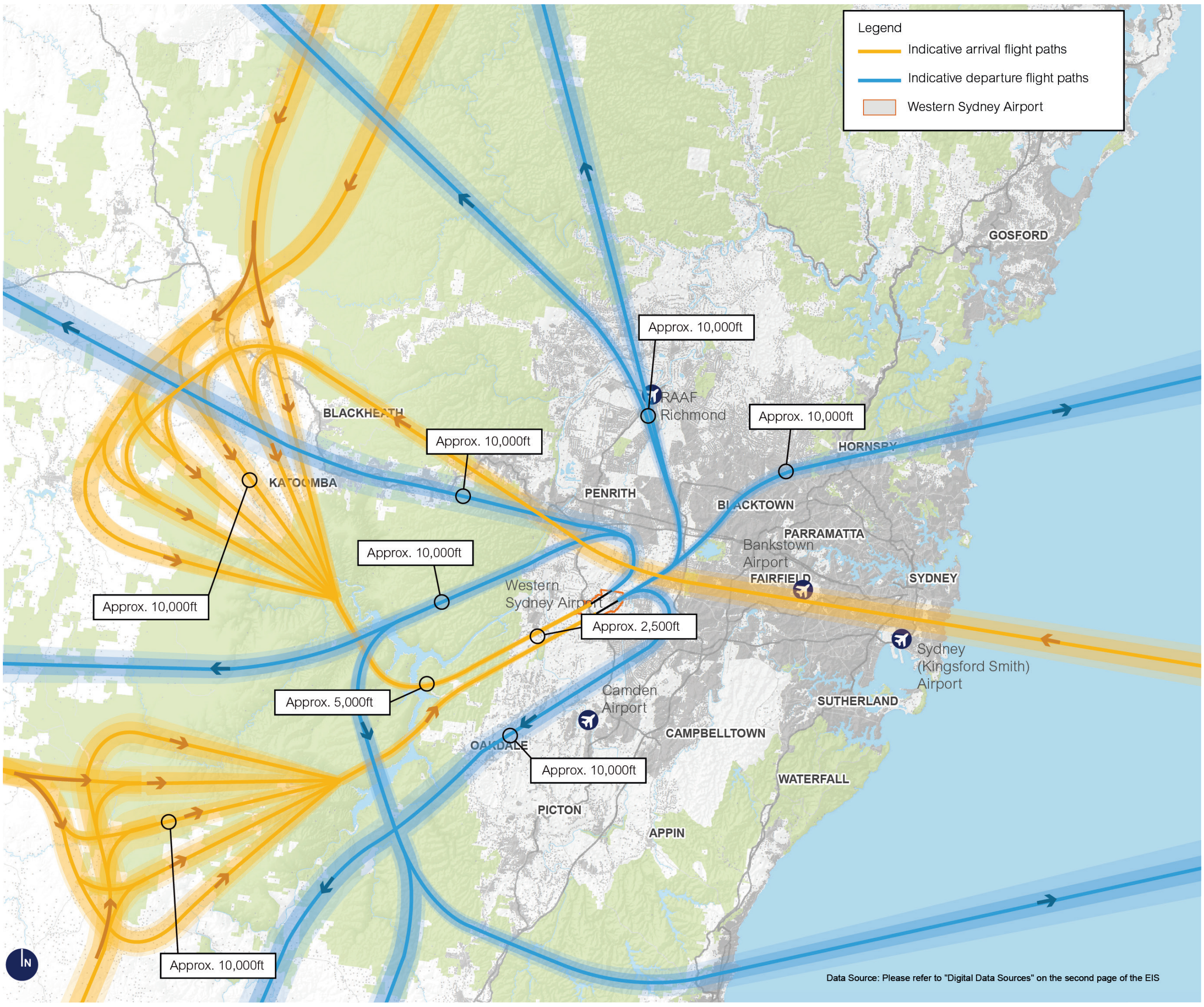
Importantly, the conceptual design did not consider potential noise abatement opportunities, which would form a major part of the subsequent design work required prior to implementation. Consultation with airlines and other stakeholders would be undertaken through the design process, which would be subject to a separate regulatory assessment process. This process would be undertaken closer to the commencement of operation at the proposed airport.

Important considerations in airspace design include:

- efficient use of the Sydney region airspace and integration with the national air traffic network as a whole;
- airspace protections for other aerodromes in the Sydney region, including Defence establishments;
- the available navigational technologies both on ground and in aircraft at the time;
- opportunities to minimise potential noise and amenity impacts and other potential environmental issues; and
- operator and airline preferences and requirements.

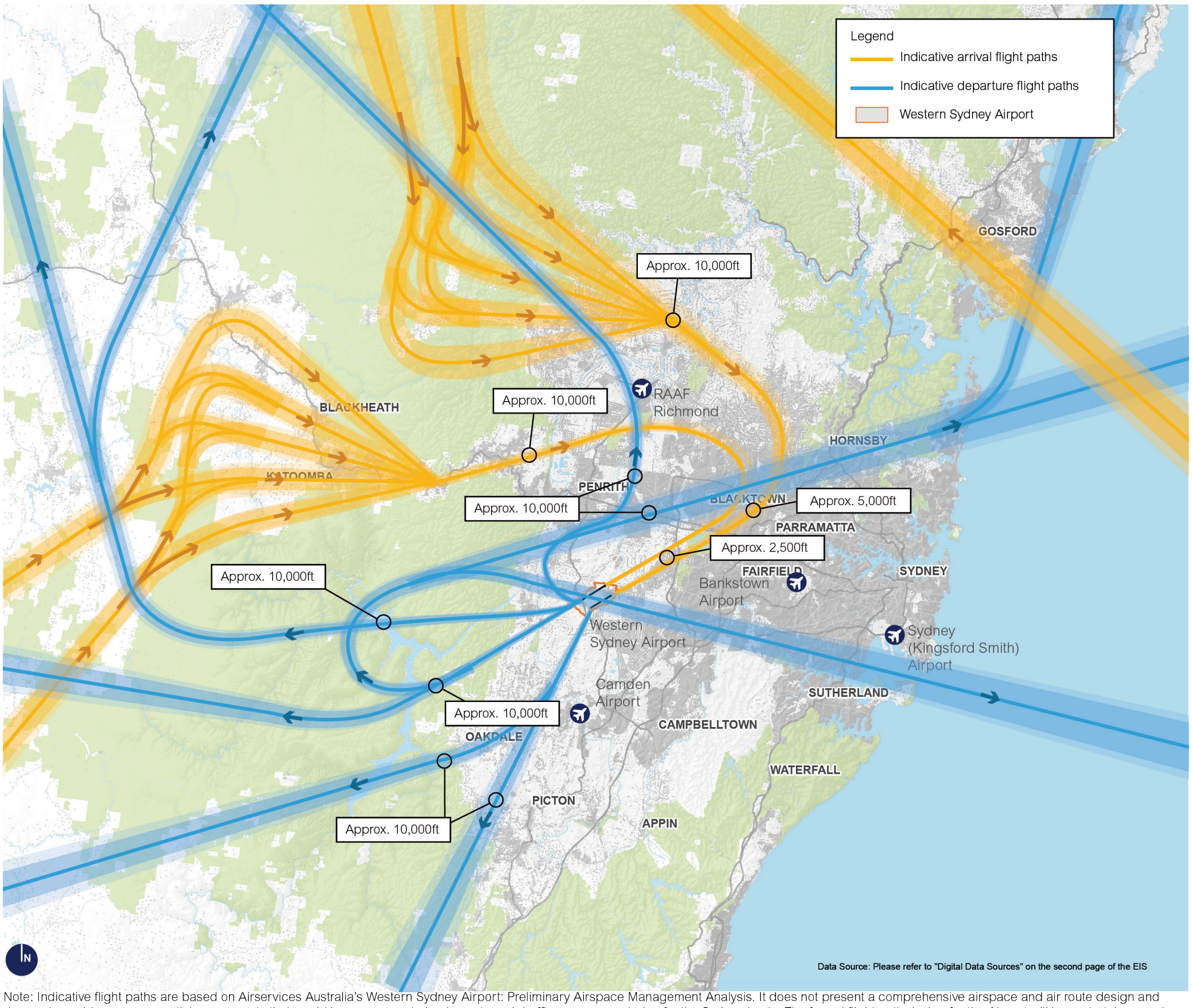
The development of the airspace design would also be subject to environmental assessment and community and industry consultation prior to commencement of operations at the proposed airport.

While particular flight paths are depicted as single lines of travel, it is not always possible for each aircraft to fly precisely along the same line. In practice, flight paths tend to be corridors up to several kilometres wide. Indicative flight paths for the long term operation with parallel runways are presented in Figure 30-2 and Figure 30-3.



Note: Indicative flight paths are based on Airservices Australia's Western Sydney Airport: Preliminary Airspace Management Analysis. It does not present a comprehensive airspace and air route design and does not consider many essential components that would be necessary to implement an air traffic management plan for the Sydney basin. The formal flight path design for the Airport will be undertaken much closer to the commencement of operations.

Figure 30-2 – Long term indicative flight paths for operating mode 05



Note: Indicative flight paths are based on Airservices Australia's Western Sydney Airport: Preliminary Airspace Management Analysis. It does not present a comprehensive airspace and air route design and does not consider many essential components that would be necessary to implement an air traffic management plan for the Sydney basin. The formal flight path design for the Airport will be undertaken much closer to the commencement of operations.

Figure 30-3 – Long term indicative flight paths for operating mode 23

30.3. Strategic level assessment

A detailed assessment of environmental impacts potentially arising from the construction and operation of the Stage 1 development is presented in Volume 2 of this draft EIS. The assessment was based upon clearly defined construction and operation parameters described in detail in Volume 1 of this draft EIS and in Part 3 of the draft Airport Plan.

Volume 3 provides a strategic level assessment of an indicative long term airport development, which is expected to include two parallel runways and supporting facilities with capacity for up to 82 million annual passengers and approximately 370,000 air traffic movements to be reached by around 2063. A strategic level approach reflects the difficulty in attempting an assessment within the context of a number of significant uncertainties relevant to the long term proposal, including:

- the far-reaching horizon over which predictions are required to be made extending between 35-50 years into the future;
- the indicative concepts for the future configuration and operation of the site by the future ALC;
- the actual aviation demand realised in future years;
- advances in technology and changes to combustion emissions;
- changes in land use patterns and population density over the forecast period; and
- the currently available environmental information and limited data on likely future baseline conditions.

The focus of the strategic level assessment for the long term development therefore centres on the key potential impacts of the expanded airport operations. Owing to the incremental nature of infrastructure provision over the period between Stage 1 and the longer term and consistent with the strategic approach adopted, construction impacts are not considered. Key issues include: noise, air quality, traffic, transport and access, surface and groundwater, planning and land use, landscape and visual amenity, social impacts and impacts on the Greater Blue Mountains World Heritage Area. Other potential issues are also in a concise and consolidated chapter.

It is recognised that aircraft noise is one of the most sensitive issues associated with the potential future development of the proposed airport and an increase in air traffic movements has the potential to increase the extent and magnitude of noise disturbance to the surrounding community. Taking this into consideration, an additional assessment of aircraft noise from a potential 2050 airport development scenario where the single runway is operating at a capacity of around 37 million annual passengers or approximately 185,000 aircraft movements per year has been conducted. This scenario provides an assessment of the extent of noise exposure and associated potential impacts when the single runway is at the maximum capacity that may be facilitated as a result of the Stage 1 development. To achieve aircraft movements in excess of the Stage 1 forecast, it is anticipated that additional infrastructure such as expansion of the taxiway system, apron and terminal would also be required. This additional infrastructure and capacity expansions would be subject to separate approvals in accordance with the Airports Act.

Consistent with the strategic approach adopted and the uncertainties noted above, this volume also does not provide any specific mitigation measures. Instead, issues for future consideration have been provided for consideration by the relevant party.

30.4. Purpose and structure of this volume

This volume is intended to provide additional information to support the consideration of the Stage 1 development assessment. For the likely key operational impacts of the proposal, additional strategic level impact assessment has been undertaken in accordance with the EIS Guidelines and using similar methods and procedures as for the Stage 1 development documented in Volume 2.

In addition to its primary role, to support the authorisation of the Airport Plan, it is also intended that the information in this volume would be of interest to NSW Government stakeholders as well as the community and could be used to inform longer term land use planning strategies. It is noted however that the future airport development concepts and subsequent impacts predicted are indicative and may change as a result of future design and development processes.

The remainder of this volume is structured as follows:

- Chapter 31 Noise;
- Chapter 32 Air quality;
- Chapter 33 Traffic, transport and access;
- Chapter 34 Surface water and groundwater
- Chapter 35 Planning and land use;
- Chapter 36 Landscape and visual amenity;
- Chapter 37 Social;
- Chapter 38 Greater Blue Mountains World Heritage Area;
- Chapter 39 Other environmental matters; and
- Chapter 40 Conclusion and recommendations.

The EIS technical reports in Volume 4 also contain more detailed information regarding the potential impacts and implications of the long term airport development.

31. Noise

31.1. Introduction

This chapter provides a review of the predicted aircraft and ground-based noise impacts associated with the potential long term development of the proposed airport. The chapter draws on comprehensive assessments of aircraft overflight and ground-based noise undertaken for the proposed airport which are included as Appendices D1 and D2 in Volume 4.

The assessment addresses two operational scenarios including a single runway operating at or near capacity and a predicted long term development of the airport comprising two parallel runways. The following operating scenarios were considered:

- 37 million annual passengers – this represents a stage of development, which could be reached in 2050, at which time the single runway would likely be approaching its maximum capacity and further demand growth would require construction of a second runway; and
- 82 million annual passengers – this represents a stage of development, assumed to be reached in 2063, when the airport comprises two operating runways and both runways are operating close to capacity.

Incremental expansion of airport infrastructure between these key time periods is assumed to be undertaken but would be subject to separate approvals under the Airports Act.

Considerations of the findings of the assessment in relation to social amenity, world heritage values and human health have been addressed in Chapters 37, 38 and 39 respectively.

31.2. Approach to aircraft noise assessment

31.2.1. Methodology

The methodology for the assessment of aircraft overflight noise is described in detail in Chapter 10 of Volume 2. The Integrated Noise Model was used to calculate noise exposure levels. Inputs to the modelling included the predicted numbers of aircraft operations by different aircraft types, airport operating modes, indicative aircraft flight paths and schedules, topography and meteorology.

For each aircraft type, flight path and stage length (for departures), custom-designed software was used to calculate noise levels at each point on a 185 metres by 185 metres size grid covering the assessment area. This was used to develop noise contours for each of the airport operating strategies.

31.2.1.1. Flight paths and operating modes

The flight paths and procedures used for the assessment of the long term noise assessment are indicative, which introduces uncertainty in regards to predicting the anticipated noise impacts. A future airspace design process is expected to be undertaken closer to the commencement of operations and would be expected to evolve in time throughout the life of the proposed airport. Other issues that are difficult to forecast for the long term scenario include noise emission levels from future aircraft types, which are expected to get progressively quieter and more efficient with ongoing technological advances.

Three primary operating modes were considered for the single runway 2050 scenario including:

- Mode 05 – aircraft arrive from the south-west and depart to the north-east;
- Mode 23 – aircraft arrive from the north-east and depart to the south-west; and
- Head-to-head – all landings and take off movements occur in opposing directions, to and from the south-west.

The availability of each operating mode at any given time would depend on meteorological conditions, particularly wind direction and speed, the number of presenting aircraft and the time of day. Due to the relatively low and consistent wind speeds at Badgerys Creek, it is likely that the preferred operating mode would be in place over 80 per cent of the time. However, the assumed order for selection of the operating modes has a notable effect on the overall noise impact from the airport. In this context, the preferred strategies that were considered are described below:

- Prefer 05 – all aircraft would be directed to approach and land from the south-west and directed to take-off to the north-east. If this is not possible for meteorological or operating policy reasons, then second priority would be given to operations in the opposite direction (i.e. the 23 direction);
- Prefer 23 – all aircraft would be directed to approach and land from the north-east and take-off to the south-west. If this is not possible for meteorological or operating policy reasons, then second priority would be given to operations in the opposite direction (i.e. the 05 direction);
- Prefer 05 with head-to-head – as per Prefer 05, except that during the night hours of 10.00 pm and 7.00 am, head–to-head operating mode to the south-west would be used when:
  - there are no more than a total of 20 aircraft movements in the hour following the relevant time; and
  - wind conditions allow the use of both runway directions;
- Prefer 23 with head-to-head – as per Prefer 05 with head-to-head, except that when head-to-head operating mode is not in use, Prefer 23 applies rather than Prefer 05.

If Prefer 05 or Prefer 23 is in use during the night-time period, the operating mode would revert to head-to-head under the following conditions:

- the use of head-to-head has been allowed for at least two hours before the change time; and
- the use of head-to-head would be allowed for at least two hours after the change time.

For the long term 2063 scenario, a number of alternative airport operating modes are also possible. However, it is difficult to accurately to determine the likely availability, capacity and usage of such modes at this point in time and therefore only the Prefer 05 and Prefer 23 strategies were considered for the two-runway 2063 scenario.

31.2.1.2. Predicted future aircraft movements

Predicted future numbers of aircraft movements (one movement consists of an aircraft either taking off or landing) were developed in the form of 'synthetic schedules'. For each aircraft movement in the synthetic schedule the aircraft family, operation type (arrival or departure), time of operation and port of origin or destination is identified.

Predicted total aircraft movements for a typical busy day for the indicative long term development (refer to Section 2.5 in Appendix E1) are summarised in Table 31–1.

Table 31–1 – Predicted daily aircraft movements in 2050 and 2063 by aircraft family (busy day)

Aircraft	Daily movements 2050	Daily movements 2063
Passenger Movements		
Airbus A320	176	378
Airbus A330	128	286
Airbus A380	4	8
Boeing 737	104	196
Boeing wide-body general	20	40
Boeing 777	26	78
DeHaviland DHC8	12	10
Saab 340	10	10
Freight Movements		
Airbus A330	2	2
Boeing 737	6	6
Boeing 747	28	38
Boeing 767 – 400	8	10
Boeing 767-300	4	6
Boeing 777-300	2	4
Boeing 777-200	4	6
Small Freight	20	32

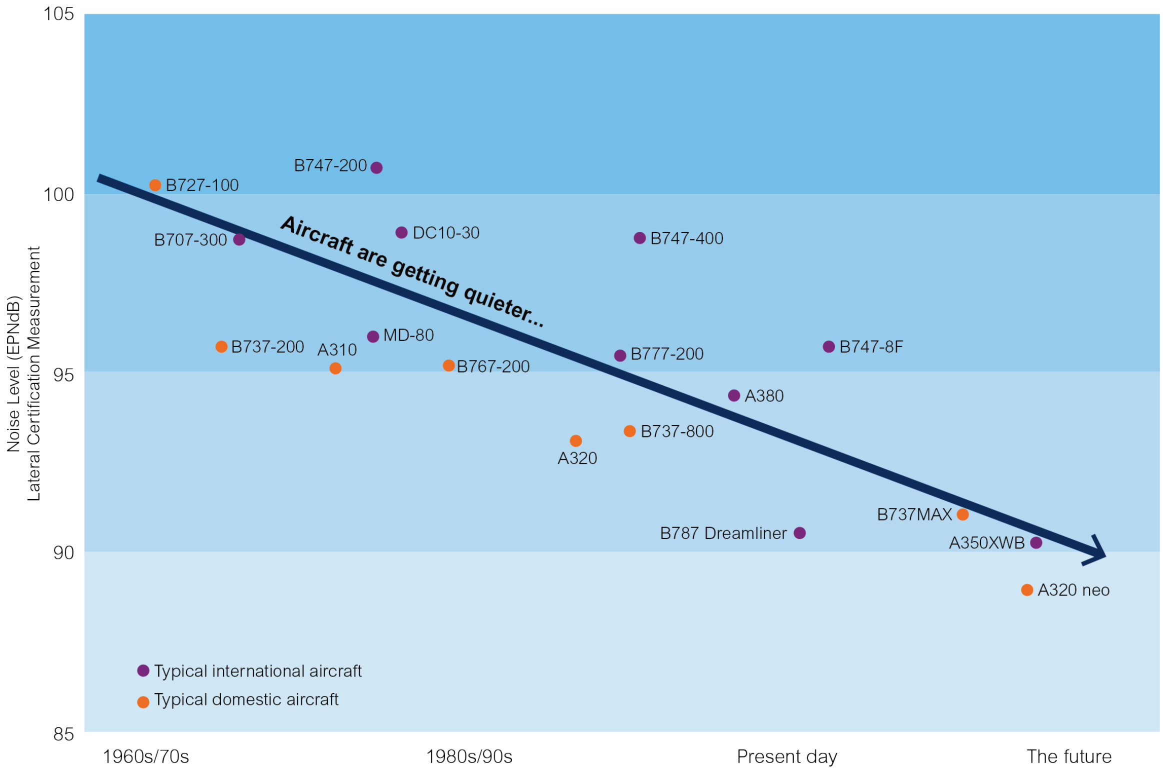
31.2.2. Understanding noise

31.2.2.1. Sources of aircraft noise

A long term development of the proposed airport would result in changes to the pattern of aircraft movements in the airspace above Western Sydney due to the progressive increase in capacity of the initial runway and the introduction of new aircraft flight paths following the proposed commissioning of the second runway. The pattern of noise impacts is complex and depends on the time of day, season, airport operating mode and the changing land use in Western Sydney.

The type of engine, the operational stage and the height of the aircraft influence the amount of noise generated by aircraft operations. Engines are the dominant noise source for the majority of a flight cycle and engine noise can be particularly pronounced when aircraft are operating on the ground as a result of elevated thrust during take-off and reverse thrust during landing. Reverse thrust involves the diversion of the engine exhaust to assist with deceleration upon landing and the noise levels produced by this procedure are typically higher than those from an aircraft take-off.

Advances in aviation technology are resulting in a reduction in noise generated by aircraft. As shown on Figure 31-1, aircraft have become progressively quieter with the adoption of new models into service. It is expected that quieter aircraft like the Airbus 350XWB, Airbus 320neo, and Boeing 737 MAX would be introduced during the operation of the proposed airport and the louder aircraft such as the Boeing 747 are likely to be progressively retired. Despite the likely introduction of these next generation aircraft, the assessment of noise impacts has been based on aircraft types that are commonplace today, including the louder Boeing 747 and the Airbus A320.



Source: ICAO and Federal Aviation Administration (USA) as included in Sydney Airport Master Plan 2033

Figure 31-1 – Reduction in aircraft noise over time

31.2.2.2. Land use planning

For land use planning around airports, Australia has adopted the Australian Noise Exposure Forecast (ANEF) system, which describes cumulative aircraft noise for an annual period. The system underpins Australian Standard 2021 *Acoustics—Aircraft noise intrusion—Building siting and construction* (AS2021), which contains advice on the acceptability of building sites based on ANEF zones. The acceptability criteria vary depending on the type of land use, with an aircraft noise exposure level of less than 20 ANEF considered acceptable for the building of new residential dwellings. An Australian Noise Exposure Concept (ANEC) is a noise exposure chart produced for a hypothetical future airport usage pattern, and is useful for considering the land use planning consequences of alternative operating strategies. ANEC noise exposure contours are calculated using the same methods as the ANEF; however, they use indicative data on aircraft types, aircraft operations and flight paths.

A series of ANECs were developed for the 1985 *Second Sydney Airport Site Selection Programme: Draft Environmental Impact Statement* (1985 Draft EIS) (Kinhill Stearns 1985). These contours were adopted as an "ANEF" for land use planning purposes and have guided subsequent planning controls implemented by the NSW Government and relevant local councils in the vicinity of the airport site. These planning controls serve to limit the types of development permitted to occur within particular noise exposure zones.

The key planning decision made subsequent to the 1985 EIS is the ministerial direction under section 117(20) of the *Environmental Planning and Assessment Act 1979* (NSW). The direction applies to all land within the ANEF in the local government areas of Fairfield, Liverpool, Penrith and Wollondilly and requires that planning proposals not contain provisions enabling development which could hinder the potential for development of a Second Sydney Airport. The direction has subsequently been enforced through the *Penrith Local Environmental Plan 2010* and *Liverpool Local Environmental Plan 2008*.

31.2.2.3. Measuring noise

Consistent with for the assessment of the proposed Stage 1 development, the following noise measures were used for assessment of 2050 and 2063 scenarios:

- ANEC – a measure of noise exposure levels for an 'annual average day' that uses indicative data on aircraft types, aircraft operations and flight paths to provide a measure of aircraft noise impacts using the same methods as the ANEF;
- N70 – the average number of aircraft noise events per day with maximum noise levels exceeding 70 dBA. A noise level of 70 dBA outside a building would generally result in an internal noise level of approximately 60 dBA, if windows are open to a normal extent. This noise level is sufficient to disturb conversation, in that a speaker would generally be forced to raise their voice to be understood, or some words may be missed on television or radio;

- N60 – the average number of aircraft noise events per day with maximum noise levels exceeding 60 dBA during the night-time period of 10 pm to 7 am. An external noise level of approximately 60 dBA represents an internal level of 50 dBA if windows are open. An internal noise level of 50 dBA is commonly used as a design criterion for noise in a bedroom to protect against sleep disturbance. A criterion of 60 dBA was considered appropriate for recreation areas, both passive and active, on the basis that at this level a person may need to raise their voice to be properly heard in conversation;
- The 90th percentile is a statistical category representing noise values that would be exceeded on only 10 per cent of days. Hence the 90th percentile N70 and N60 values represent 'worst case' days where there would be a particularly high number of movements; and
- L_{Amax} – the maximum A-weighted noise level predicted or recorded over a period. In this assessment, L_{Amax} denotes the maximum level of noise predicted at a location during a single overflight occurring at any time.

Existing and forecast population estimates were developed based on the September 2014 release of the NSW Bureau of Transport Statistics population forecasts. These forecasts take into account metropolitan planning development forecasts for future land use in Sydney as well as NSW Department of Planning and Environment population forecasts. The limit of these forecasts is currently 2041. In order to project to 2063 and beyond, Series B population growth rate estimates used by the Australian Bureau of Statistics in their long-term population forecasts were applied to determine the number of receivers expected to be impacted by the long term development.

31.3. Aircraft noise in 2050

This section considers aircraft noise impacts for a 2050 scenario where the single runway is is at or near its predicted maximum capacity servicing around 37 million annual passengers or approximately 185,000 aircraft movements per year.

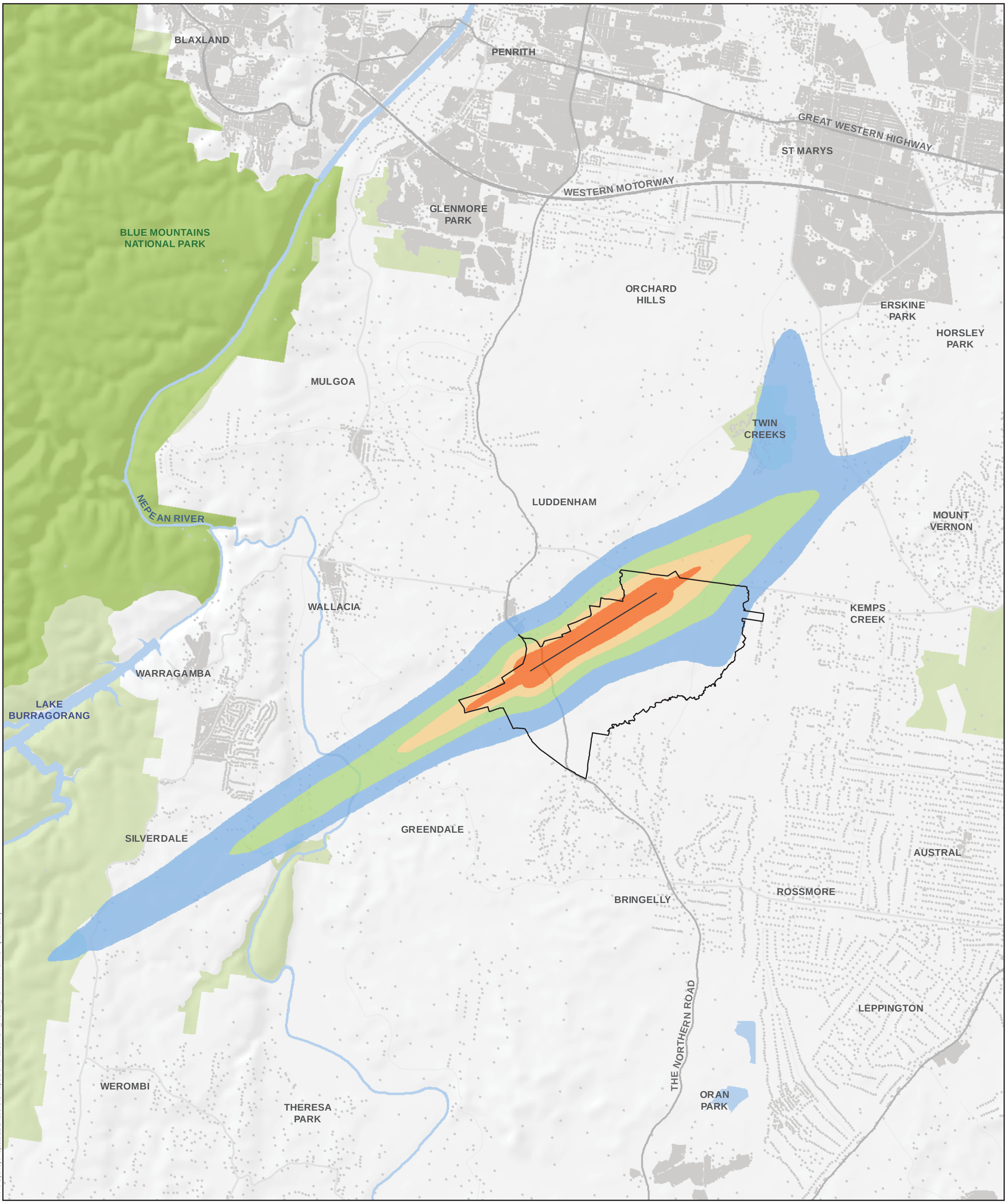
31.3.1. ANEC contours

ANEC contours based on indicative flight paths are considered in this section for environmental assessment comparison purposes. Predicted ANEC contours for Prefer 05 and Prefer 23 operating strategies are presented in Figure 31-2 and Figure 31-3. The 20 ANEC contour represents the area where new residential development is described as conditionally acceptable and the 25 ANEC contour represents the area within which new residential development becomes unacceptable under AS 2021:2015 *Acoustics – Aircraft noise intrusion – Building siting and construction*.

The area enclosed by the 20 ANEC is largely rural residential in nature and the estimated population within these contours in 2050 is shown in Table 31–2.

Table 31–2 – Estimated population within ANEC contours (2050)

ANEC	Operating strategy			
	Prefer 05	Prefer 23	Prefer 05 with head-to-head	Prefer 23 with head-to-head
20–25	1,173	1,255	1,014	1,293
25–30	261	313	315	302
30–35	34	72	38	72
>35	0	4	0	4
Total	**1,468**	**1,645**	**1,367**	**1,672**

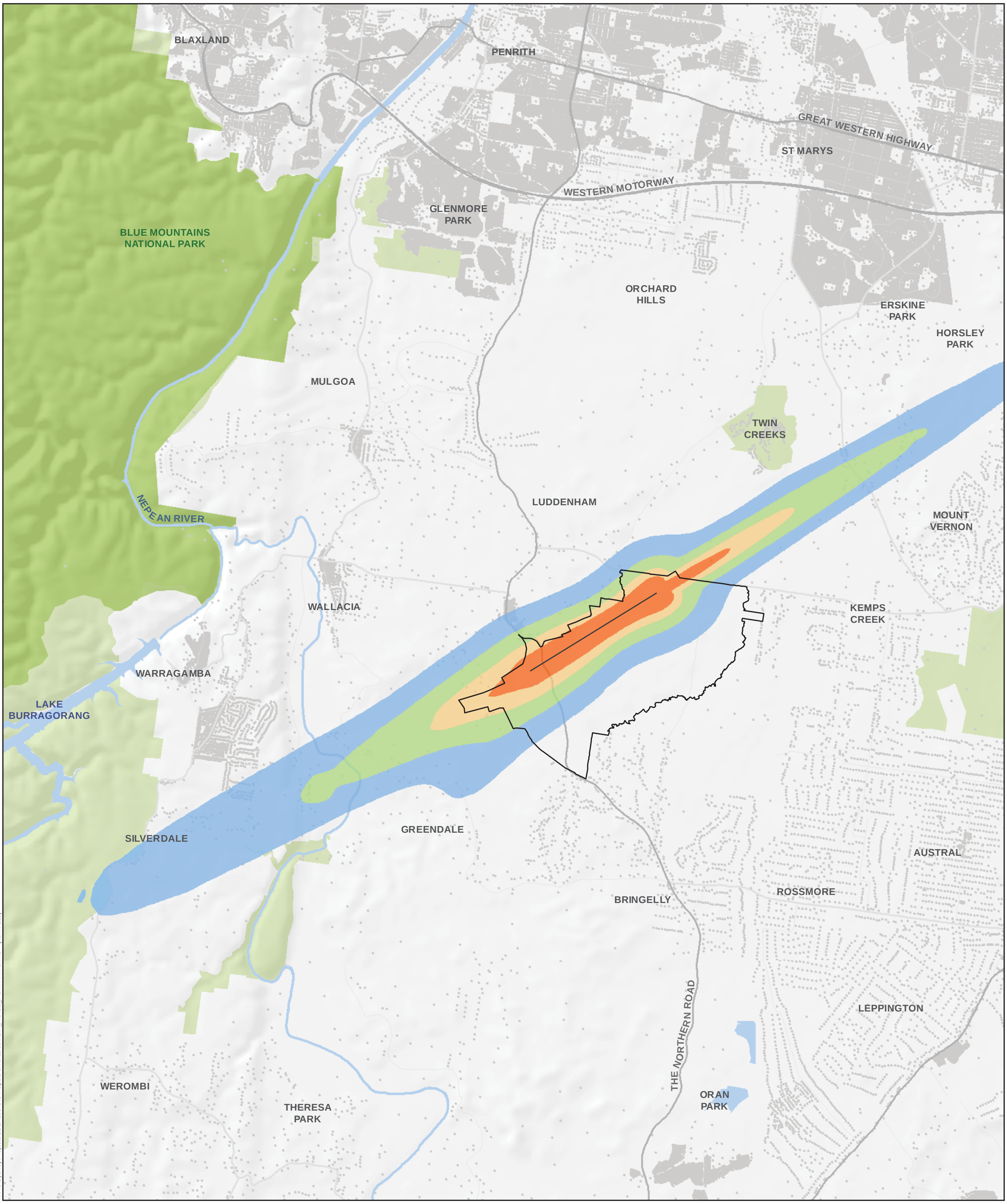


LEGEND

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

- Western Sydney Airport
- Runway
- Buildings
- Greater Blue Mountains World Heritage Area
- Parks and reserves
- ANEC = 20-25
- ANEC = 25-30
- ANEC = 30-35
- ANEC = 35+

Figure 31-2 ANEC contours for Prefer 05 operating strategy (2050)



LEGEND

Western Sydney Airport	Greater Blue Mountains World Heritage Area	ANEC = 20-25
Runway	Parks and reserves	ANEC = 25-30
Buildings		ANEC = 30-35
		ANEC = 35+

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

0 0.75 1.5 3
Kilometres

Figure 31-3 ANEC contours for Prefer 23 operating strategy (2050)

The total population within the 20 ANEC contour is similar for both the Prefer 05 and Prefer 23 operating strategies, however certain areas surrounding the airport site may be exposed to different noise levels depending upon the selected strategy. The increased usage of the single runway under the 2050 scenario also extends the boundaries of the ANEC contours to new areas compared to the proposed Stage 1 development.

While there are differences between the Prefer 05 and Prefer 23 operating strategies, the introduction of head to head operations at night does not greatly influence the contours (refer to Section 4.5 of Appendix E1). This is because even with an additional 6 dBA weighting for night-time noise events, as included in the ANEF formula, overall noise exposure is still dominated by daytime events.

Figure 31-4 and Figure 31-5 show the year 2050 ANEC contours compared to those presented in the 1985 Draft EIS (Kinhill Stearns 1985). The 1985 ANEC was prepared for a dual runway airport and have been used for land use planning purposes to date. The 2050 ANEC contours for the single runway are generally comparable to the northern half of the 1985 ANEC with slight extensions to the north and the south-west. These differences reflect revised modelling assumptions including updated forecasts for the number of aircraft movements, new indicative flight paths and changes in the assignment of aircraft to particular flight paths. The 2050 ANEC contours cover considerably less land to the east and south of the airport site than the 1985 ANEC contours.

The existing planning controls arising from the 1985 ANEC contours have restricted development for the majority of the land area captured within the modelled 2050 ANEC contours.

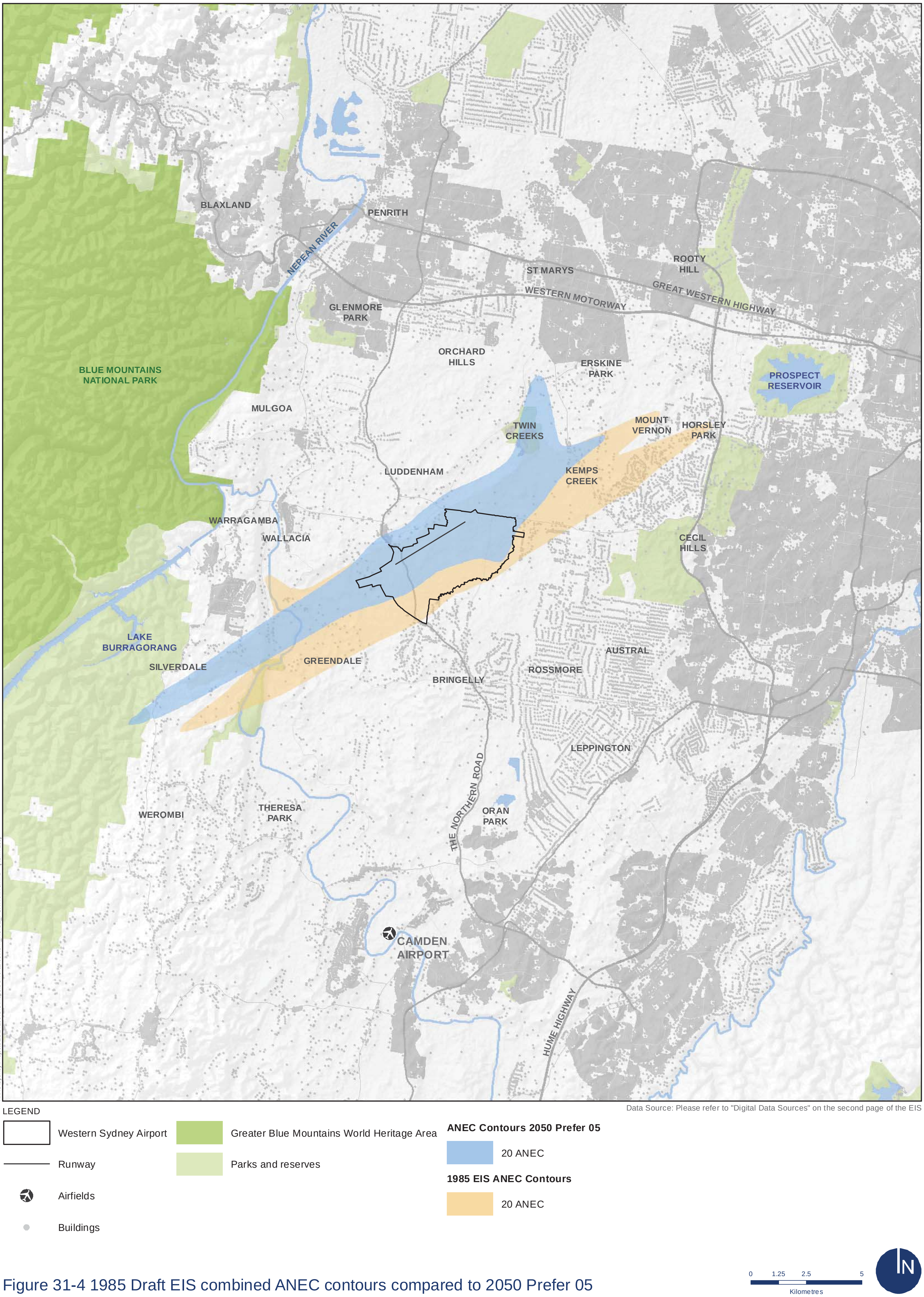
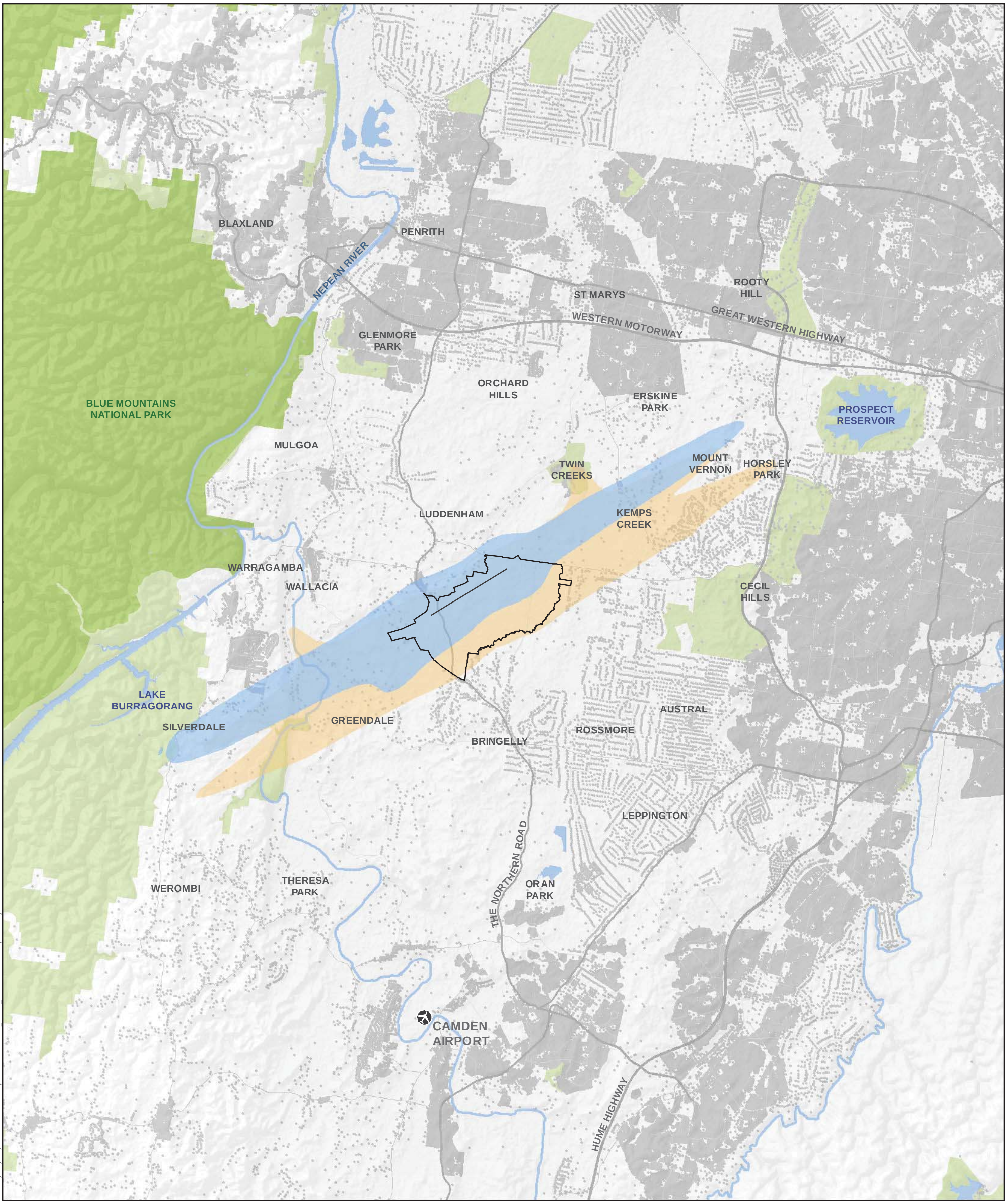


Figure 31-4 1985 Draft EIS combined ANEC contours compared to 2050 Prefer 05



LEGEND

- Western Sydney Airport
- Runway
- Airfields
- Buildings
- Greater Blue Mountains World Heritage Area
- Parks and reserves

ANEC Contours 2050 Prefer 23

- 20 ANEC

1985 EIS ANEC Contours

- 20 ANEC

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

0 1.25 2.5 5
Kilometres

N:\AU\Sydney\Projects\21\24265\GIS\Maps\Deliverables\KBM_NOISE_PORTRAIT3.mxd [KBM: 136]

Figure 31-5 1985 Draft EIS combined ANEC contours compared to 2050 Prefer 23

31.3.2. Maximum noise levels

Single-event noise contours depict the maximum noise levels (L_{Amax}) resulting from a single operation of a specific aircraft type on all applicable arrival or departure flight paths. The aircraft types used in modelling for the 2050 scenario are generally the same as those used for the proposed Stage 1 development and therefore the single event contours would typically remain unchanged.

One exception is that the predicted schedule for the Stage 1 development included assessment of the Boeing 747 (or equivalent) as the noisiest aircraft with a maximum stage length of 5 (corresponding to a departure for Singapore) whereas the 2050 scenario includes stage 9 departures (corresponding to departures for Los Angeles). As noted in Chapter 10, the Boeing 747 is being phased out of passenger services by airlines and it is unlikely that any operations by this aircraft type would occur at the proposed airport in 2050.

According to the predicted schedule, stage 9 departures by Boeing 747 aircraft are predicted to occur an average of once every two days by 2050 and may occur on any of a number of tracks. Although contours are shown for these events on tracks heading south from the airport, it is very unlikely that a stage 9 departure would occur on these tracks as there are no destinations for which this would be a preferred departure direction.

The additional fuel load required to reach stage 9 destinations results in an elevated engine noise level to achieve take-off. Maximum noise level contours for this additional event type are shown in Figure 31-6 and Figure 31-7. At the most-affected residences, close to the airport, L_{Amax} noise levels from these events would be in the range 85 – 95 dBA. There are less than ten existing residences within the 90 dBA L_{Amax} contour for these events, located to the south-west of the airport.

When these events occur on the indicative track leading north in the 05 direction, L_{Amax} noise levels exceeding 75 dBA could be experienced in densely-populated areas around St Marys, with levels above 80 dBA in some parts of Erskine Park.

Figure 31-8 and Figure 31-9 show L_{Amax} noise levels from a B747 arrival on any track. Noise levels in this case are identical to those experienced during the proposed Stage 1 development. Noise levels of 60 to 70 dBA are predicted over sections of Erskine Park and St Marys, extending to parts of Blacktown. Noise levels from this event would also reach 60 dBA at Blaxland, beneath the merge point for arrivals.

Maximum noise levels from other more common aircraft operations would be as described in Chapter 10 for the Stage 1 development as the aircraft type and stage length would remain consistent.

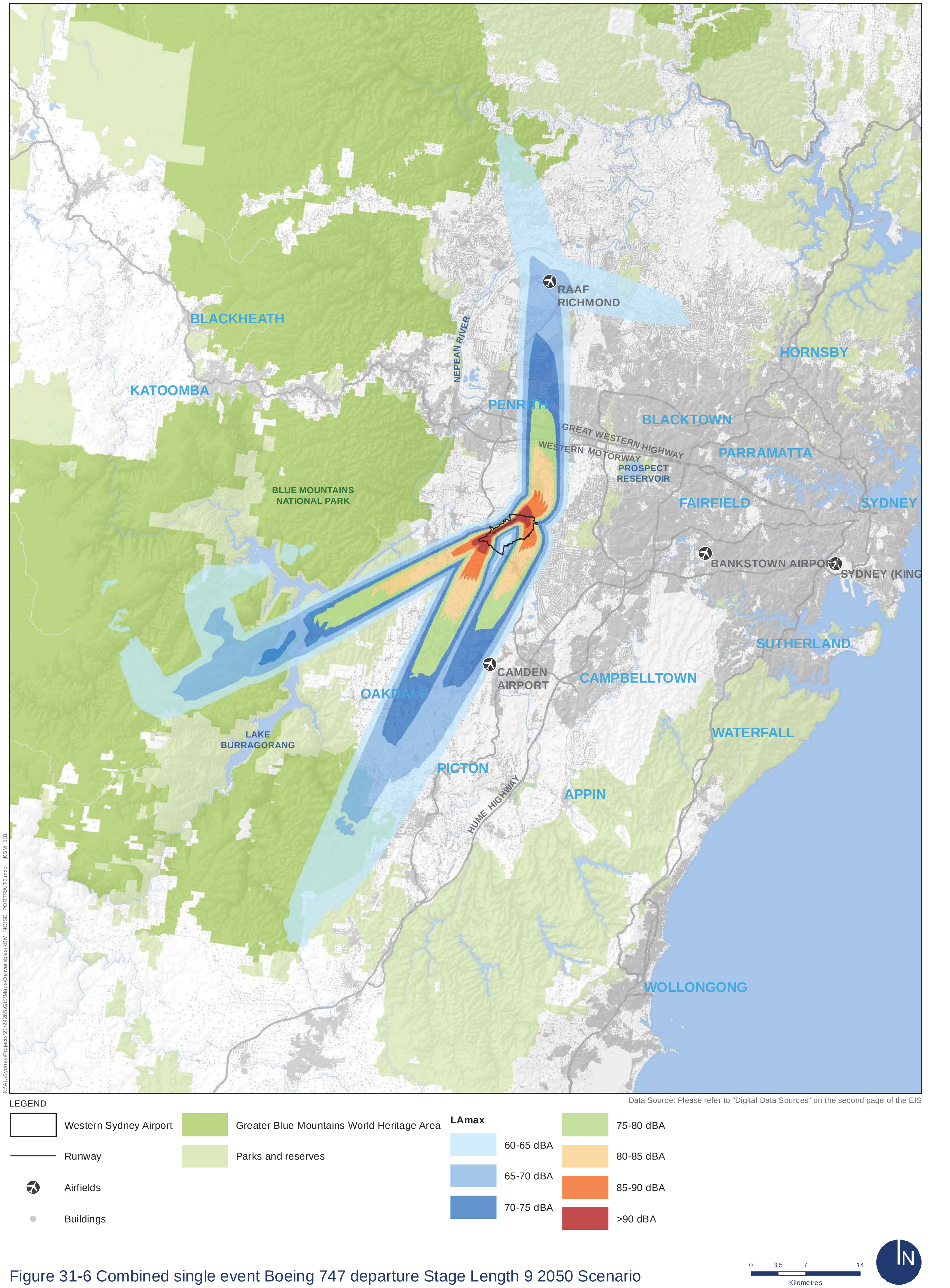
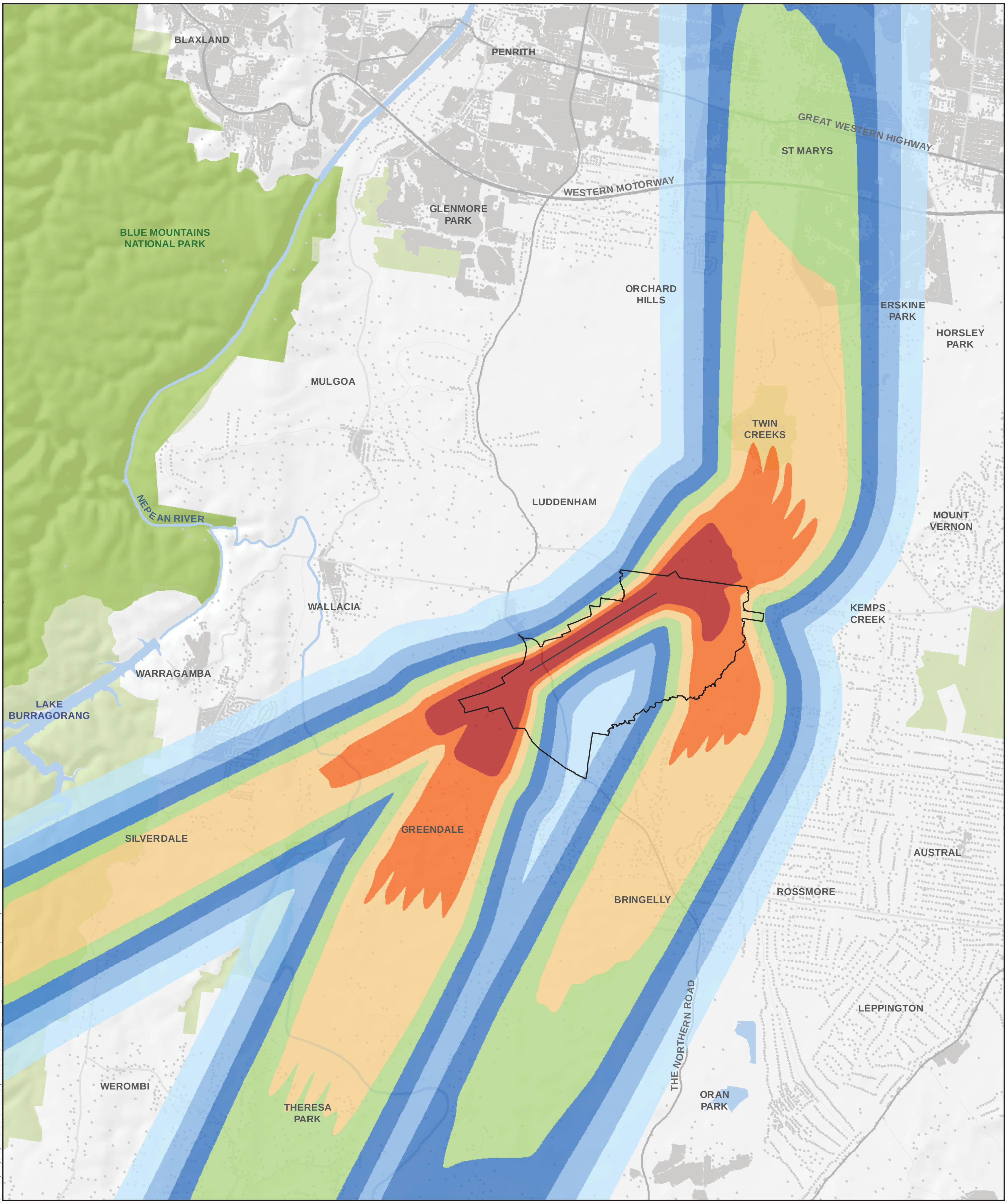


Figure 31-6 Combined single event Boeing 747 departure Stage Length 9 2050 Scenario



LEGEND

Western Sydney Airport	Greater Blue Mountains World Heritage Area
Runway	Parks and reserves
Buildings	

LAmax

- 60-65 dBA
- 65-70 dBA
- 70-75 dBA
- 75-80 dBA
- 80-85 dBA
- 85-90 dBA
- >90 dBA

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

0 0.75 1.5 3
Kilometres

Figure 31-7 Combined single event Boeing 747 departure Stage Length 9 2050 Scenario (meso scale)

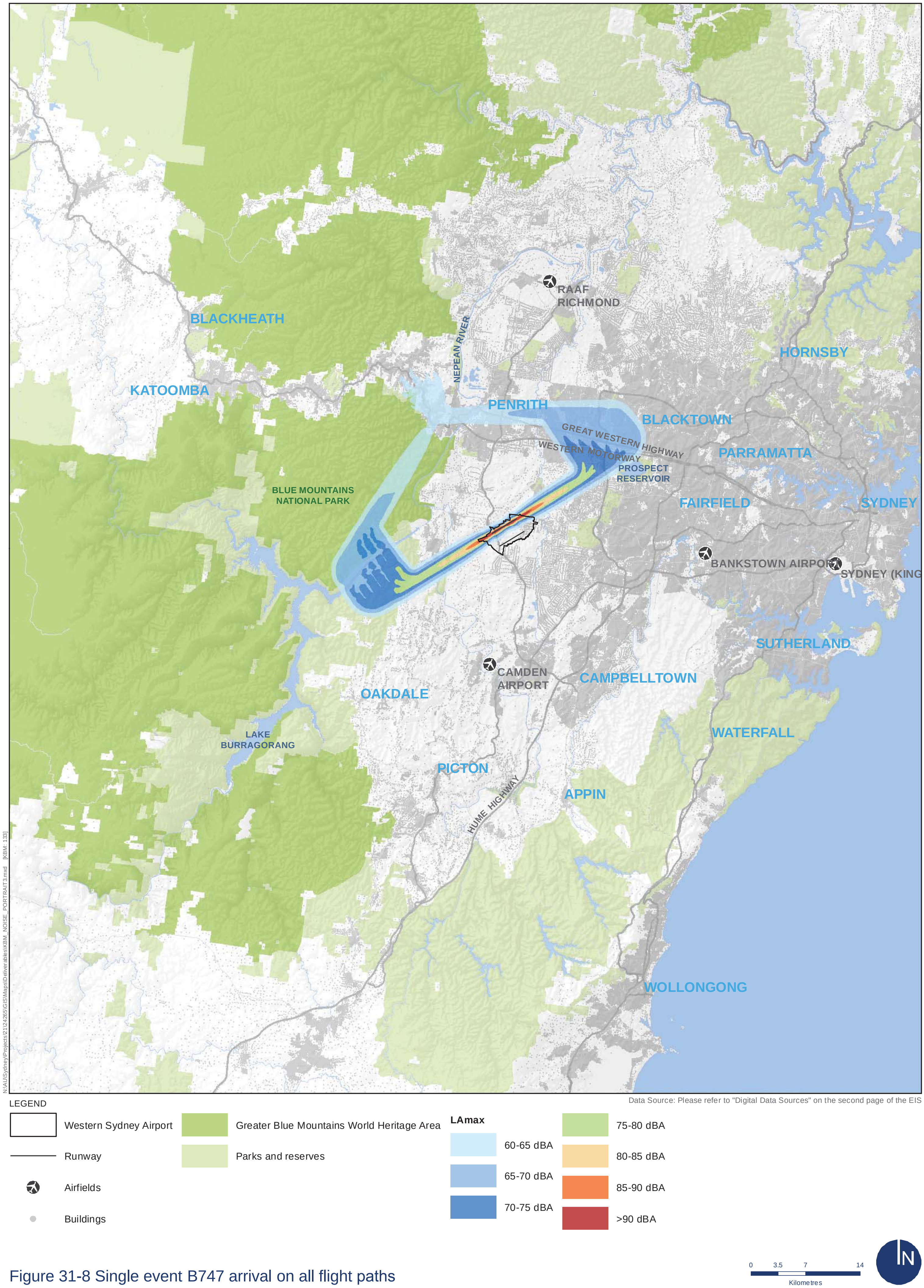
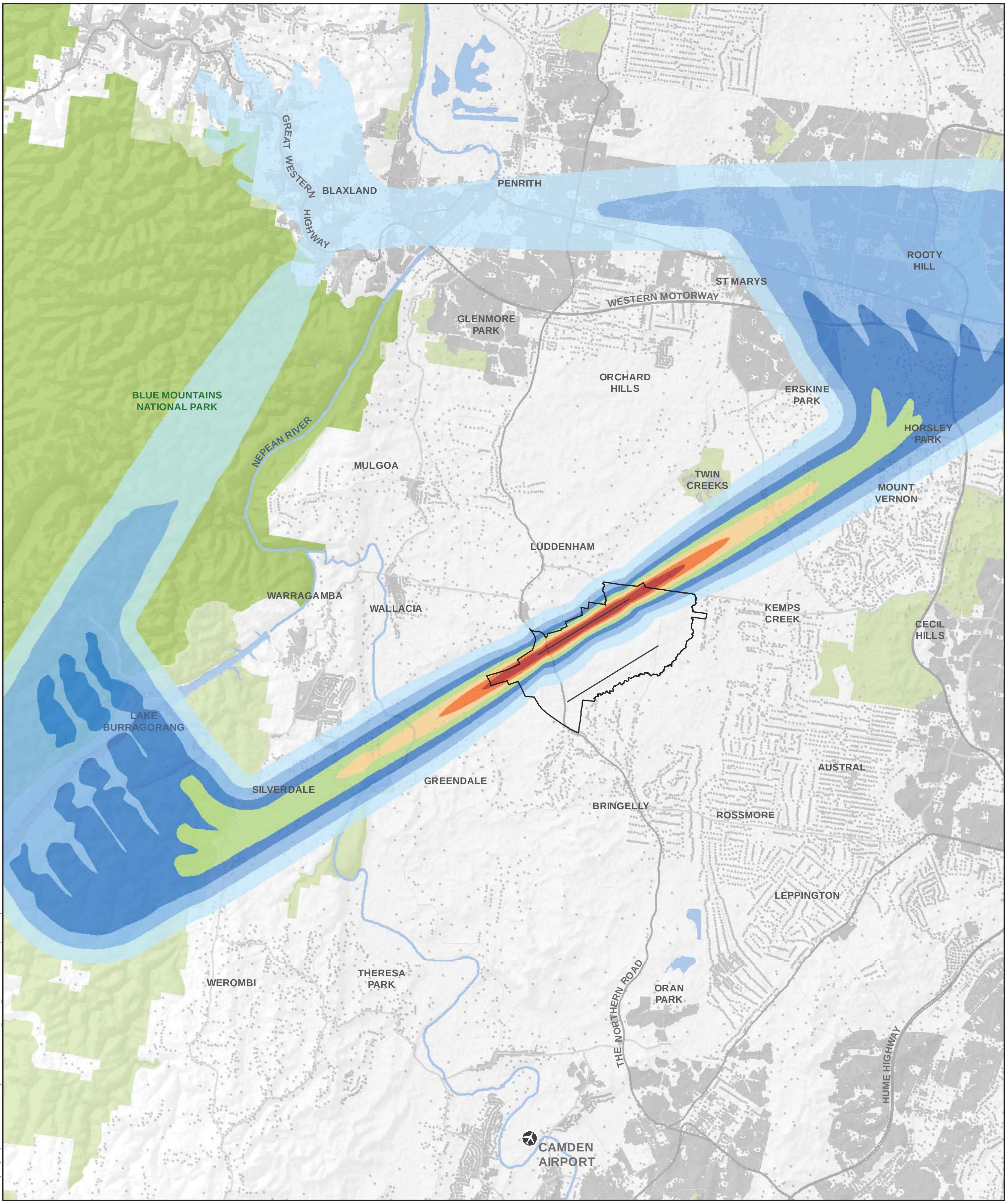


Figure 31-8 Single event B747 arrival on all flight paths



LEGEND

Western Sydney Airport
Runway
Airfields
Buildings
Greater Blue Mountains World Heritage Area
Parks and reserves

LAmax
60-65 dBA
65-70 dBA
70-75 dBA
75-80 dBA
80-85 dBA
85-90 dBA
>90 dBA

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

0 1 2 4
Kilometres

N

Figure 31-9 Single event B747 arrival on all flight paths (meso scale)

31.3.3. Noise over 24 hours

31.3.3.1. N70 results – 2050 scenario

As the volume of air traffic increases beyond 2030, the extent of predicted noise impact would also gradually increase. Based on current forecasts, aircraft movements at the proposed airport would approach capacity for the single runway configuration by about 2050. The predicted N70 contours for the 2050 scenario for four operating strategies are presented in Figure 31-10 to Figure 31-13. These represent the predicted annual average number of movements per day with L_{Amax} noise levels exceeding 70 dBA.

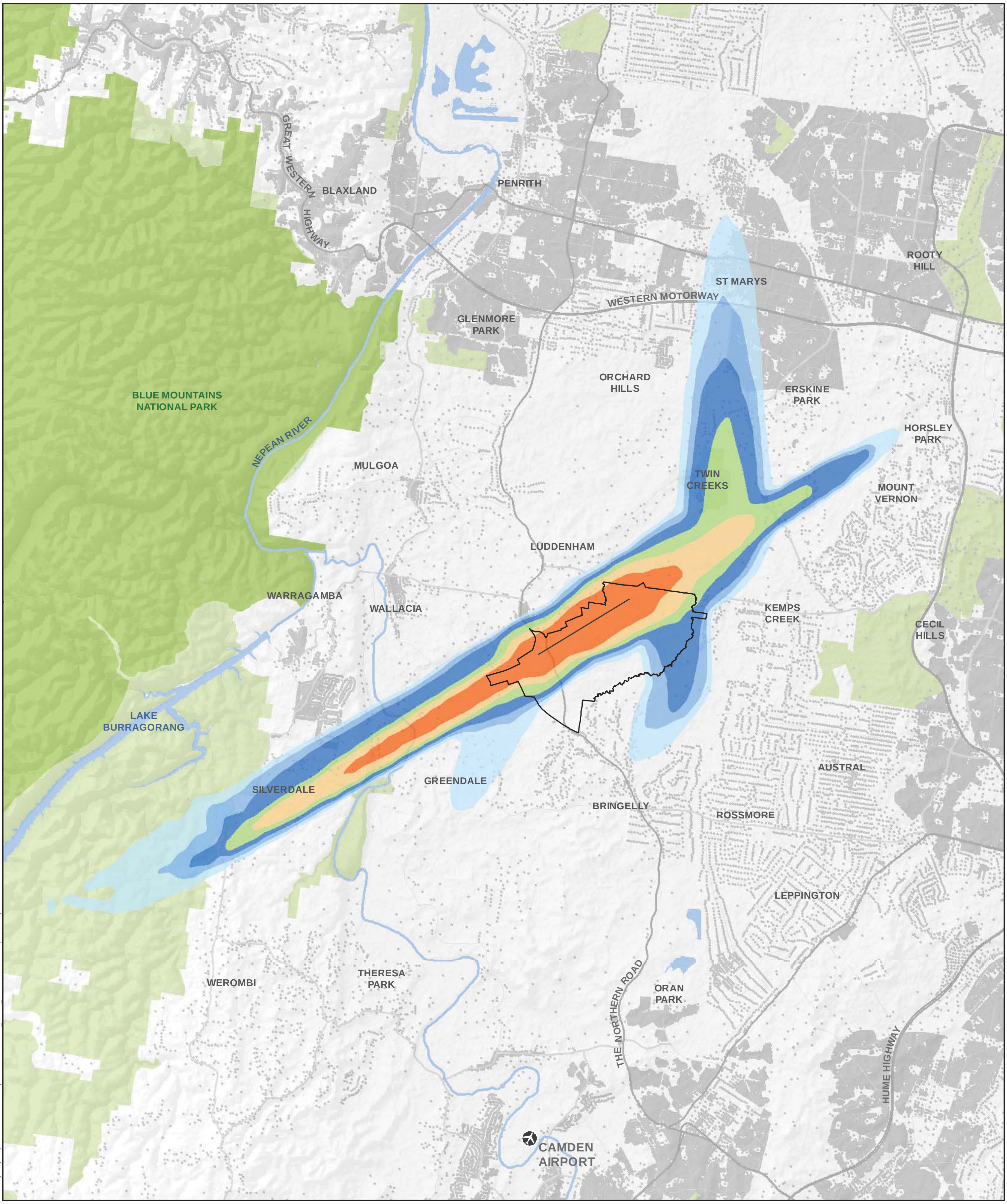
The Prefer 05 operating strategy results in greater impact on residents in densely-populated areas to the north-east of the airport site, with a predicted 5 to 10 events per day above 70 dBA over developed areas around St Marys.

In comparison, the Prefer 23 operating strategy is predicted to result in an impact of less than five events per day in these areas. The predicted impact would be greater in less densely populated areas to the north of Horsley Park, and also in rural residential areas around Greendale. The Prefer 23 operating strategy also results in somewhat higher predicted impacts in some parts of the lower Blue Mountains near Warragamba.

The residential population estimated to be affected by aircraft noise above 70 dBA by 2050 is outlined in Table 31–3. Larger areas of existing built up residential development would be exposed to aircraft noise compared to the proposed Stage 1 development. The Prefer 05 operating strategy results in approximately 30,000 people being exposed to at least five noise events per day above 70 dBA. In the Prefer 23 operating strategy, this number is substantially lower at approximately 5,000 people. However, it is notable that Prefer 23 still results in rural residential areas to the south and west of the proposed airport being exposed to a greater number of noise events above 70 dBA.

Table 31–3 – Estimated population within N70 contours – 2050

N70	Operating strategy			
	Prefer 05	Prefer 23	Prefer 05 with head-to-head	Prefer 23 with head-to-head
5–10	20,193	2,232	17,358	2,262
10–20	7,101	1,024	5,425	992
20–50	1,448	636	1,392	649
50–100	767	590	685	594
100–200	265	662	228	665
>200	139	145	180	141
Total	**29,912**	**5,288**	**25,268**	**5,303**



LEGEND

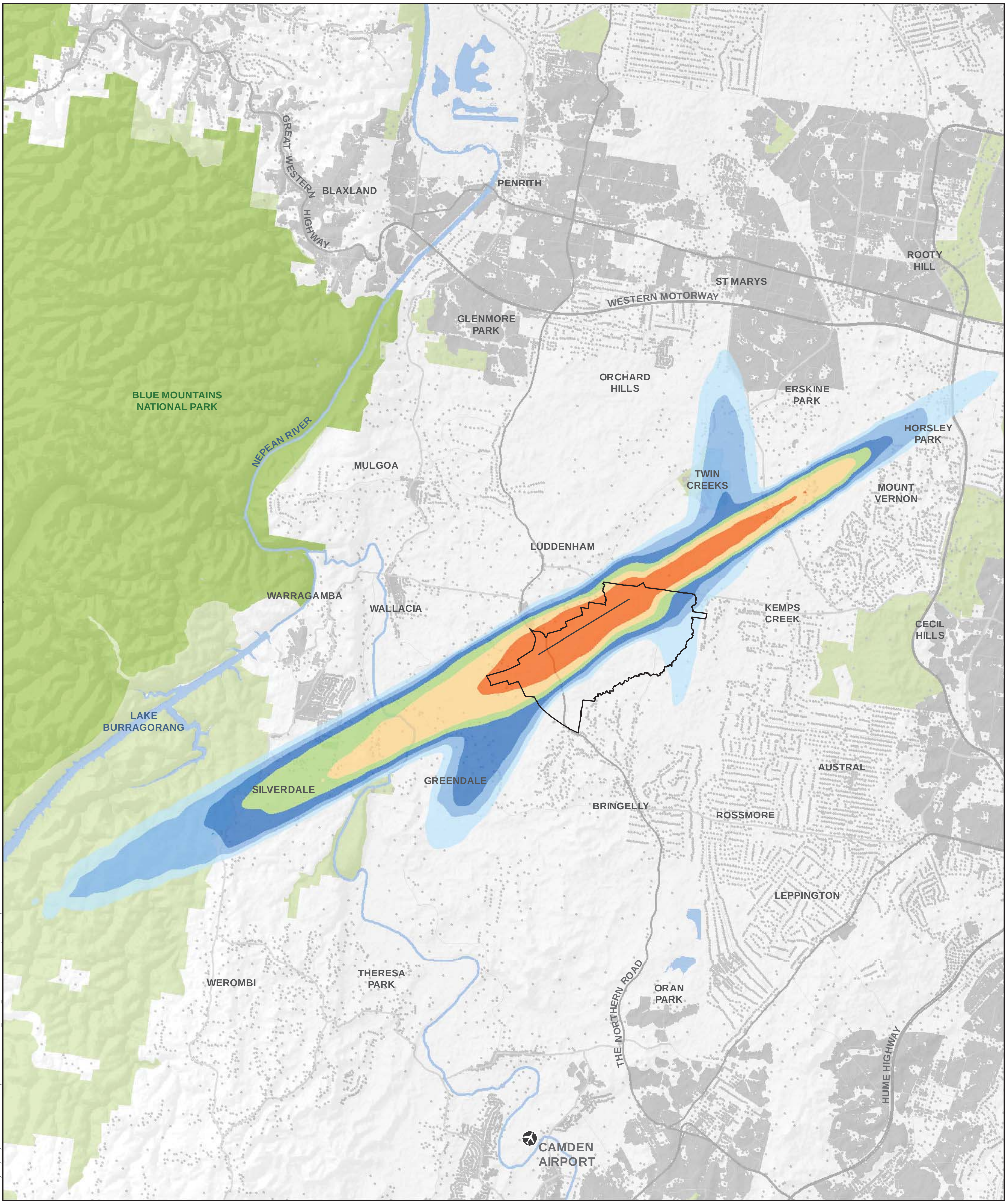
Data Source: Please refer to "Digital Data Sources" on the second page of the EIS

Western Sydney Airport	Greater Blue Mountains World Heritage Area	N70 = 5-10	N70 = 50-100
Runway	Parks and reserves	N70 = 10-20	N70 = 100-200
Airfields		N70 = 20-50	N70 = 200+
Buildings			

0 1 2 4
Kilometres

N

Figure 31-10 - N70 contours for Prefer 05 operating strategy (2050)



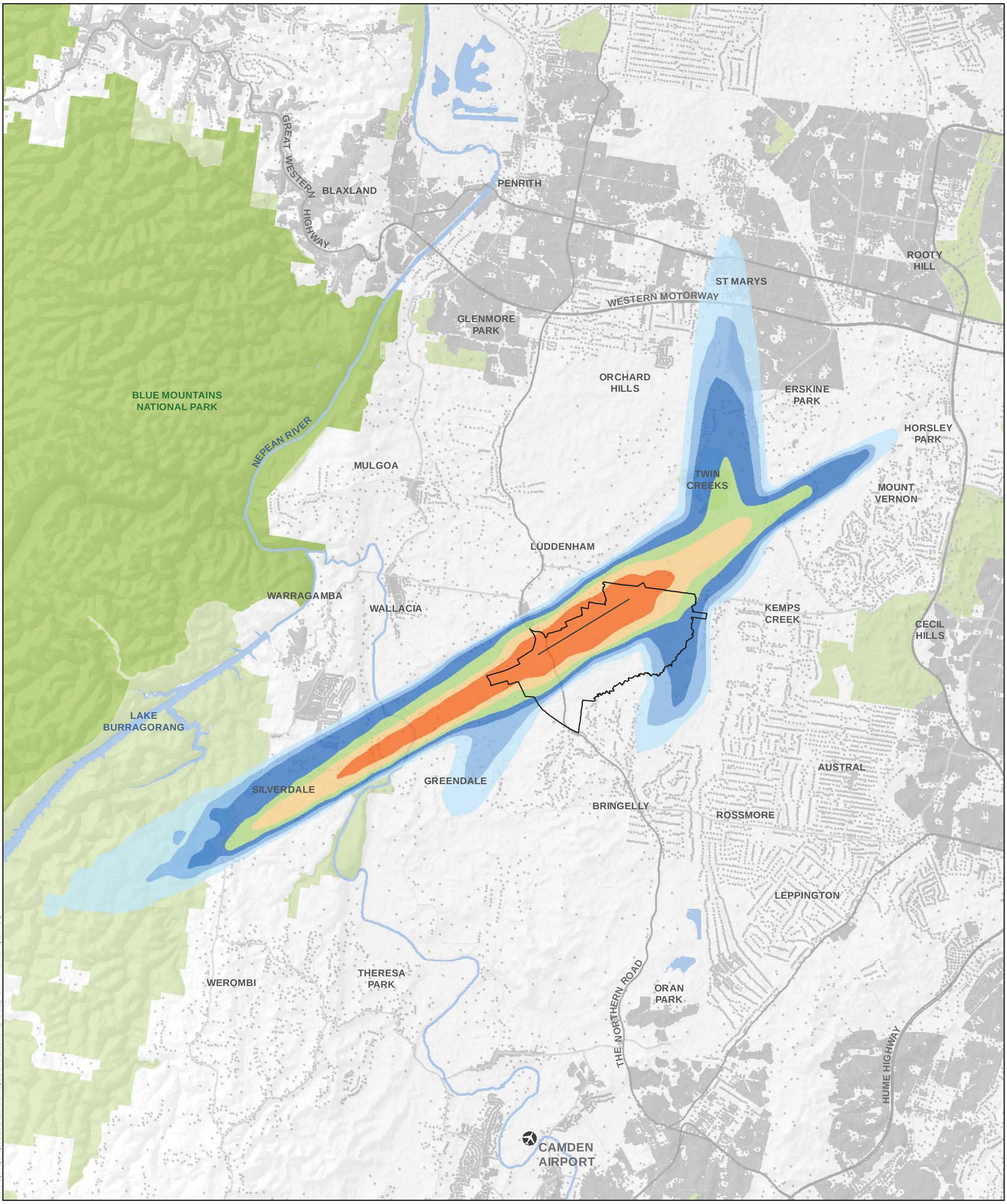
Data Source: Please refer to "Digital Data Sources" on the second page of the EIS

LEGEND

- Western Sydney Airport
- Runway
- Airfields
- Buildings
- Greater Blue Mountains World Heritage Area
- Parks and reserves
- N70 = 5-10
- N70 = 10-20
- N70 = 20-50
- N70 = 50-100
- N70 = 100-200
- N70 = 200+

0 1 2 4
Kilometres

Figure 31-11 - N70 contours for Prefer 23 operating strategy (2050)



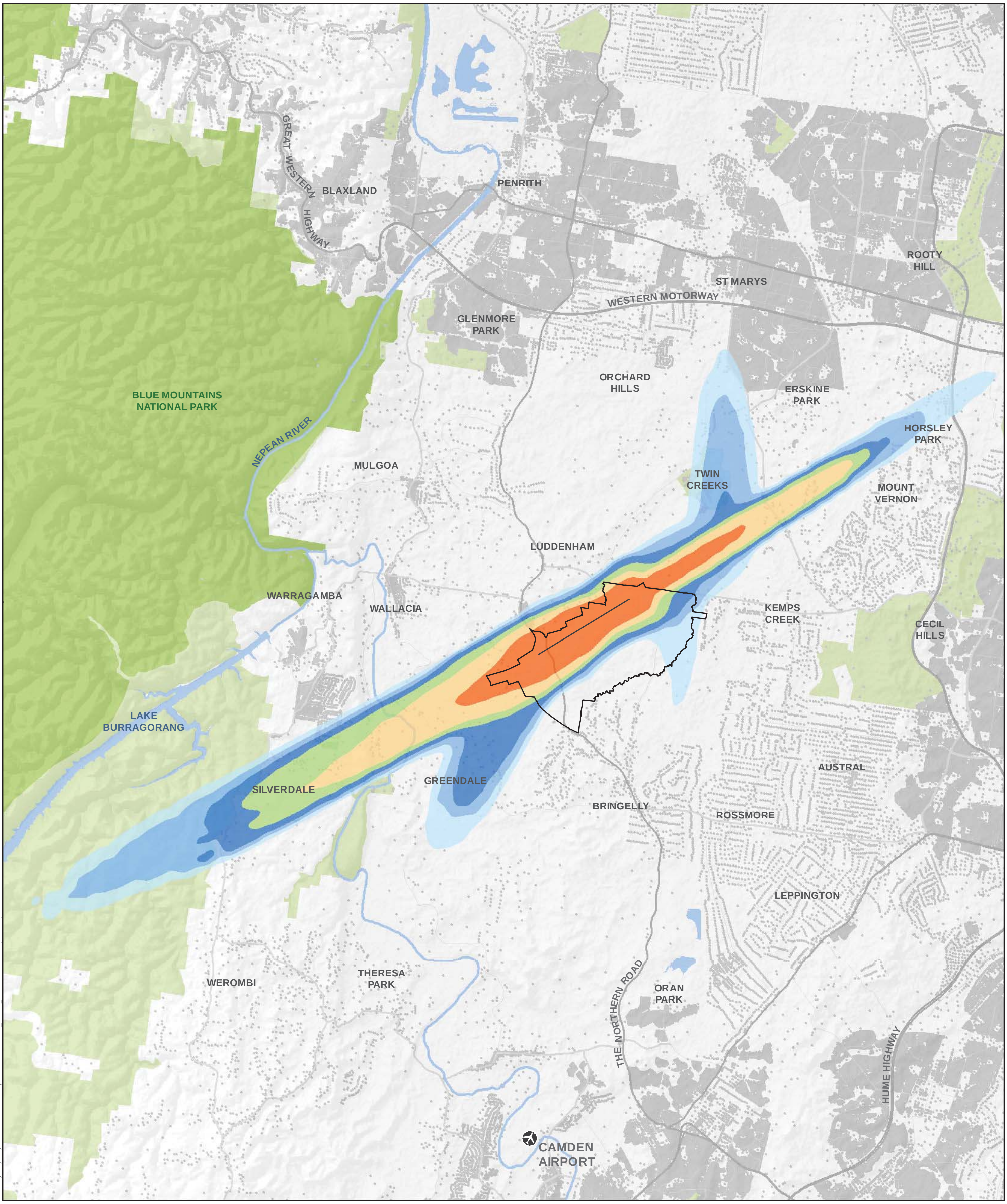
LEGEND

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

	Western Sydney Airport		Greater Blue Mountains World Heritage Area		N70 = 5-10		N70 = 50-100
	Runway		Parks and reserves		N70 = 10-20		N70 = 100-200
	Airfields				N70 = 20-50		N70 = 200+
	Buildings						

Figure 31-12 - N70 contours for Prefer 05 with head to head operating strategy (2050)

0 1 2 4
Kilometres



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

LEGEND

- Western Sydney Airport
- Runway
- Airfields
- Buildings
- Greater Blue Mountains World Heritage Area
- Parks and reserves
- N70 = 5-10
- N70 = 10-20
- N70 = 20-50
- N70 = 50-100
- N70 = 100-200
- N70 = 200+

0 1 2 4
Kilometres

N

Figure 31-13 - N70 contours for Prefer 23 with head to head operating strategy (2050)

31.3.3.2. 90th percentile N70 results – 2050 scenario

The 90th percentile values of N70 calculated over all days for the 2050 scenario are shown on Figure 31-14 and Figure 31-15. The N70 values represent the number of daily aircraft noise events over 70 dBA that would be exceeded on only 10 per cent of days. This can be thought of as a typical 'worst case' day for airport operations in each operating strategy. The figures also show the average day N70 values for comparison. Head-to-head operations are not shown as this strategy makes very little difference to the results.

The most noticeable feature of these figures is that generally the predicted difference between noise impact on average and worst case days would not be large. This is due to the relatively low and consistent wind speeds at the airport site, which mean the preferred mode of operation could be selected over 80 per cent of the time for any given strategy.

Although established built-up areas are not predicted to experience more than five events per day over 70 dBA on an average day for the Prefer 23 operating strategy, there are areas to the south of St Marys that would do so on a typical worst case day. In fact, in these areas a typical worst case day for the Prefer 23 operating strategy would be similar to an average day for the Prefer 05 operating strategy.

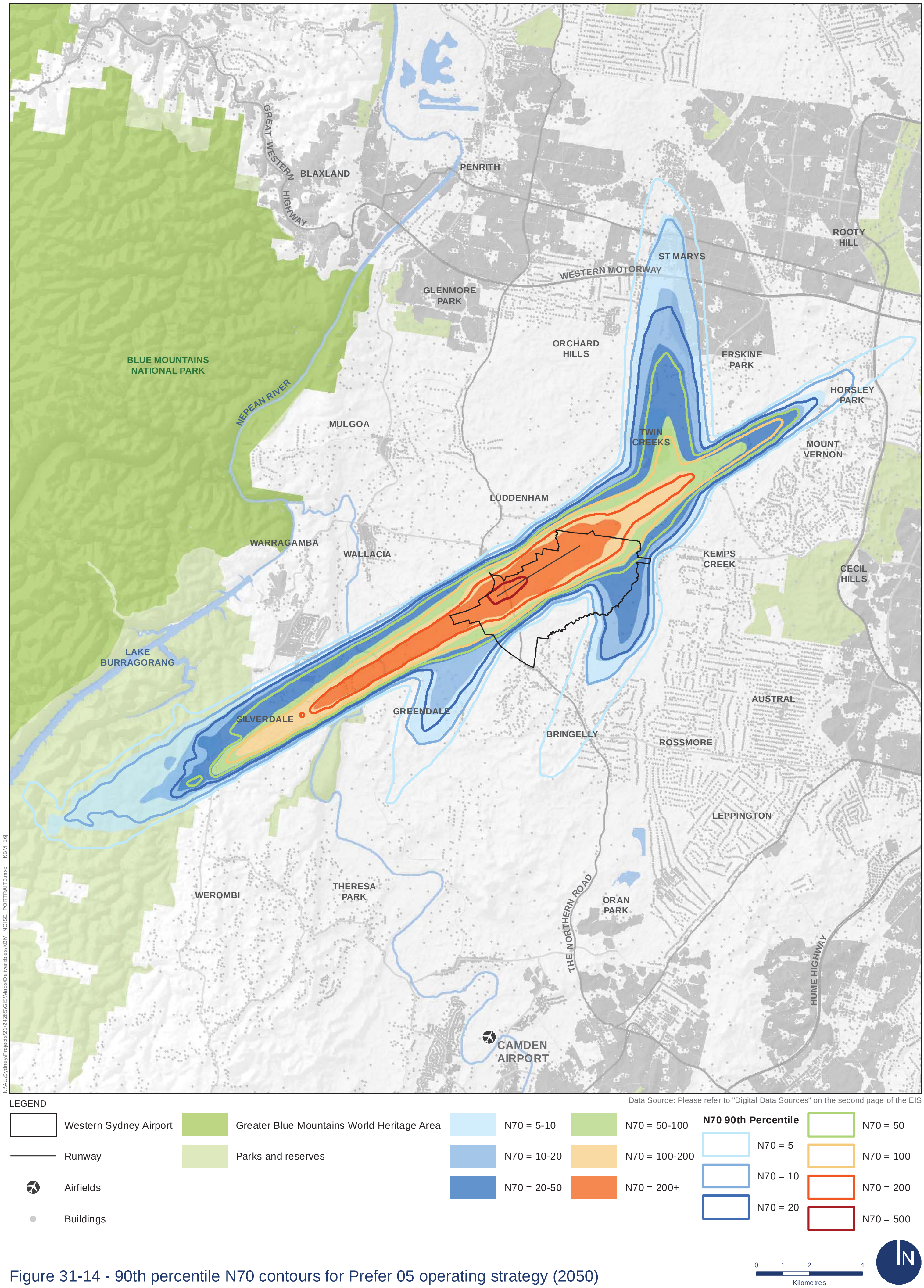


Figure 31-14 - 90th percentile N70 contours for Prefer 05 operating strategy (2050)

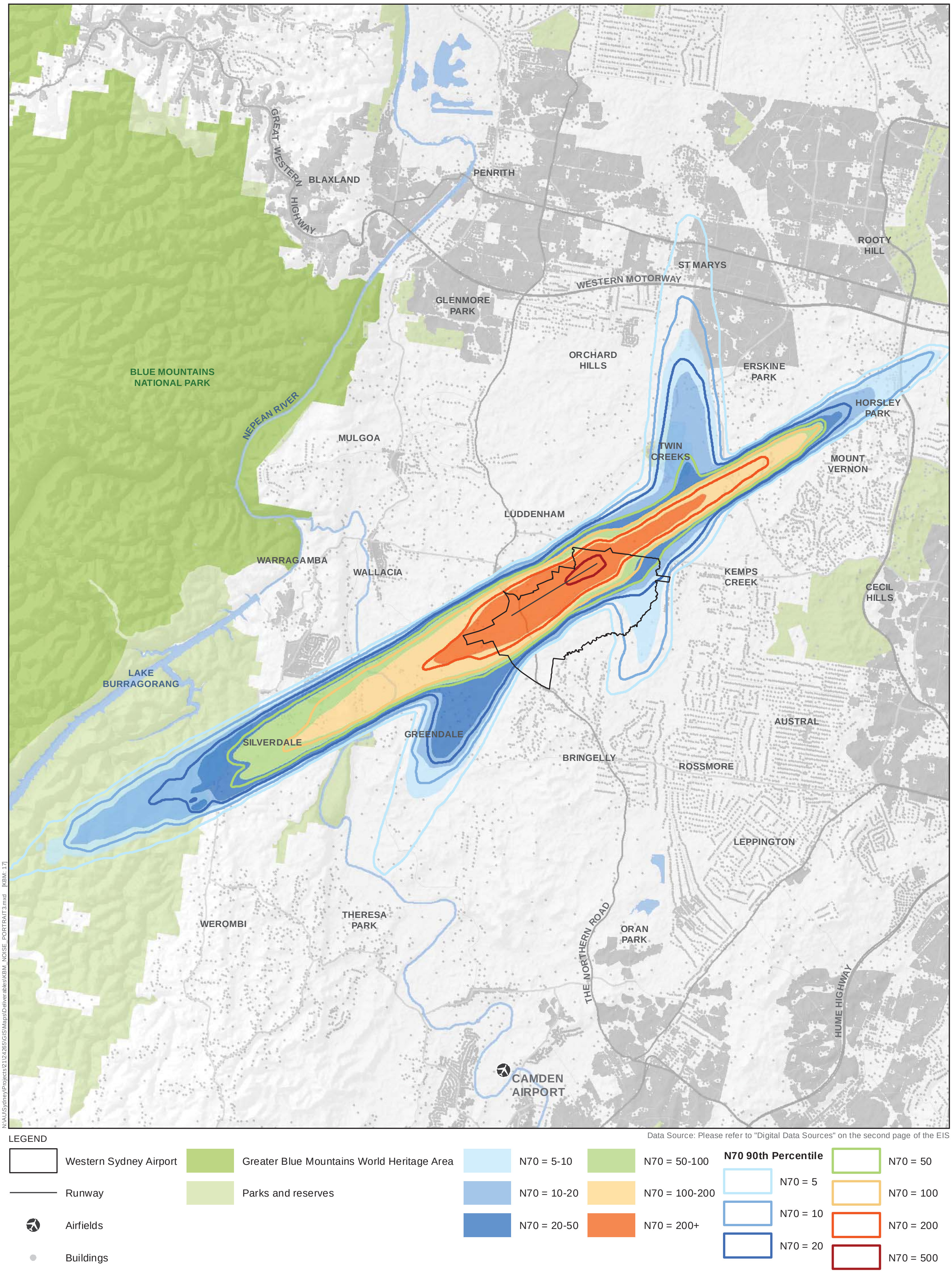


Figure 31-15 - 90th percentile N70 contours for Prefer 23 operating strategy (2050)

31.3.4. Night-time noise

31.3.4.1. N60 results – 2050

The number of noise events exceeding 60 dBA (N60) has been used to describe the impact of noise at night. Predicted N60 values in 2050 are shown for the standard night period 10 pm – 7 am in Figure 31-16 to Figure 31-19 for the four operating strategies.

Under the 2050 assessment scenario, large areas with high population densities are predicted to experience over 20 noise events per night exceeding 60 dBA under the Prefer 05 operating strategy, particularly to the north of the airport site around St Marys and Erskine Park. Large areas of residential development to the north-east are also predicted to experience night-time noise impacts under the Prefer 23 operating strategy, but at a lower frequency of 5–10 events per night.

Areas in close proximity to the airport site including Luddenham and rural residential areas south-west of the site are predicted to experience a high number of noise events per night under all operating modes.

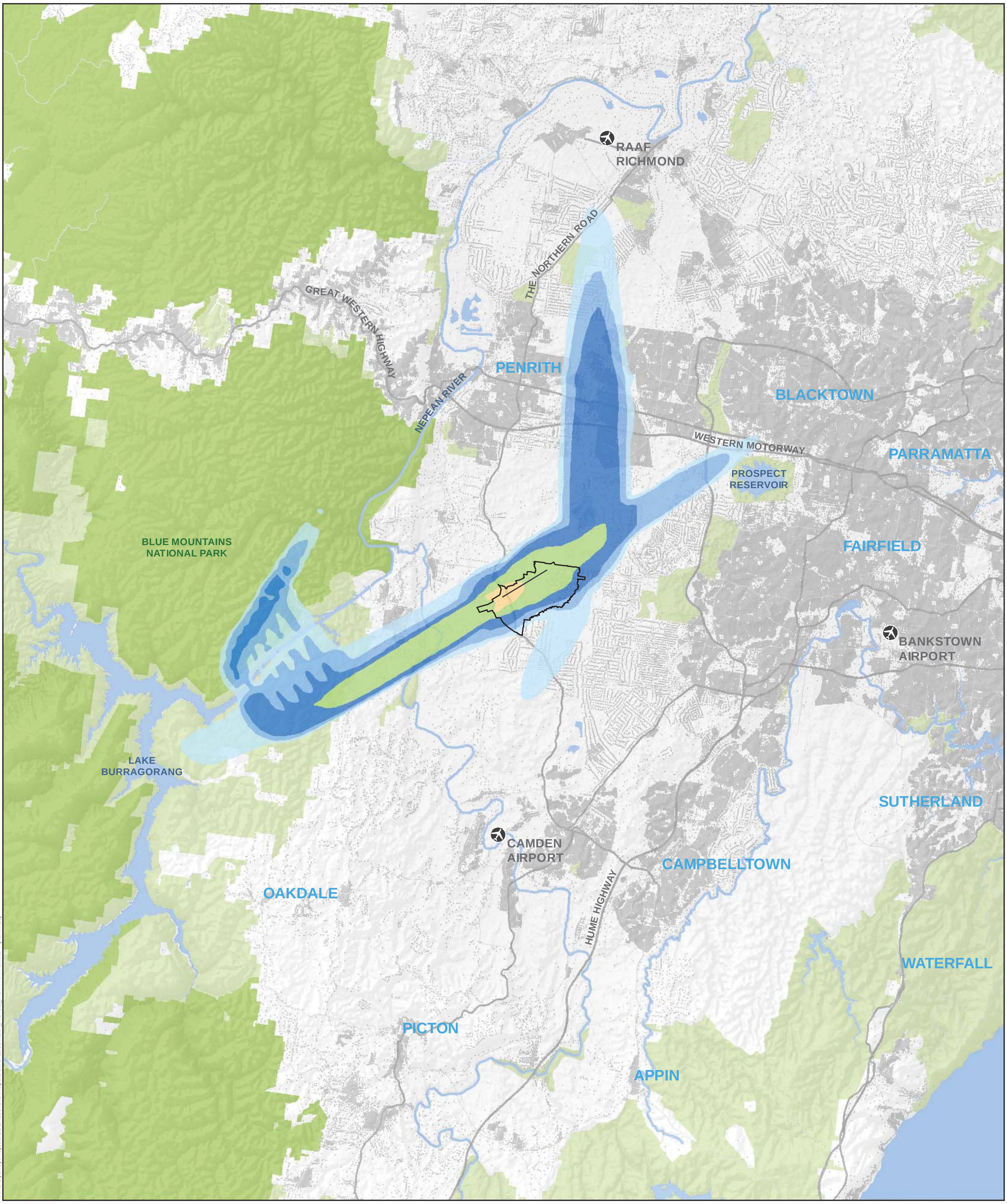
The night-time noise impact towards the north-east could be reduced by the use of the head-to-head mode where available. This would result in almost no built-up residential areas being exposed to more than five events above 60 dBA per night. The head to head operating mode would have minimal effect on the level of disturbance to residents in close proximity to the site.

Table 31–4 shows the number of people predicted to be affected by night-time noise above 60 dBA in 2050. By this time, the population experiencing night-time noise impacts at some level is predicted to increase substantially. At 2050 levels of aircraft traffic, the use Prefer 23 with head-to-head operating strategy offers clear benefits in terms of the number of residents exposed to night-time noise.

Table 31–4 – Estimated population within N60 contours – 2050

N60	Operating strategy			
	Prefer 05	Prefer 23	Prefer 05 with head-to-head	Prefer 23 with head-to-head
5–10	29,128	143,827	81,187	30,560
10–20	34,552	18,211	15,513	1,987
20–50	72,138	4,953	3558	4,111
50–100	1,600	3,395	2,664	3,440
>100	13	5	1,44	0
Total	**137,431**	**170,390**	**103,067**	**40,099**

The 90th percentile night-time N60 values, representing the predicted number of events per night exceeding 60 dBA on a ‘worst case’ night, are presented in Appendix E2 in Volume 4. Differences between average and worst case days are generally not large. However, particularly with head-to-head operations, more developed residential areas would be exposed to more than five events per night on a worst case night than on an average night.



N:\AU\Sydney\Projects\21\24265\GIS\Maps\Deliverables\KBM_NOISE_PORTRAIT3.mxd [KBM: 18]

LEGEND

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

Western Sydney Airport

Runway

Airfields

Buildings

Greater Blue Mountains World Heritage Area

Parks and reserves

N60 = 5-10

N60 = 10-20

N60 = 20-50

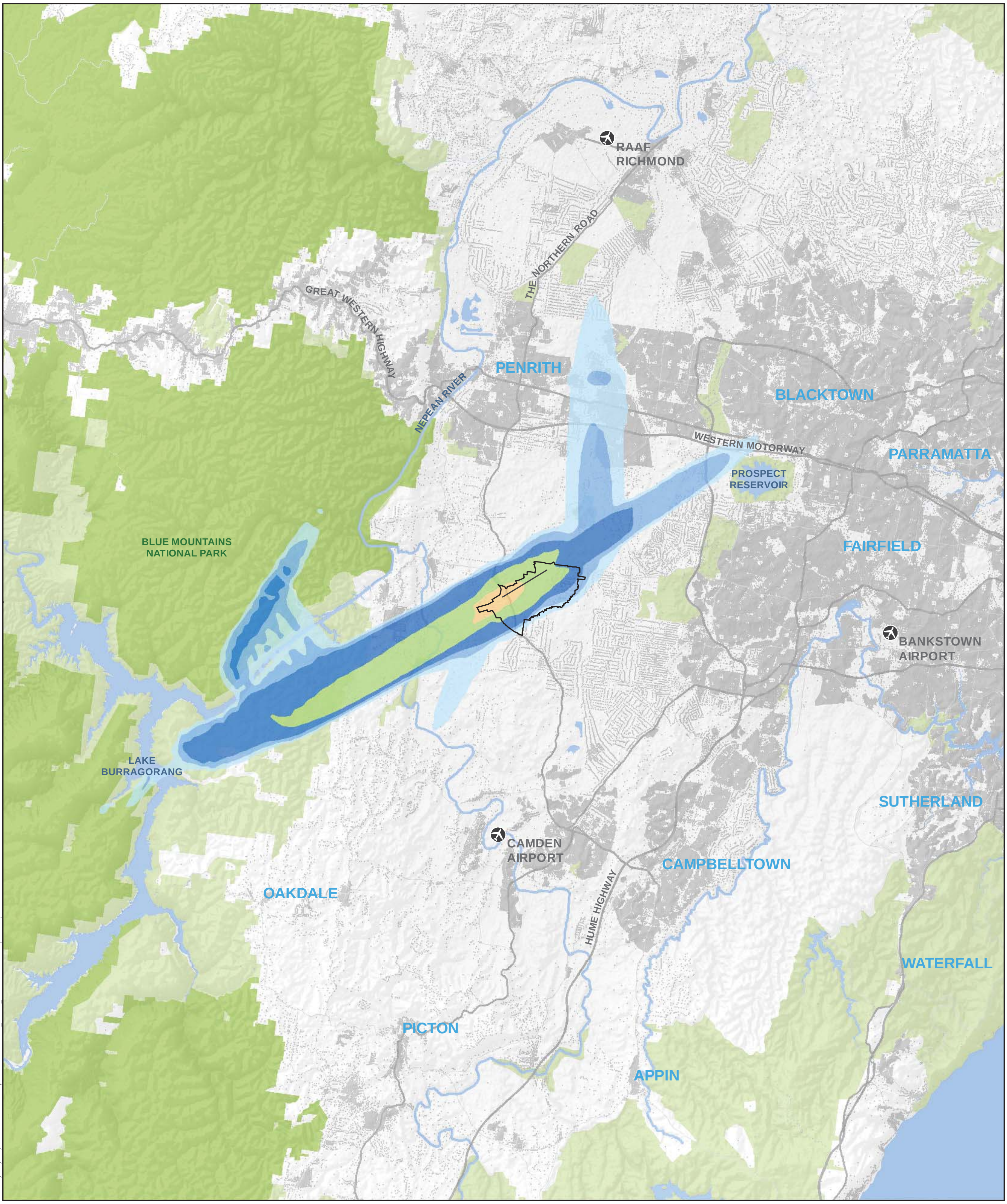
N60 = 50-100

N60 = 100+

0 2.25 4.5 9
Kilometres

Figure 31-16 - N60 contours for Prefer 05 operating strategy (2050)

Figure 31-17 - N60 contours for Prefer 23 operating strategy (2050)



LEGEND

Western Sydney Airport	Greater Blue Mountains World Heritage Area	N60 = 5-10
Runway	Parks and reserves	N60 = 10-20
Airfields		N60 = 20-50
Buildings		N60 = 50-100
		N60 = 100+

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

0 2.25 4.5 9
Kilometres

N

Figure 31-18 - N60 contours for Prefer 05 operating strategy with head to head (2050)

N:\AU\Sydney\Projects\21\24265\GIS\Maps\Deliverables\KBM_NOISE_PORTRAIT3.mxd [KBM: 21]

LEGEND

- Western Sydney Airport
- Runway
- Airfields
- Buildings
- Greater Blue Mountains World Heritage Area
- Parks and reserves
- N60 = 5-10
- N60 = 10-20
- N60 = 20-50
- N60 = 50-100
- N60 = 100+

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

0 2.25 4.5 9
Kilometres

Figure 31-19 - N60 contours for Prefer 23 operating strategy with head to head (2050)

31.3.5. Recreational areas

A number of relatively small recreational areas, located near to the airport site, have been identified within the area potentially affected by aircraft overflight noise. These range from sports areas used for active pursuits (such as horse riding, bowling or golf) to nature reserves which may be used for more passive activities.

The impact of aircraft noise in recreational areas can be quantified by the number of events per day with maximum noise levels exceeding 60 and 70 dBA. Where a noise level exceeds 60 dBA, a person may need to raise their voice to be properly heard in conversation, but this level would be unlikely to cause disruption to active sporting pursuits. However, it would be noticeable and could impact on the acoustic amenity of areas used for passive recreation for the duration of the aircraft overflight. Noise levels above 70 dBA would require increased voice effort (although not shouting) for conversation to be understood, and would likely be considered to be acoustically intrusive in passive recreation areas for the duration of the overflight.

Table 31–5 and Table 31–6 show the identified recreation areas and the predicted values of N60 and N70 for the Prefer 05 and Prefer 23 operating strategies. The values shown are for the period 7 am – 6 pm, representing the times when these areas would most likely be used.

Table 31–5 – Average daily noise events with L_{Amax} exceeding 60 dBA (N60) at recreational receivers (2050)

Recreational receiver	2050 scenario	
	Prefer 05	Prefer 23
Bents Basin State Conservation Area / Gulguer Nature Reserve	24	49
Kemps Creek Nature Reserve	0	0
Rossmore Grange	11	2
Horsley Park Reserve	0	0
Twin Creeks Golf & Country Club	78	27
Sydney International Equestrian Centre	0	0
Whalan Reserve, St Marys	4	10

Table 31–6 – Average daily noise events with L_{Amax} exceeding 70 dBA (N70) at recreational receivers (2050)

Recreational receiver	2050 scenario	
	Prefer 05	Prefer 23
Bents Basin State Conservation Area / Gulguer Nature Reserve	0	0
Kemps Creek Nature Reserve	0	0
Rossmore Grange	0	0
Horsley Park Reserve	0	0
Twin Creeks Golf & Country Club	28	11
Sydney International Equestrian Centre	0	0
Whalan Reserve, St Marys	0	0

The results indicate that most of the identified recreational receivers would not be subject to aircraft overflight noise events with maximum levels exceeding 70 dBA.

Aircraft overflight noise levels from aircraft at Twin Creeks Golf & Country Club would be noticeable and at times a raised voice effort would be required for effective communication. At this location the predicted noise exposure would be significantly reduced under a Prefer 23 operating strategy.

Bents Basin State Conservation Area / Gulguer Nature Reserve, Rossmore Grange and Whalan Reserve would be subject to a number of flyover events with noise levels exceeding 60 dBA which would be noticeable to users of these areas. At Bents Basin State Conservation Area and Gulguer Nature Reserve and Whalan Reserve noise exposure levels would be lower under a Prefer 05 operating strategy while at Rossmore Grange they would be lower under a Prefer 23 strategy.

31.4. Aircraft noise in 2063

This section considers aircraft noise impacts for a long term development scenario where the airport is handling around 82 million annual passengers by around 2063. This scenario represents an assessment of noise exposure at a point in time when the airport has two runways, which are both operating close to their theoretical capacity.

The flight paths and operating procedures to be used by aircraft in the long term are indicative and would be subject to further detailed consideration before being finalised. There is also considerable uncertainty regarding noise emission levels from future aircraft, although generally they can be anticipated to be lower than the current aircraft types used in this assessment.

A number of alternative airport operating modes may be available under conditions of low traffic volume that may potentially result in reduced noise impacts. However, it is not possible to accurately ascertain which modes would be possible at a time so far into the future and therefore only the Prefer 05 and Prefer 23 operating strategies have been considered.

31.4.1. ANEC contours

ANEC contours for the two operating strategies considered in this assessment are shown in Figure 31-20 and Figure 31-21. The contours cover a larger area than compared to the 2050 scenario, extending to the south and east of the airport site following commissioning of the second runway. The estimated population within the ANEC contours for 2063 operations is shown in Table 31–7.

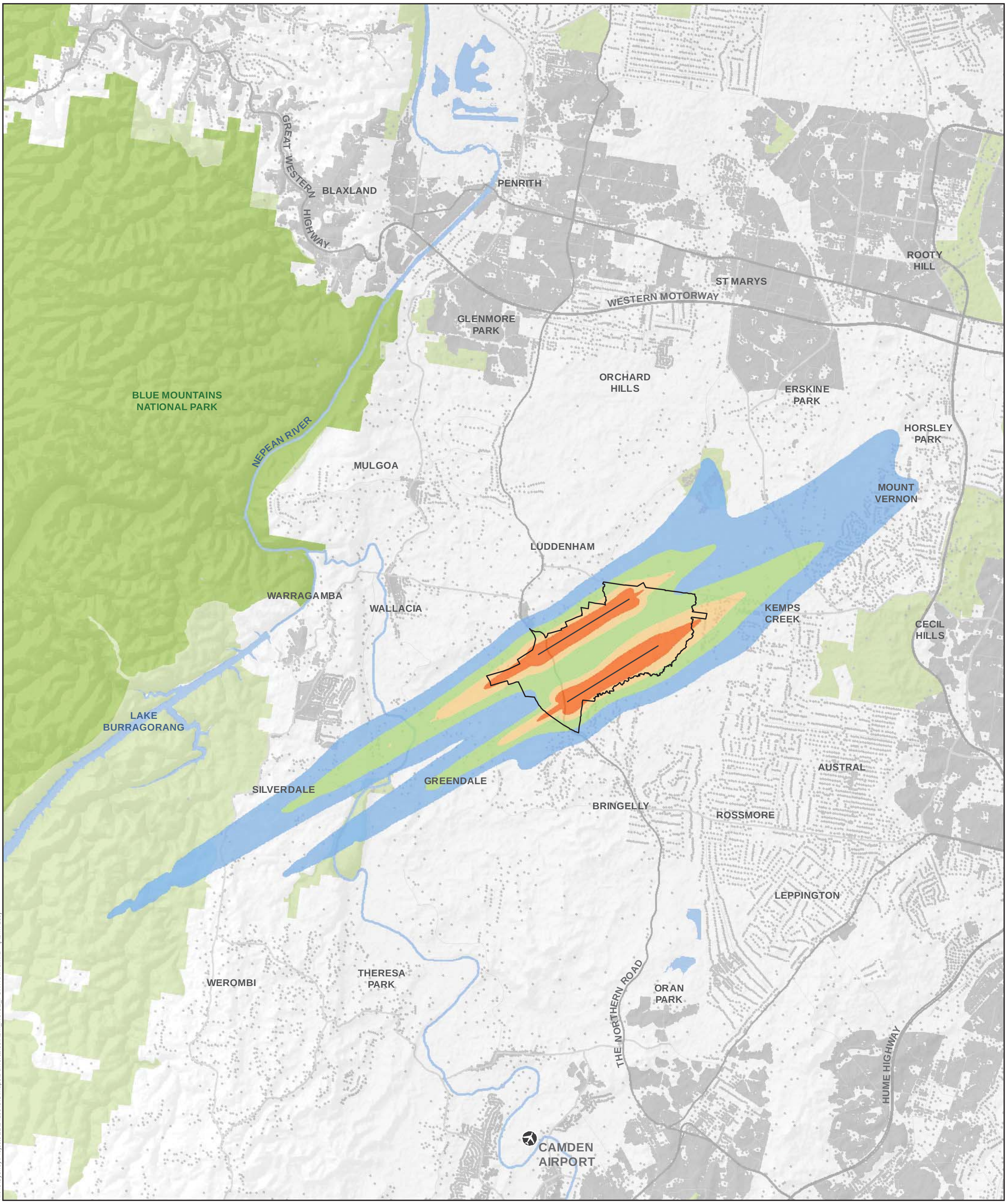
Table 31–7 – Estimated population within ANEC contours (2063)

N70	Operating mode	
	Prefer 05	Prefer 23
20-25	5,803	7,832
25-30	1,486	1,934
30-35	570	527
>35	0	26
Total	**7,858**	**10,319**

Figure 31-22 and Figure 31-23 show the year 2063 ANEC contours compared to those presented in the 1985 Draft EIS (Kinhill Stearns 1985). The 1985 ANEC was prepared for a dual runway airport and has been used for land use planning purposes to date.

The modelled 2063 ANEC contours for the long term development are generally comparable to the 1985 ANEC with slight extensions to the north and the south-west. These differences primarily reflect revised modelling assumptions including updated forecasts for the number of aircraft movements, new indicative flight paths and changes in the assignment of aircraft to particular flight paths. Compared to the 1985 ANEC, the modelled 2063 ANEC extends further to the south-west of the proposed airport site into the Burragorang State Conservation Area.

Existing planning controls based on the 1985 ANEC contours have restricted development within the majority of the land area covered by the modelled 2063 ANEC contours.



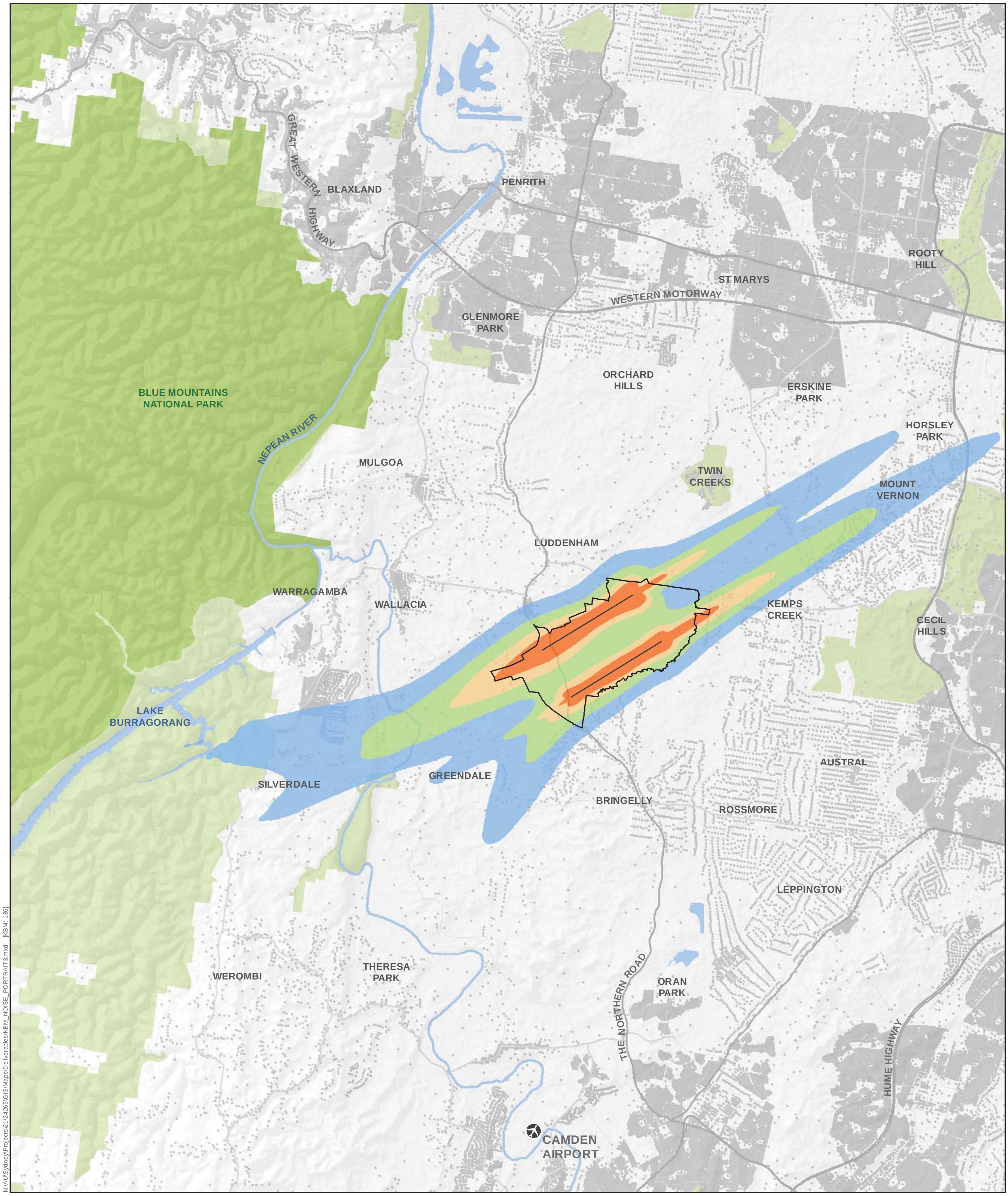
LEGEND

Western Sydney Airport	Greater Blue Mountains World Heritage Area	ANEC = 20-25
Runway	Parks and reserves	ANEC = 25-30
Airfields		ANEC = 30-35
Buildings		ANEC = 35+

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

0 1 2 4
Kilometres

Figure 31-20 ANEC contours for Prefer 05 operating strategy (2063)



LEGEND

Western Sydney Airport

Runway

Airfields

Buildings

Greater Blue Mountains World Heritage Area

Parks and reserves

ANEC = 20-25

ANEC = 25-30

ANEC = 30-35

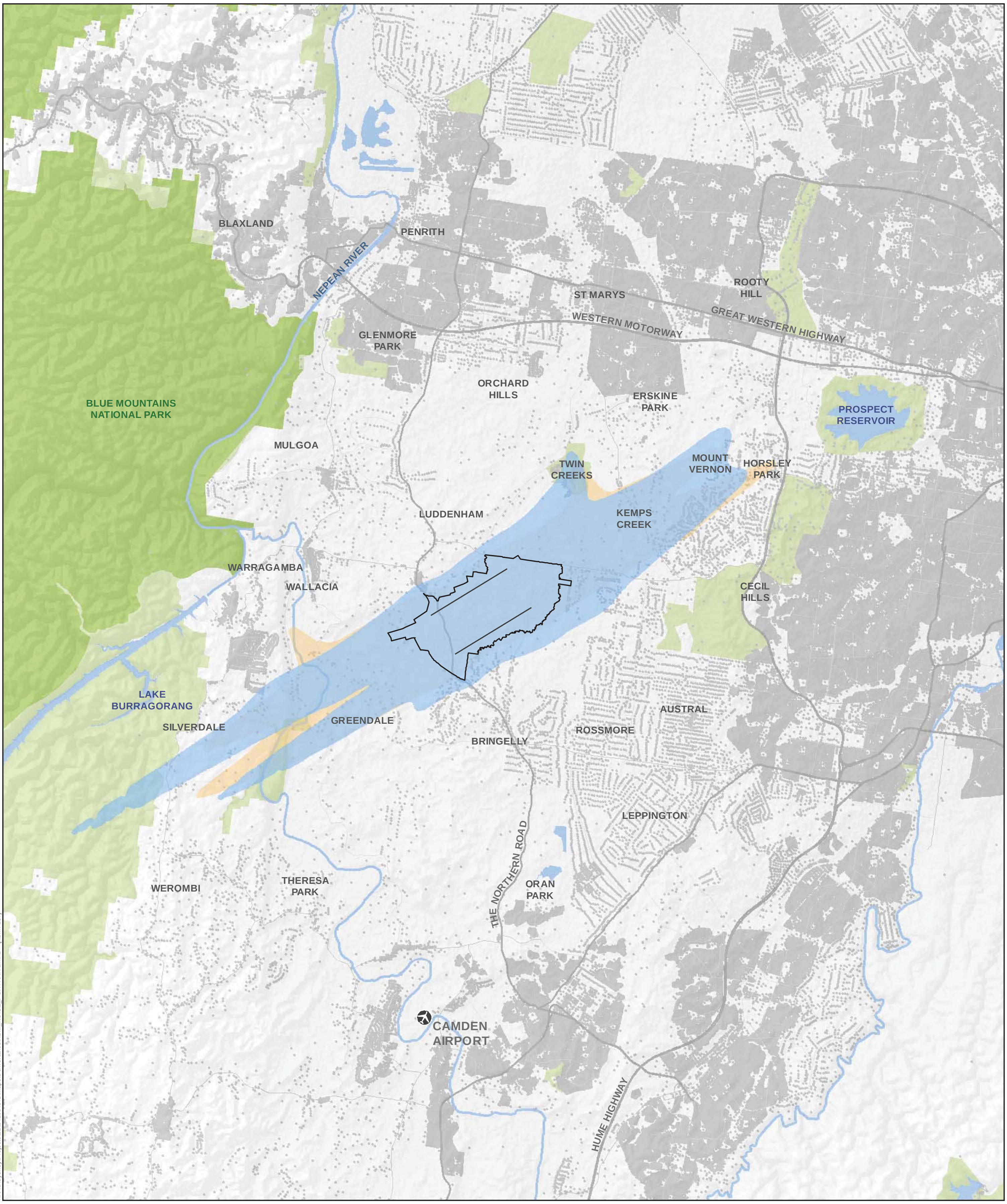
ANEC = 35+

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

0 1 2 4
Kilometres

N

Figure 31-21 ANEC contours for Prefer 23 operating strategy (2063)



LEGEND

- Western Sydney Airport
- Runway
- Airfields
- Buildings
- Greater Blue Mountains World Heritage Area
- Parks and reserves

ANEC Contours 2063 Prefer 05

- 20 ANEC

1985 EIS ANEC Contours

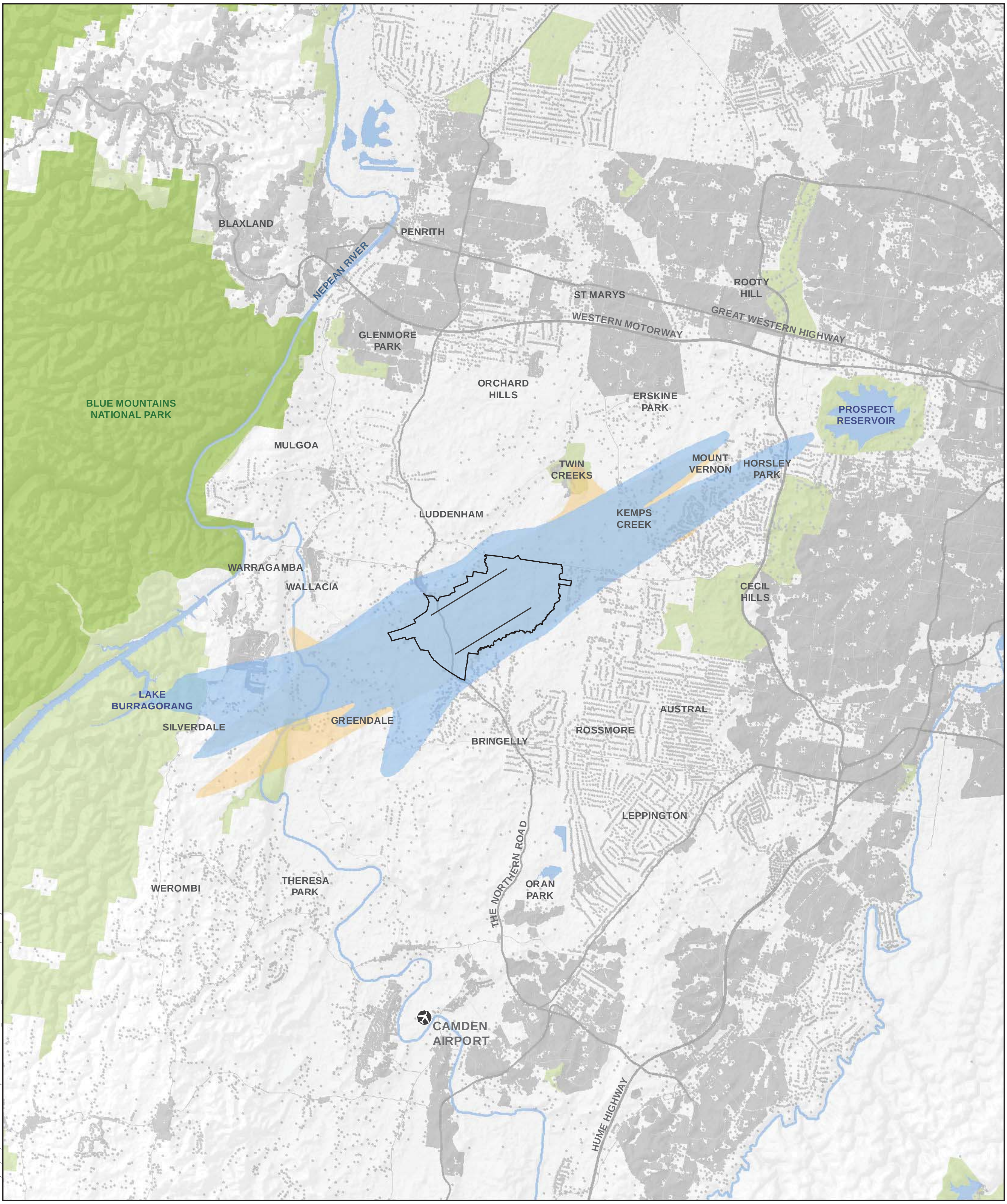
- 20 ANEC

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

0 1.25 2.5 5
Kilometres

N

Figure 31-22 1985 Draft EIS combined ANEC contours compared to 2063 Prefer 05



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LEGEND

- Western Sydney Airport
- Runway
- Airfields
- Buildings
- Greater Blue Mountains World Heritage Area
- Parks and reserves

ANEC Contours 2063 Prefer 23

- 20 ANEC

1985 EIS ANEC Contours

- 20 ANEC

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

Figure 31-23 1985 Draft EIS combined ANEC contours compared to 2063 Prefer 23

0 1.25 2.5 5
Kilometres

N

31.4.2. Maximum noise levels

Single-event noise contours depict the maximum noise levels (L_{Amax}) resulting from a single operation of a specific aircraft type on all applicable arrival or departure flight paths. Figure 31-24 to Figure 31-29 show composite, single event L_{Amax} noise level contours for departures and approaches by Boeing 747 (the loudest noise event predicted to occur at the airport) and Airbus A320 aircraft (a more common aircraft type), based on indicative flight paths for the indicative long term development scenario. These figures show that noise events above 60 dBA would be experienced over a wider area, compared to a single runway, due to the additional flight paths associated with the operation of the second runway.

In particular, a Boeing 747 (or a future type with equivalent noise emission) operating on certain departure paths would result in noise levels exceeding 60 dBA over more areas of the Blue Mountains National Park, and in some areas, the maximum noise level would exceed 70 dBA. As previously noted, the Boeing 747 is being phased out of passenger services and it is unlikely that any operations by this aircraft type would occur at the proposed airport in 2063.

Maximum noise levels from other operations would affect similar numbers of residents to the proposed Stage 1 development, but the pattern of exposure would be extended with additional residential areas newly exposed to noise levels exceeding 60 dBA and some, notably in Silverdale, to noise events over 70 dBA from A320 departures.

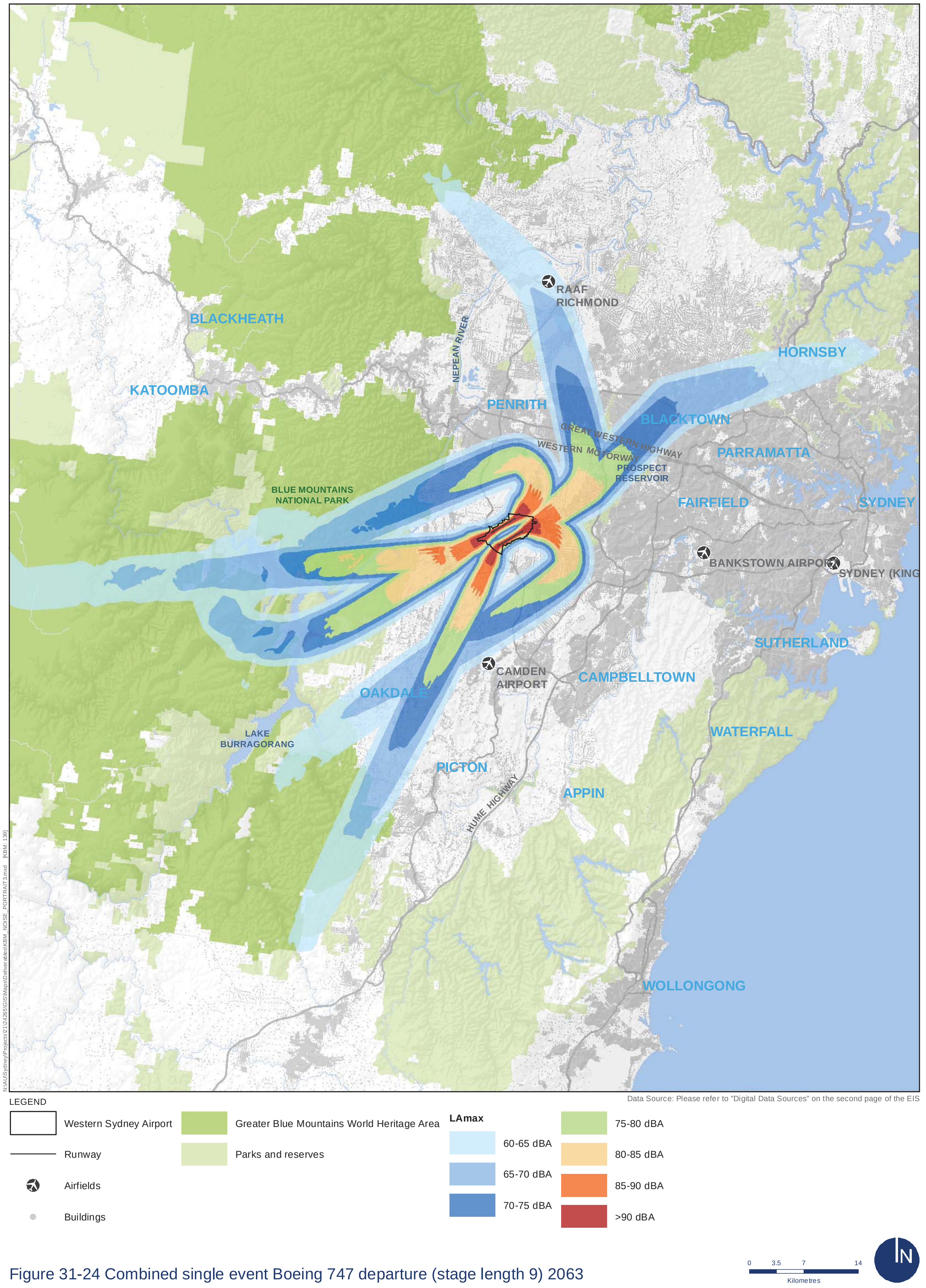
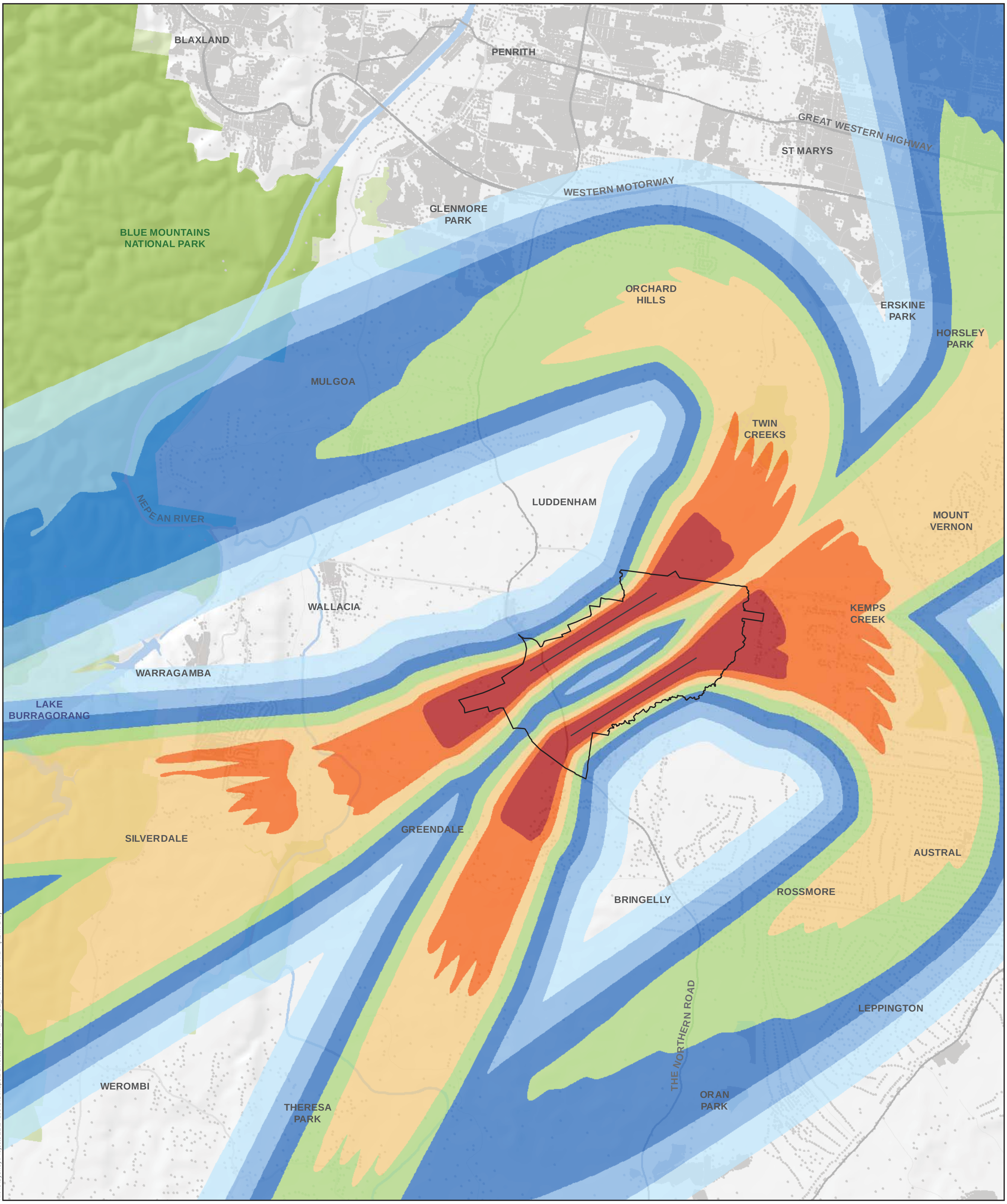


Figure 31-24 Combined single event Boeing 747 departure (stage length 9) 2063



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LEGEND

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

- Western Sydney Airport
- Runway
- Buildings
- Greater Blue Mountains World Heritage Area
- Parks and reserves

LAmax

- 60-65 dBA
- 65-70 dBA
- 70-75 dBA
- 75-80 dBA
- 80-85 dBA
- 85-90 dBA
- >90 dBA

Figure 31-25 Combined single event Boeing 747 departure (stage length 9) 2063 (meso scale)

0 0.75 1.5 3
Kilometres

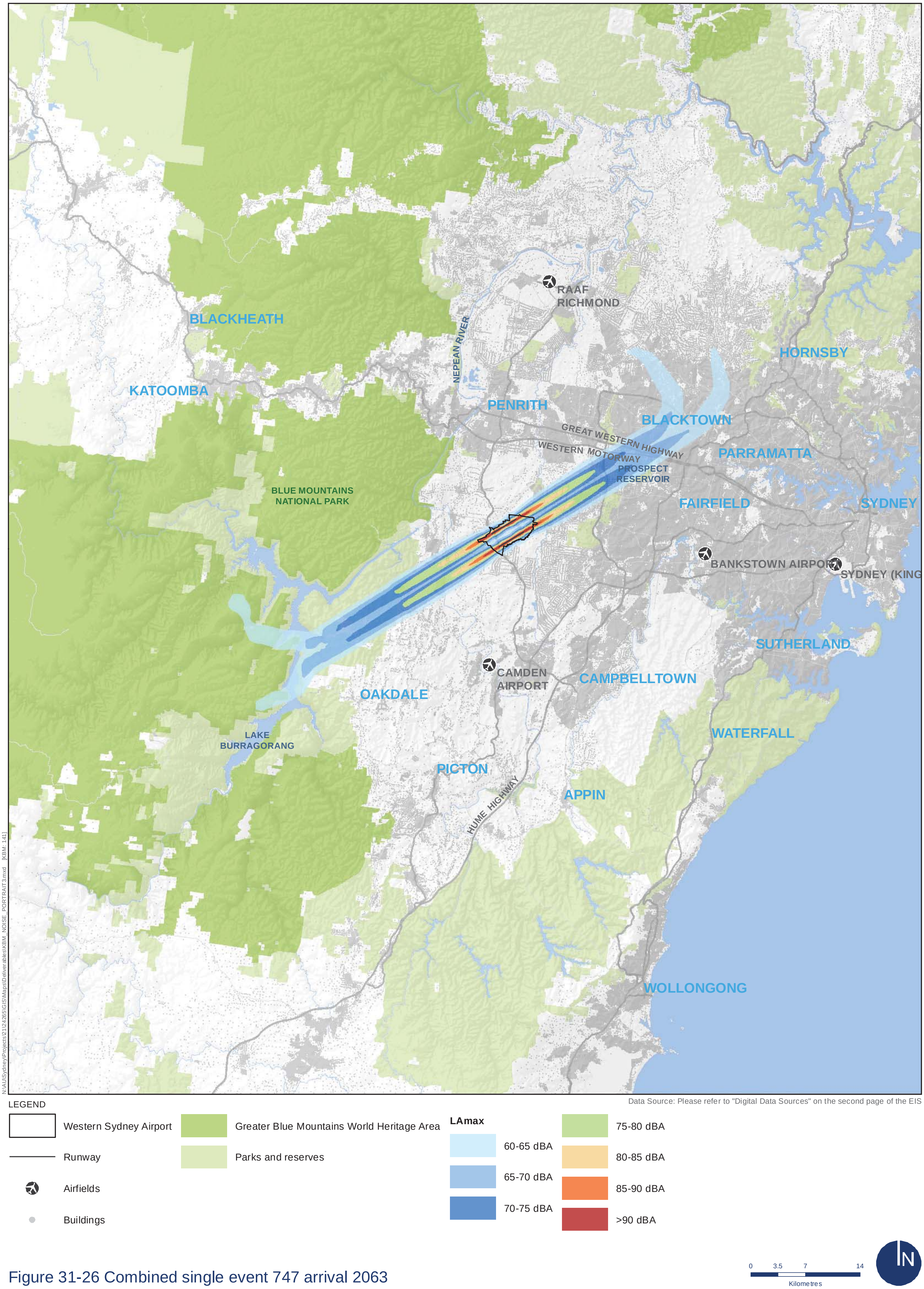
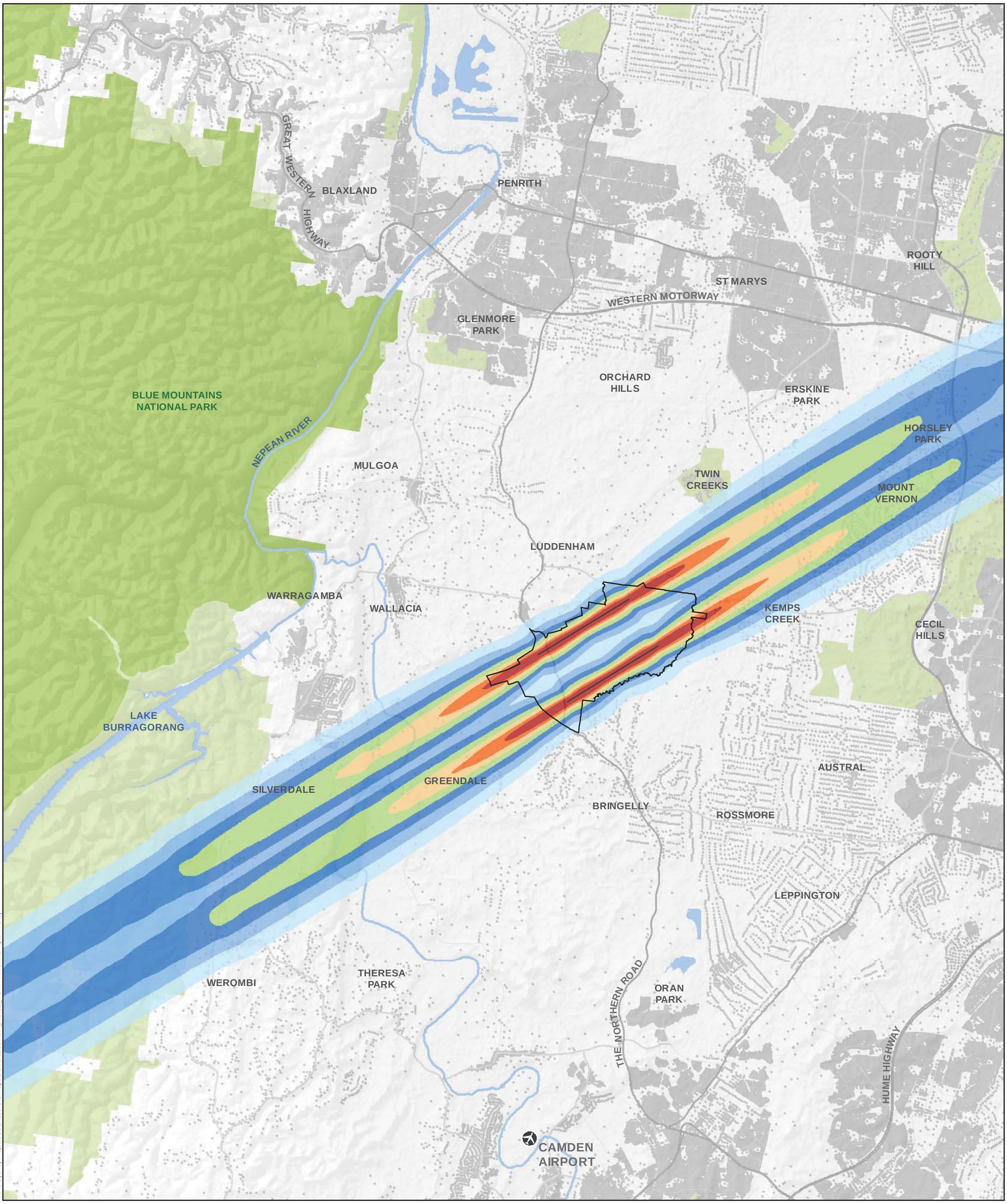


Figure 31-26 Combined single event 747 arrival 2063



LEGEND

Western Sydney Airport
Runway
Airfields
Buildings
Greater Blue Mountains World Heritage Area
Parks and reserves

LAmax

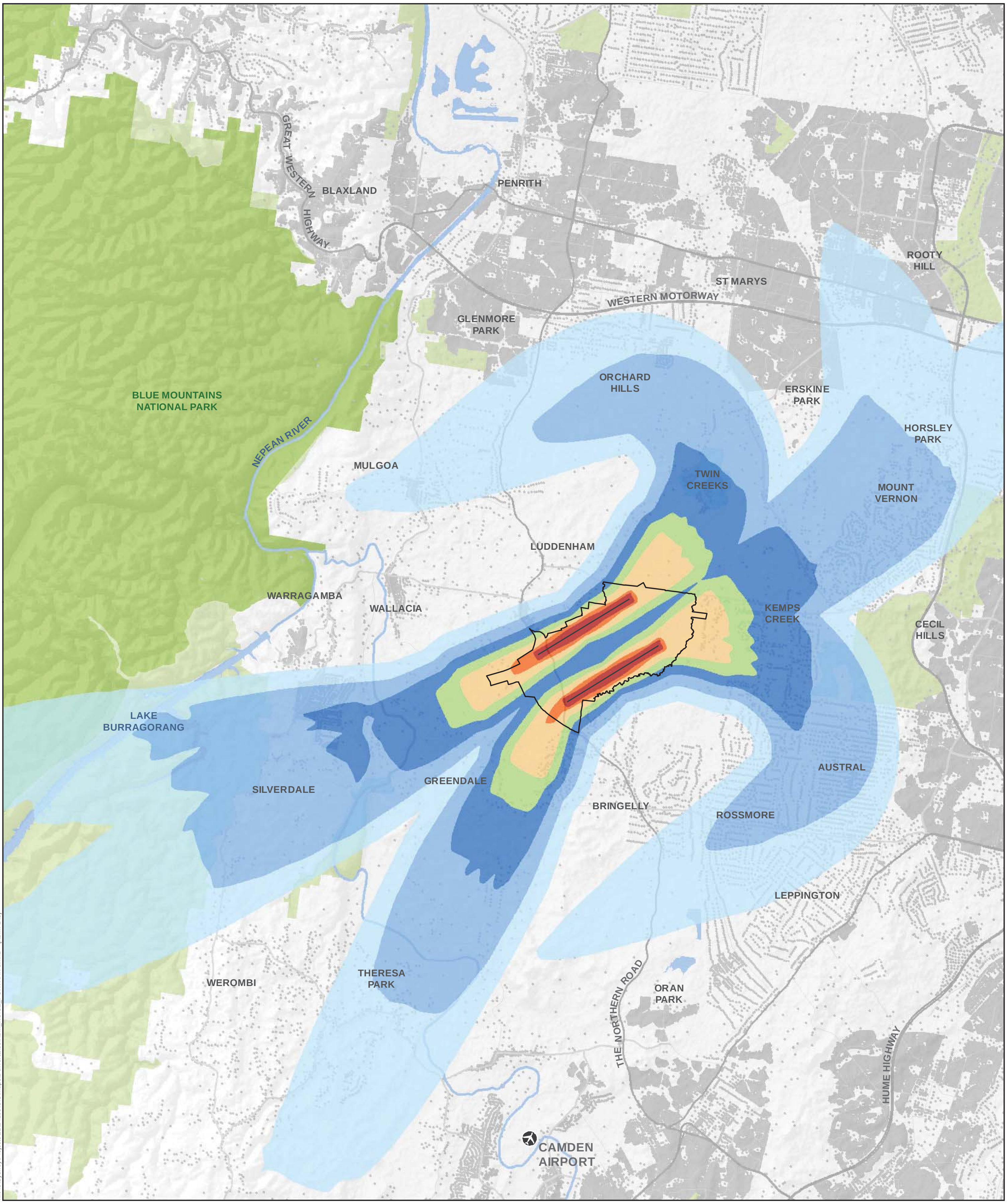
60-65 dBA
65-70 dBA
70-75 dBA
75-80 dBA
80-85 dBA
85-90 dBA
>90 dBA

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

0 1 2 4
Kilometres

N

Figure 31-27 Combined single event 747 arrival 2063 (meso scale)



LEGEND

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

Western Sydney Airport	Greater Blue Mountains World Heritage Area	LAmax
Runway	Parks and reserves	60-65 dBA
Airfields		65-70 dBA
Buildings		70-75 dBA
		75-80 dBA
		80-85 dBA
		85-90 dBA
		>90 dBA

0 1 2 4
Kilometres

N

Figure 31-28 Combined single event Airbus A320 departure (stage length 4) 2063

LEGEND

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

Western Sydney Airport
Runway
Airfields
Buildings

Greater Blue Mountains World Heritage Area
Parks and reserves

LAmax

60-65 dBA
65-70 dBA
70-75 dBA
75-80 dBA
80-85 dBA
85-90 dBA
>90 dBA

0 2.25 4.5 9
Kilometres

Figure 31-29 Combined single event Airbus A320 arrival 2063

31.4.3. Noise over 24 hours

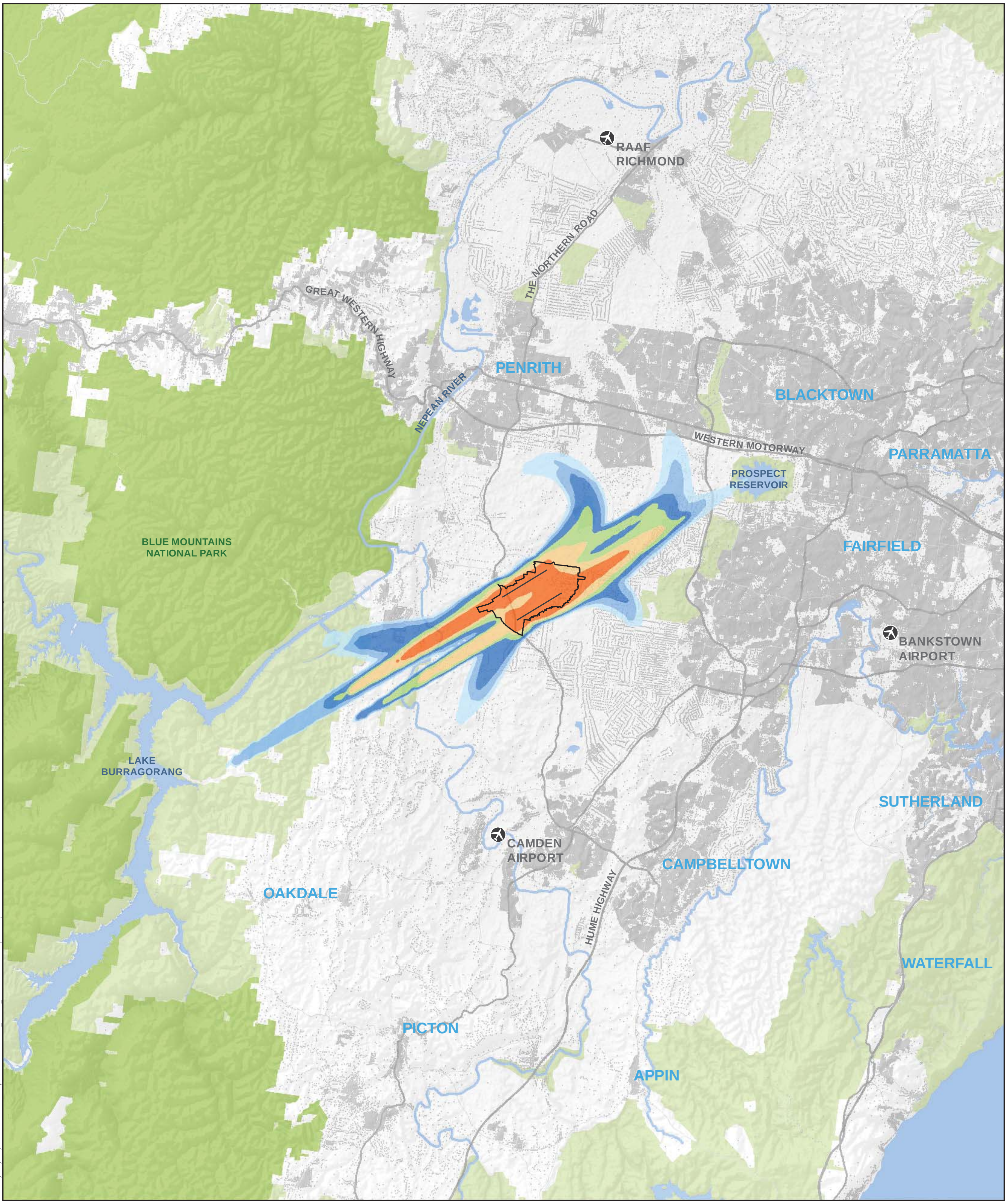
31.4.3.1. N70 results – 2063 scenario

N70 contours for the Prefer 05 and Prefer 23 strategies in 2063 are shown in Figure 31-30 and Figure 31-31. Compared with the results for 2050, there are fewer densely-populated areas within the N70 = 5 – 10 contour, despite a predicted doubling in the number of aircraft movements at the proposed airport between 2050 and 2063. This is particularly true for the Prefer 05 operating strategy, where movements can be spread across two runways and the locations of flight paths are less constrained. However, additional residential areas including Horsley Park would be impacted by infrequent noise events and Kemps Creek and Mount Vernon would be subject to an increased frequency of noise events.

For the 2063 scenario with two runways operating, there would be little expected difference in the number of residents experiencing various numbers of noise events between the Prefer 05 and Prefer 23 strategies. Table 31–8 shows the estimated population within N70 contours for the Prefer 05 and Prefer 23 strategies.

Table 31–8 – Estimated population within N70 contours (2063)

N70	Operating strategy	
	Prefer 05	Prefer 23
5–10	3,493	3,738
10–20	3,926	2,988
20–50	4,454	3,807
50–100	2,542	3,106
100–200	1,920	2,511
>200	1,083	1,321
Total	**17,417**	**17,472**



LEGEND

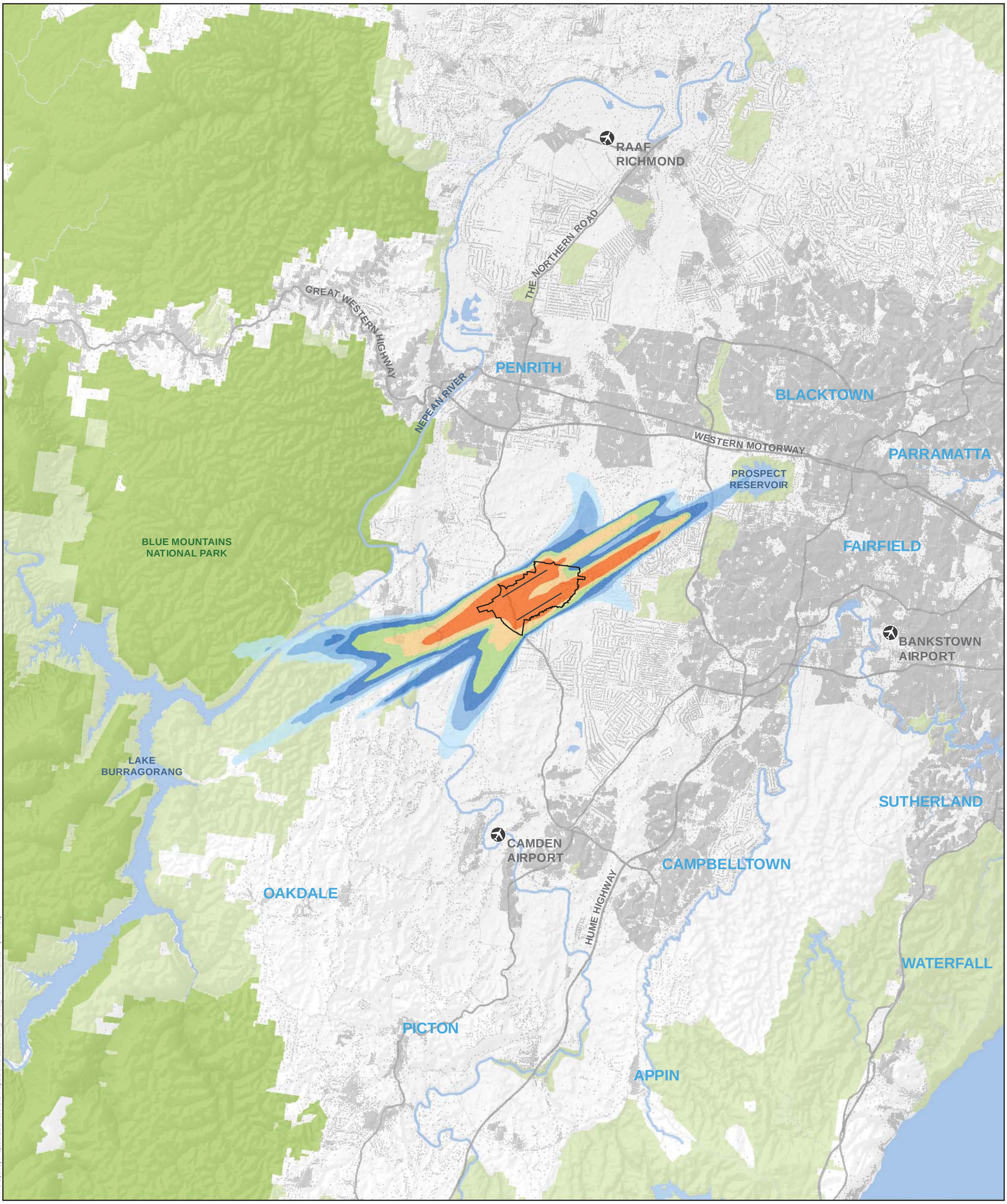
Data Source: Please refer to "Digital Data Sources" on the second page of the EIS

Western Sydney Airport	Greater Blue Mountains World Heritage Area	N70 = 5-10	N70 = 50-100
Runway	Parks and reserves	N70 = 10-20	N70 = 100-200
Airfields		N70 = 20-50	N70 = 200+
Buildings			

0 2.25 4.5 9
Kilometres

N

Figure 31-30 - N70 contours for Prefer 05 operating strategy (2063)



LEGEND

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

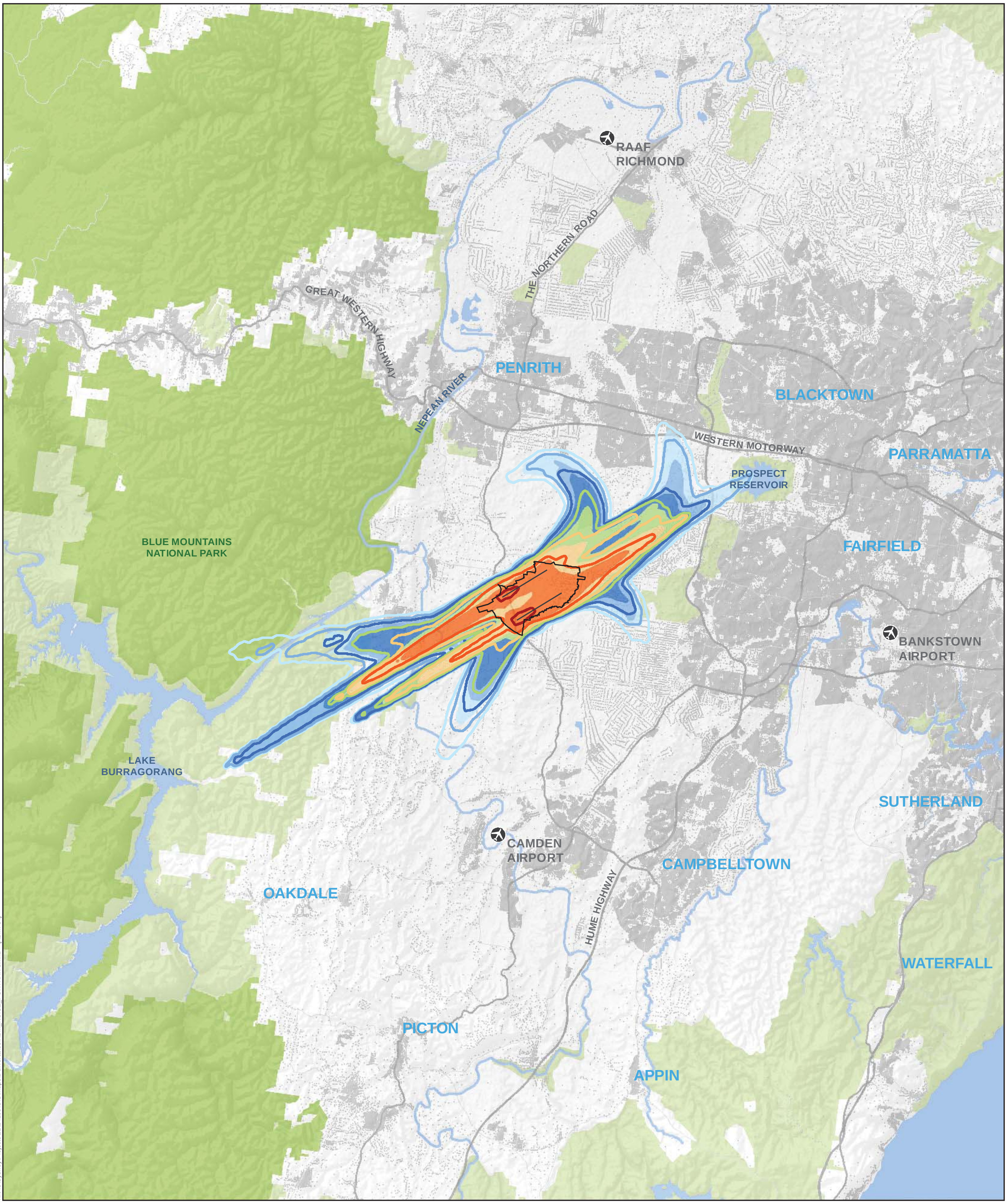
- Western Sydney Airport
- Runway
- Airfields
- Buildings
- Greater Blue Mountains World Heritage Area
- Parks and reserves
- N70 = 5-10
- N70 = 10-20
- N70 = 20-50
- N70 = 50-100
- N70 = 100-200
- N70 = 200+

0 2.25 4.5 9
Kilometres

Figure 31-31 - N70 contours for Prefer 23 operating strategy (2063)

31.4.3.2. 90th percentile N70 results – 2063 scenario

Figure 31-32 and Figure 31-33 show calculated 90th percentile N70 contours for the Prefer 05 and Prefer 23 operating strategies in 2063. The difference between the two modes is much less significant than when comparing average days, and also less significant when compared to the results for the 2050 scenario.



LEGEND

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

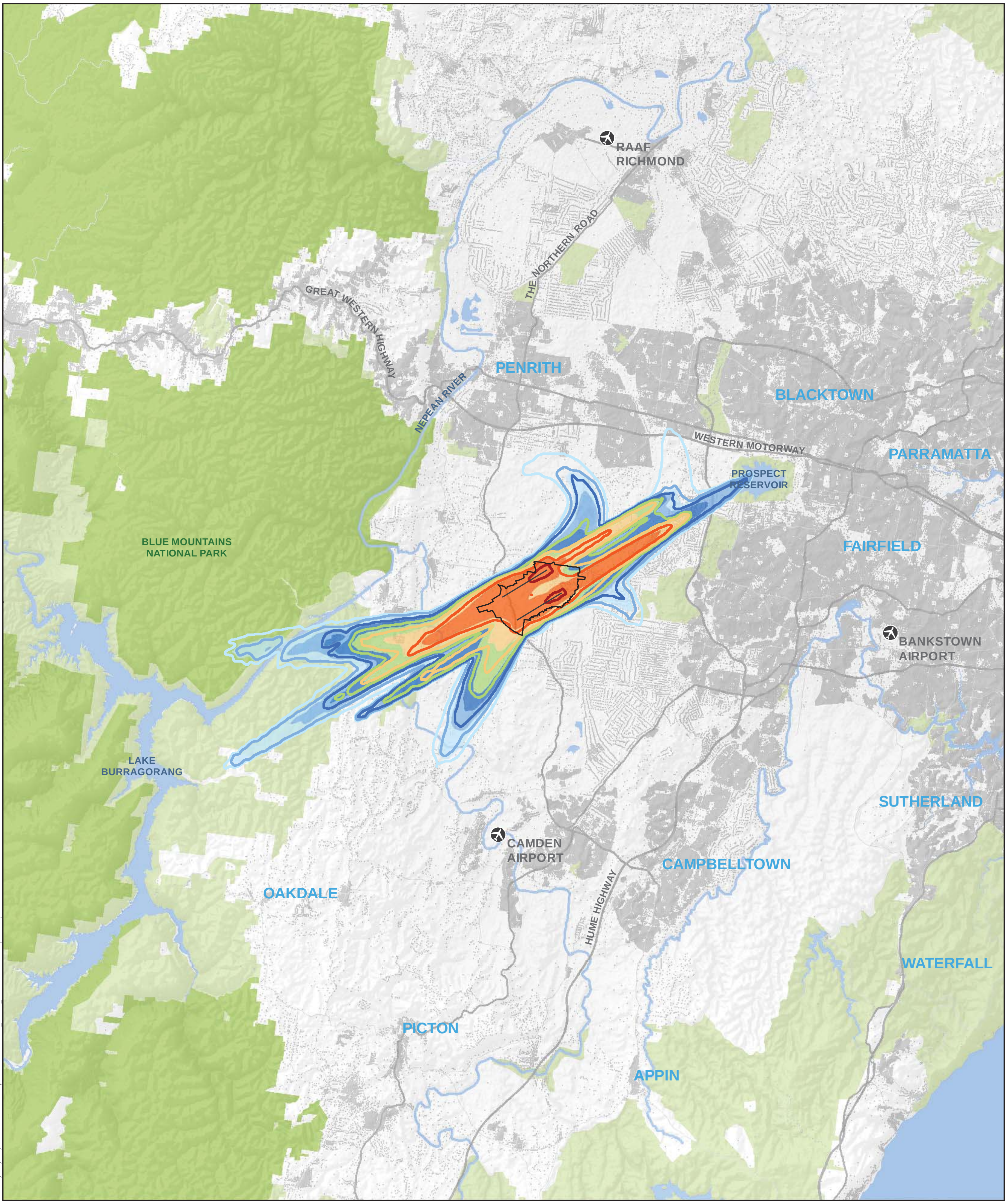
Western Sydney Airport	Greater Blue Mountains World Heritage Area	N70 = 5-10
Runway	Parks and reserves	N70 = 10-20
Airfields		N70 = 20-50
Buildings		N70 = 50-100
		N70 = 100-200
		N70 = 200+

N70 90th Percentile

- N70 = 5
- N70 = 10
- N70 = 20
- N70 = 50
- N70 = 100
- N70 = 200
- N70 = 500

0 2.25 4.5 9
Kilometres

Figure 31-32 - 90th percentile N70 contours for Prefer 05 operating strategy (2063)



LEGEND

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

- Western Sydney Airport
- Runway
- Airfields
- Buildings
- Greater Blue Mountains World Heritage Area
- Parks and reserves
- N70 = 5-10
- N70 = 10-20
- N70 = 20-50
- N70 = 50-100
- N70 = 100-200
- N70 = 200+

N70 90th Percentile

- N70 = 5
- N70 = 10
- N70 = 20
- N70 = 50
- N70 = 100
- N70 = 200
- N70 = 500

0 2.25 4.5 9
Kilometres

Figure 31-33 - 90th percentile N70 contours for Prefer 23 operating strategy (2063)

31.4.4. Night-time noise

31.4.4.1. N60 results – 2063

The average 2063 night-time N60 contours for operating strategies Prefer 05 and Prefer 23 respectively are shown on Figure 31-34 and Figure 31-35. In either operating strategy, built-up residential areas would be affected by more than 10 events per night exceeding 60 dBA, but the extent of impact is greater in the Prefer 05 case. Additional areas to the north of the airport site including Mount Vernon and Kemps Creek are included within the N60 = 50 – 100 contour under the Prefer 05 operating strategy. Conversely, rural residential areas to the south and west of the airport such as Silverdale would be more affected under the Prefer 23 strategy. Areas in close proximity to the airport site including Luddenham and Greendale remain affected largely in accordance with the 2050 scenario.

Table 31–9 shows the number of people estimated to be affected by night time noise above 60 dBA in 2063. More residents are predicted to be affected by noise events above 60 dBA under the Prefer 05 operating strategy. However, it should be noted that analysis for 2063 does not consider the use of alternative night time operating modes for noise mitigation purposes. As noted at Section 1.2, the use of alternative operating modes, such as a “Head to Head”, may result in a lower number of residents exposed to noise levels above 60 dBA.

Table 31–9 – Estimated population within N60 contours – 2063

N60	Operating strategy	
	Prefer 05	Prefer 23
5–10	81,333	10,509
10–20	45,372	43,963
20–50	68,963	42,097
50–100	5,313	8,236
>100	0	0
Total	**200,981**	**104,805**

The 90th percentile night-time N60 values for 2063 are presented in Appendix E1 of Volume 4 and show the number of events per night exceeding 60 dBA on a worst case night. For the Prefer 05 operating strategy, the worst case contours cover substantially more area than the average contours, while in the Prefer 23 strategy, the impacted areas are almost the same.

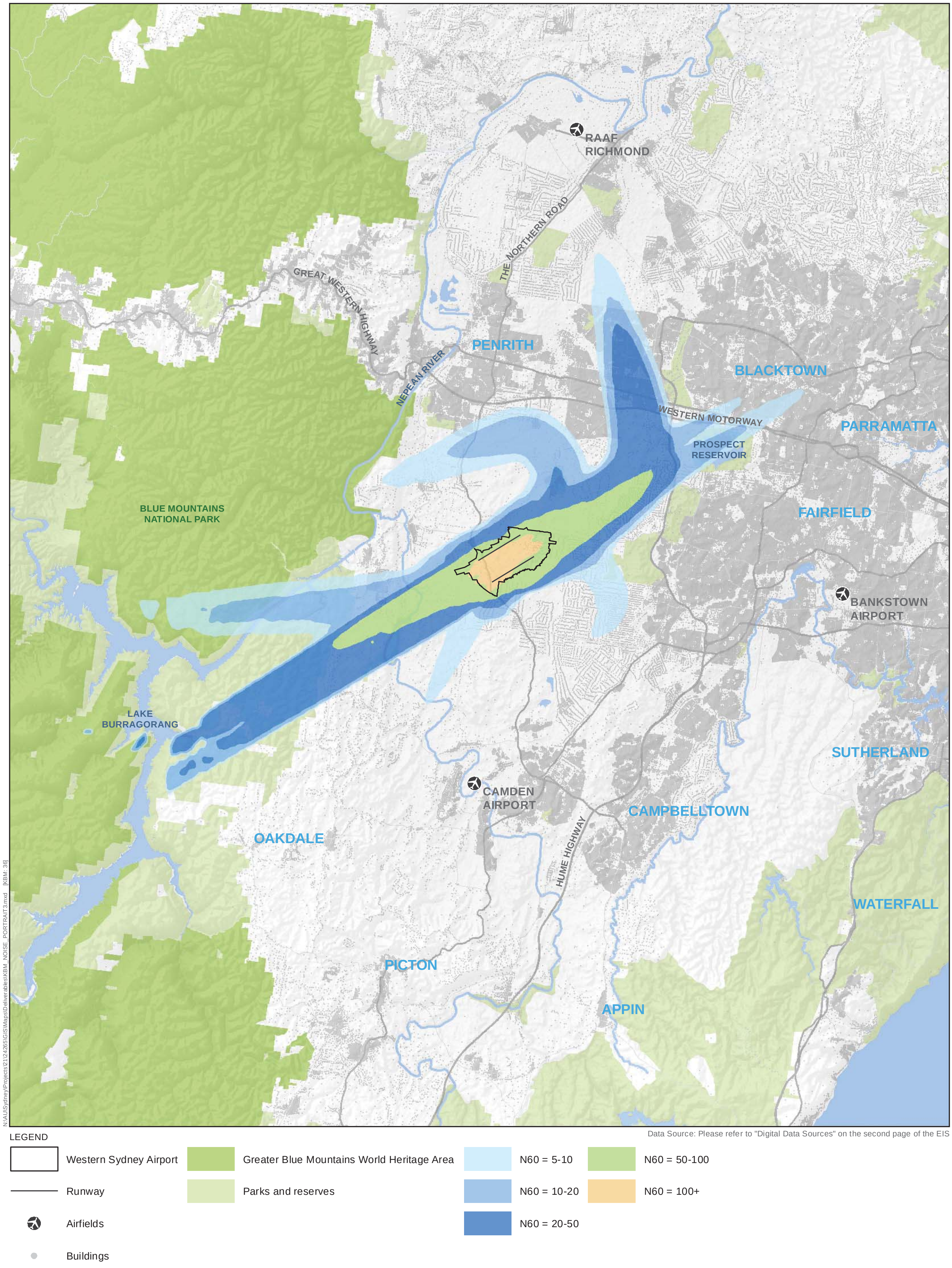


Figure 31-34 - N60 contours for Prefer 05 operating strategy (2063)

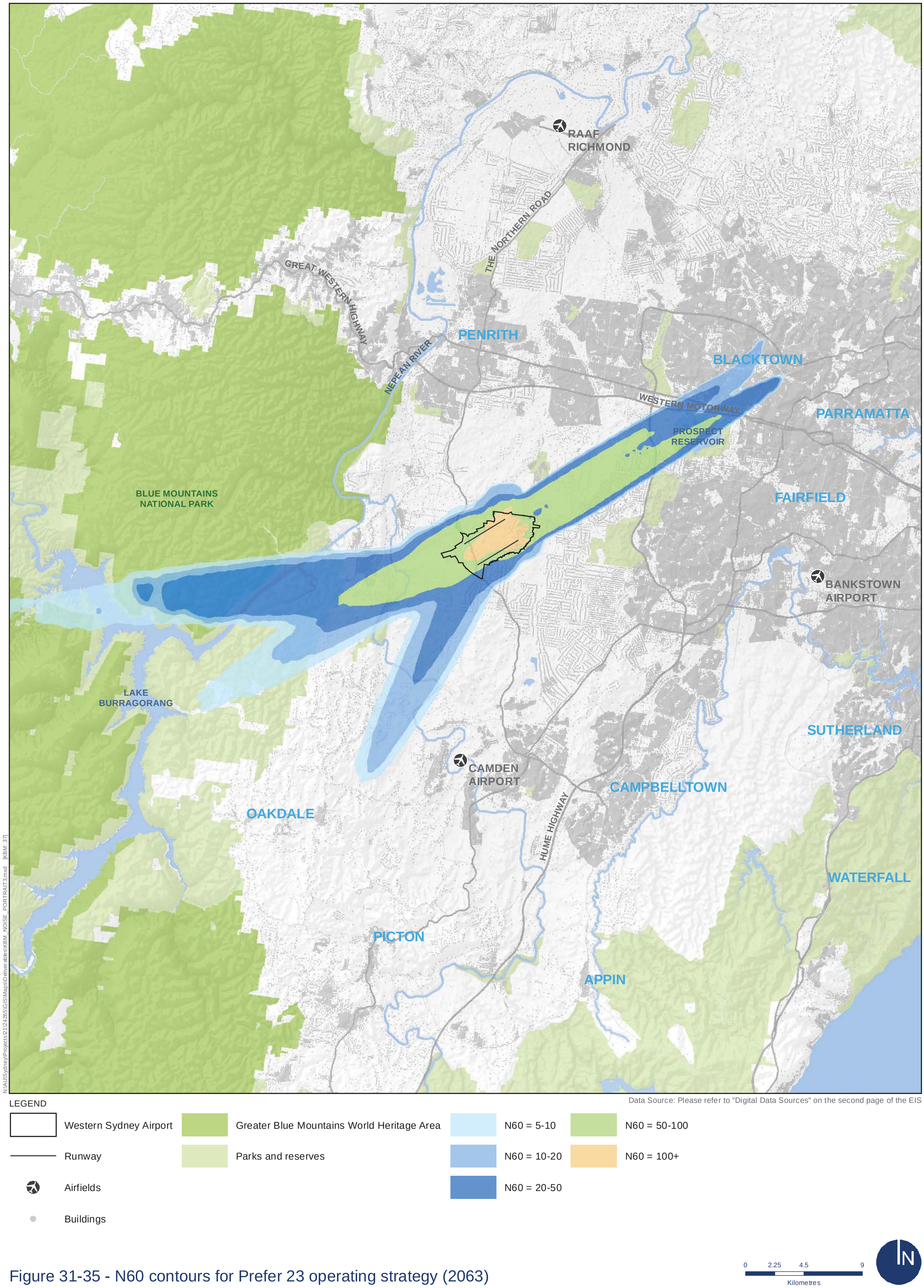


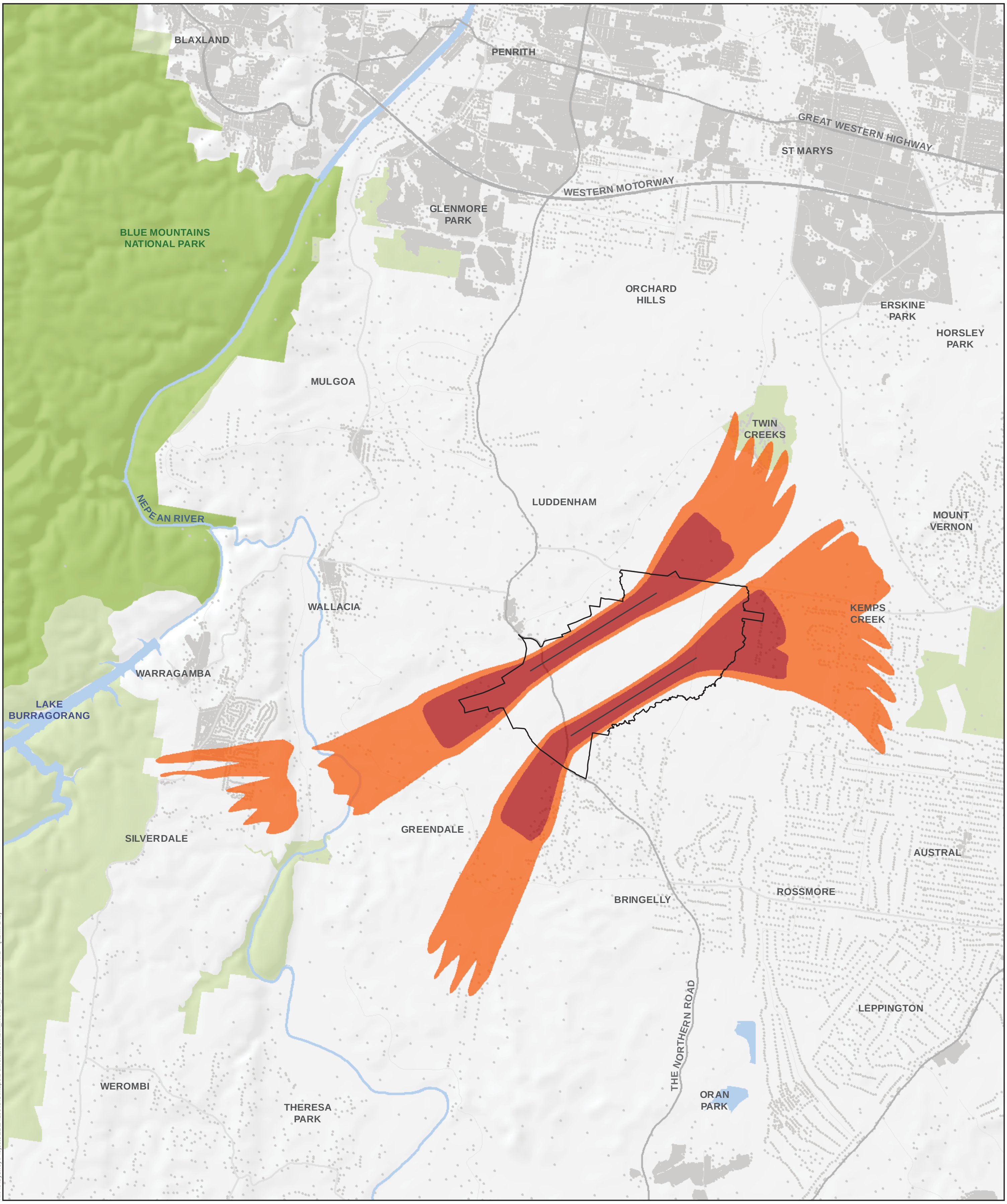
Figure 31-35 - N60 contours for Prefer 23 operating strategy (2063)

31.4.5. Noise induced vibration

At high noise levels, the low frequency components of aircraft noise can cause vibration in loosely fixed building elements, such as windows.

Even at the highest expected noise levels the levels of vibration due to low frequency noise would be well below those which may cause structural damage to buildings. With typical light building structures, noise induced vibration may begin to occur where the maximum external noise level reaches approximately 90 dBA. The effect is more common on take-offs than for landings because the noise spectrum for a take-off near the airport has stronger low frequency components.

Figure 31-36 shows 85 dBA and 90 dBA noise level contours for a Boeing 747 aircraft departure (maximum stage length). Only areas within the 90 dBA contour could expect to experience any noise-induced vibration of building structures, and even then only during the departure of a Boeing 747 aircraft with maximum stage length. Although modelled for assessment purposes, this aircraft type is not expected to be operating at a Western Sydney Airport in 2063.



LEGEND

Western Sydney Airport

Runway

Buildings

Greater Blue Mountains World Heritage Area

Parks and reserves

LAmax

85-90 dBA

>0 dBA

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

0 0.75 1.5 3 Kilometres

N

Figure 31-36 85 dBA and 90 dBA LAmax contours B747 Departure 2063 long term development

31.5. Ground-based noise

31.5.1. Approach

Ground based operational noise is primarily associated with aircraft engine ground running which is required infrequently for maintenance purposes and aircraft taxiing between the terminal building and the departure or arrival runway. Other sources of noise from within the airport are not considered to significantly contribute to potential noise impacts at nearby receivers.

Ground-based noise levels are not expected to change significantly between the proposed Stage 1 development and the maximum single runway scenario in 2050. It is not anticipated that taxiing and engine run-up noise levels would increase, but these types of noise may become more frequent in the 2050 scenario. The assessment for the proposed Stage 1 development discussed in Chapter 11 of Volume 2 is also considered generally appropriate for the 2050 scenario.

The long term development anticipates the commissioning of a second runway some time before 2063. A second runway would be accompanied by increased aircraft activity and additional noise sources in the south-eastern portion of the site as shown in Figure 31-37. The assessment of ground-based noise for a long term development has therefore focused on the 2063 scenario.

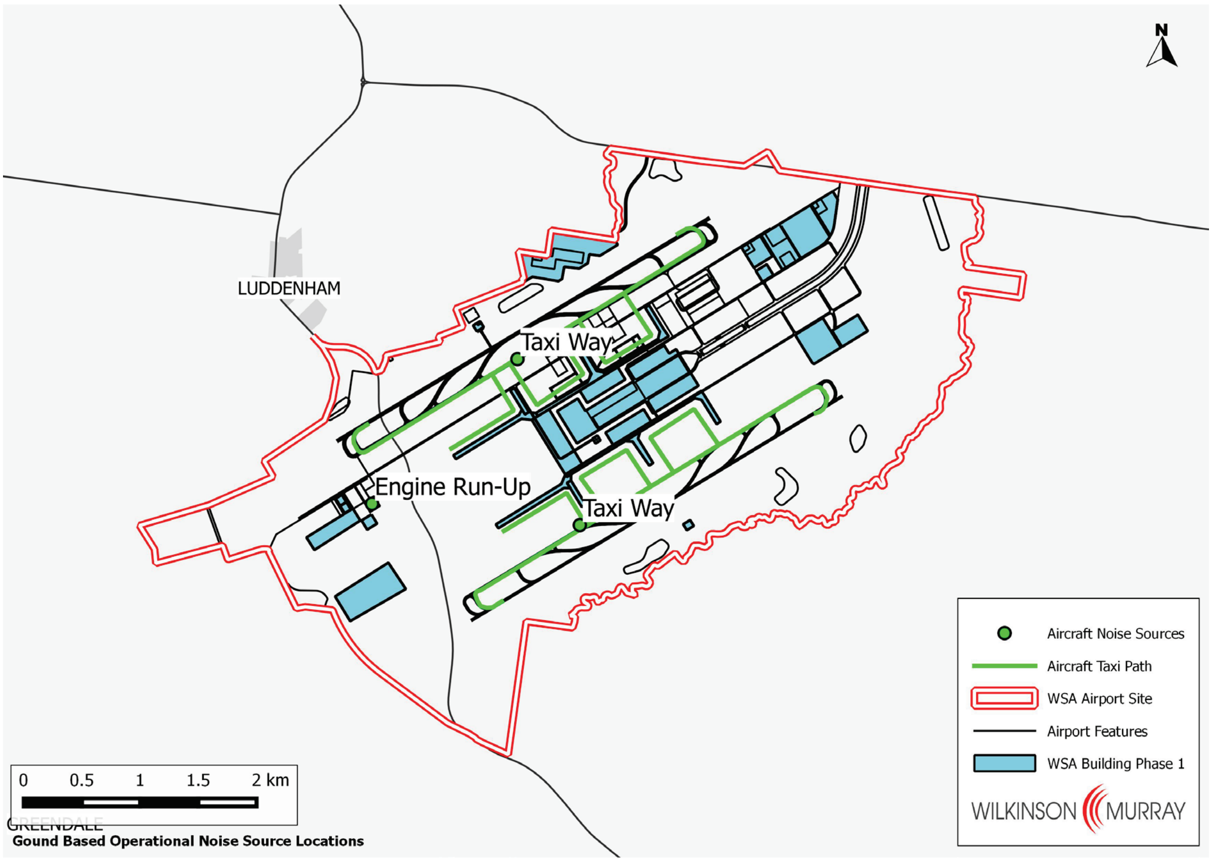


Figure 31-37 – Ground-based noise sources

The approach to the assessment of ground-based noise involves consideration of typical worst case conditions, including a ground-based temperature inversion. It should also be noted that no allowance has been made for any potential reduction in aircraft noise levels over time and the predictions discussed are based on known aircraft noise levels. The methodology for the assessment of airport operational noise presented in Chapter 11 of Volume 2 is applicable to the long term development.

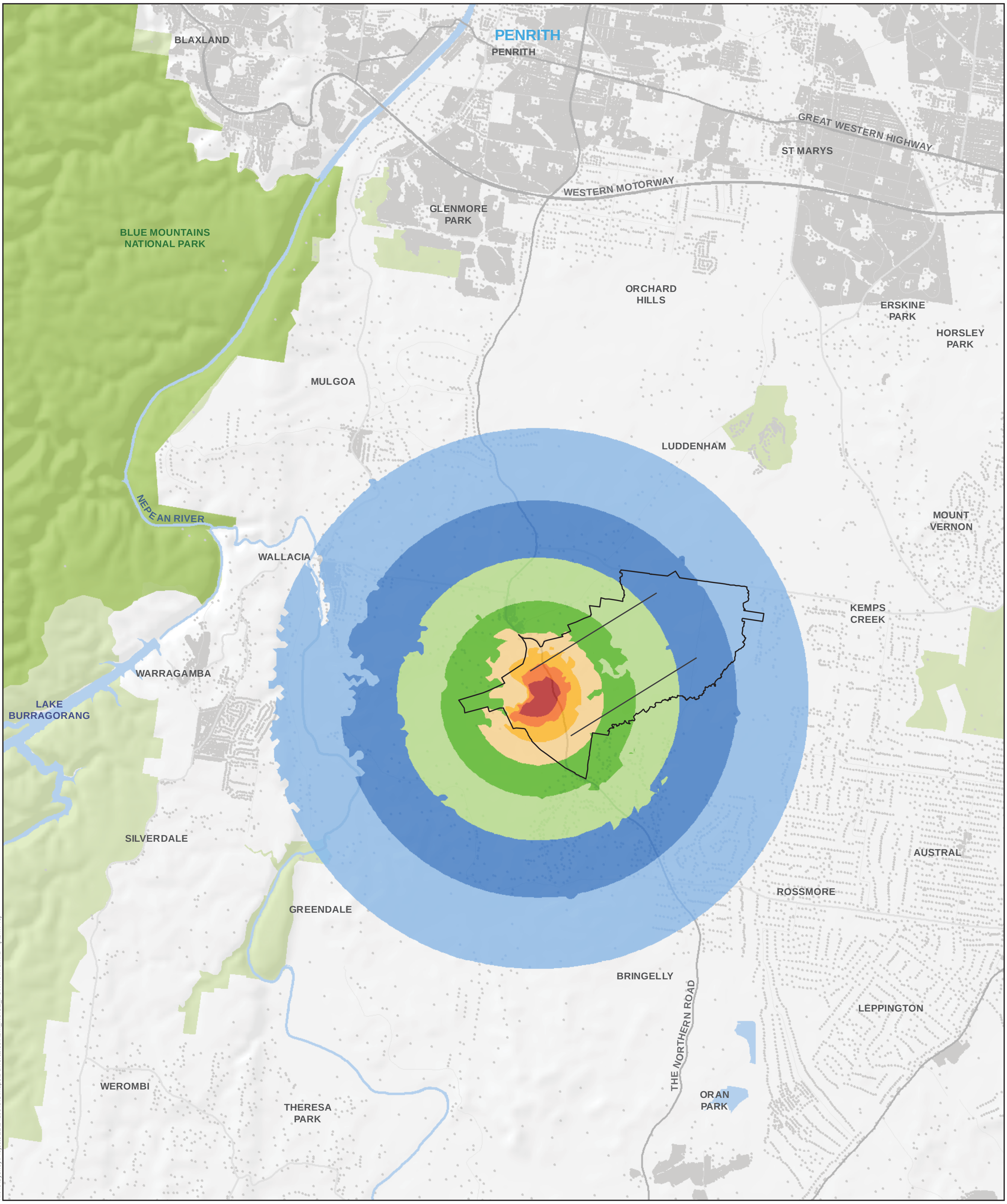
Potential construction noise and vibration impacts associated the expansion of the airport beyond the proposed Stage 1 development have not been assessed. Construction beyond the Stage 1 development would be progressive and noise assessed as part of the approval process for any future major airport development under the Airports Act. It is however noted that construction beyond 2030 would occur in the context of an operating airport and that the background noise environment would be substantially different compared to today.

31.5.2. Assessment

The indicative long term development of the proposed airport would involve the construction of a second parallel runway, most likely around 2050 when annual passenger movements reach approximately 37 million. Availability of a second runway would facilitate the adoption of different airport operating modes as well as a larger number of aircraft movements, resulting in more ground-based activity at the airport. Ground-based noise levels have been predicted and the resulting contours are shown in Figure 31-38 and Figure 31-39.

Engine ground running noise is not predicted to change substantially over time and may be shielded by additional buildings that would be constructed for the long term development. The 2063 aircraft taxiing noise contours reflect the increased number of aircraft movements and would extend further south as a result of the commissioning of the second runway. Ground run-up noise would also likely occur more frequently in the long term, although the noise contours are not predicted to change based on the modelling assumptions adopted for this assessment. For example, the assessment is based on aircraft types that are commonplace today and does not account for new generation quieter aircraft that would be introduced well before 2063. The assessment can therefore be considered conservative.

Figure 31-38 and Figure 31-39 show that elevated noise levels would be experienced in the immediate vicinity of the proposed airport, particularly around Luddenham.



LEGEND

Western Sydney Airport

Runway

Buildings

Greater Blue Mountains World Heritage Area

Parks and reserves

LAeq, 15min

45-50 dBA

50-55 dBA

55-60 dBA

60-65 dBA

65-70 dBA

70-75 dBA

75-80 dBA

>80 dBA

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

0 0.75 1.5 3

Kilometres

N:\AU\Sydney\Projects\21\24265\GIS\Maps\Deliverables\KBM_NOISE_PORTRAIT3.mxd [KBM: 40]

Figure 31-38 - Maximum noise level for engine run up (2063)

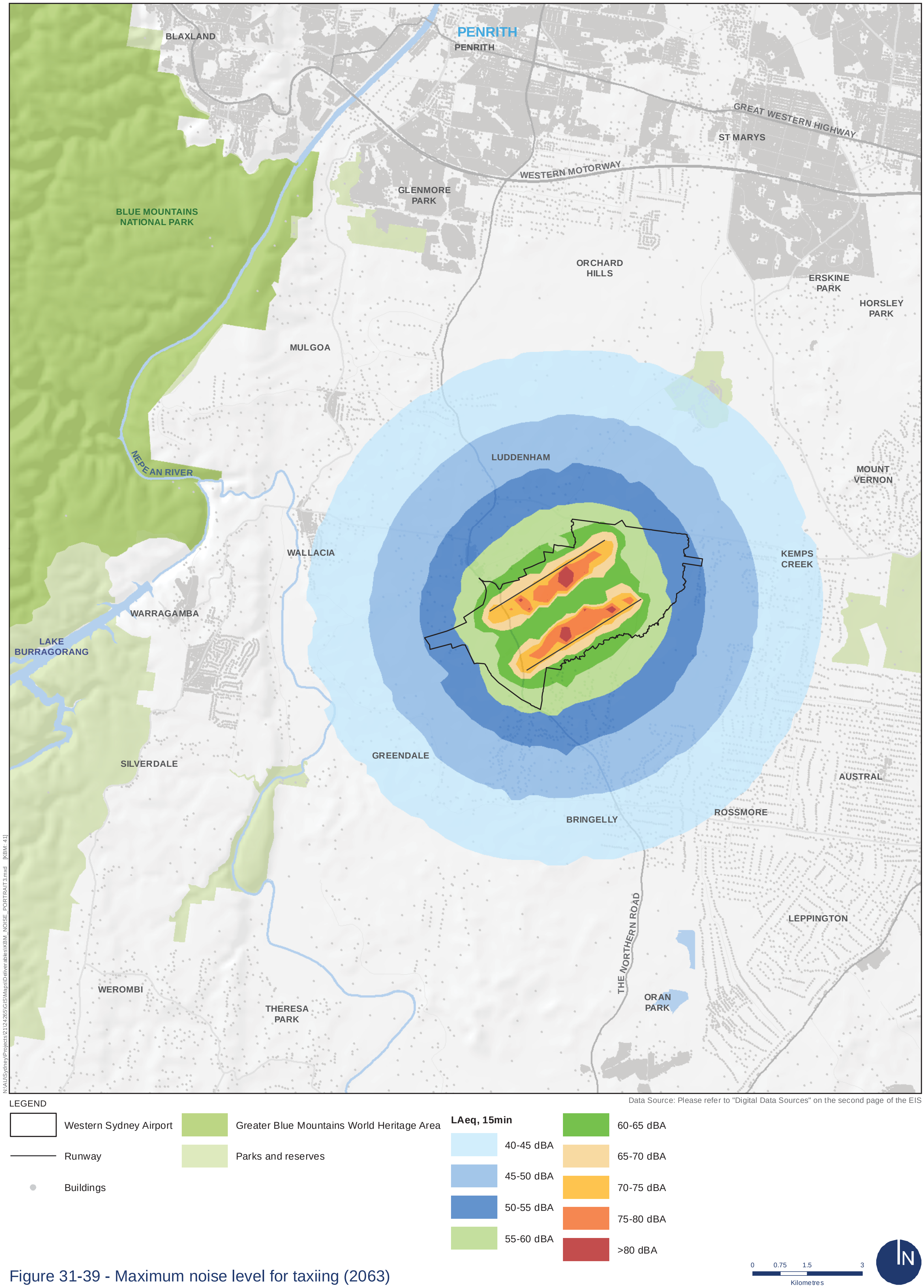


Figure 31-39 - Maximum noise level for taxiing (2063)

31.6. Considerations for future development stages

The identification of potential airport operating modes, including noise abatement opportunities, would be an important consideration in the future formal airspace design process to be undertaken closer to the proposed commencement of operations. Other approaches to mitigating aircraft overflight noise generally focus on reducing noise emissions from the aircraft themselves, planning flight paths in a way that minimises potential noise and environmental impacts and provides respite periods, together with implementing land use controls and other operating practices (e.g. use of continuous descent approaches, restrictions on use of reverse thrust at night, etc.).

It is expected that land use and planning around the proposed airport would be influenced by the development of an official ANEF chart as part of the future airspace design process. It is envisaged that planning controls based on a long term development scenario would be implemented prior to the introduction of dual runway operations in order to promote appropriate development in the vicinity of the proposed airport.

The National Airports Safeguarding Framework (NASF) provides land use planning guidance and principles and guidelines in order to:

- improve community amenity by minimising aircraft noise-sensitive developments near airports including through the use of additional noise metrics and improved noise-disclosure mechanisms; and
- improve safety outcomes by ensuring aviation safety requirements are recognised in land use planning decisions through guidelines being adopted by jurisdictions on various safety-related issues.

31.7. Summary of findings

Assessment of the noise impacts associated with a long term development scenario for the proposed airport has considered both aircraft overflight and ground based noise.

The flight paths and procedures to be used by aircraft using the proposed airport (either the single runway or the long term two-runway configuration) are indicative and would require further detailed consideration before being finalised. Other sources of uncertainty, such as noise emission levels from future aircraft types, and the role and pattern of movements at a dual runway airport, also reduce the certainty in predicting future impacts. The assessment does however broadly indicate the areas that may be impacted by aircraft noise in the long term.

For aircraft overflight noise, the following assessment scenarios were considered:

- 37 million annual passengers – which could be reached in about 2050 when the initial runway would likely be approaching its maximum capacity; and
- 82 million annual passengers – assumed to be reached in 2063, when the airport comprises two operating runways and both runways are operating close to capacity.

For the loudest aircraft operations (long-range departures by a Boeing 747 aircraft or equivalent), maximum noise levels over 85 dBA would be experienced at residential locations near the airport site. Maximum noise levels of 75–80 dBA are predicted within built-up areas in St Marys and Erskine Park. Maximum noise levels from more common aircraft types such as Airbus A320 or equivalent are predicted to be 60–70 dBA in built-up areas around St Marys and Erskine Park, and over 70 dBA in some areas to the south-west of the airport such as around Greendale.

The extent to which particular areas would be potentially exposed to aircraft noise would be strongly influenced by the airport operating strategies adopted, especially when operating a single runway at maximum capacity. In terms of total population, the ‘Prefer 05’ operating strategy (which gives preference to approaches and departures in a south-west to north-east direction) is predicted to have substantially more impact on existing residential areas than the ‘Prefer 23’ operating strategy, in which the opposite direction is preferred. Most residents that would be affected under the ‘Prefer 05’ strategy are in suburbs to the north of the airport site, including St Marys and Erskine Park. Predominantly rural-residential areas to the south-west, including Greendale and parts of Silverdale would be affected under the ‘Prefer 23’ strategy. Adoption of ‘Head to Head’ operations would also slightly reduce the number of residents affected.

For night-time operations in 2050, the operating strategy with least impact is ‘Prefer 23 with Head-to-Head’. Other operating strategies are predicted to result in substantially greater numbers of residents being affected by night-time noise, and in particular, a ‘Prefer 05’ strategy would result in large parts of St Marys experiencing more than 20 aircraft noise events per night above 60 dBA.

The operating strategies would have less influence following the implementation of operations on the second runway. Despite the forecast number of movements at the airport approximately doubling between 2050 and 2063, there are fewer densely populated areas currently located within the noise affected areas for the 2063 scenario, particularly for the Prefer 05 operating strategy. The reason is that movements can be spread between two runways and the locations of flight paths are less constrained in the two runway scenario. The total number of residents affected may increase in the future as a result of population growth and ongoing housing development over the next 50 years. The continuation of existing planning controls will limit the potential for new residential development to be impacted by a progressive increase in usage of the airport.

Australian Noise Exposure Concept (ANEC) contours for the indicative long term development are similar to those for the single runway airport in 2050, although they extend over a somewhat larger area to the south as a result of operation of the second runway. For the 2063 scenario, the 20 ANEC contour does not enclose any existing built-up residential areas, such as townships of Warragamba and Silverdale.

The identification of potential noise abatement operating strategies would be an important consideration in the future formal airspace design process to be undertaken closer to the proposed commencement of operations. Within five years of an airport lease being granted, the ALC will be required to submit for approval a draft master plan including a ANEF and an environment strategy to manage noise emissions from the operation of the proposed airport. The masterplan is required to be updated on a five yearly basis and will involve ongoing consideration of strategies to manage noise emissions from the site.

Other approaches to mitigating aircraft overflight noise generally focus on reducing noise emissions from the aircraft themselves, planning flight paths in a way that minimises potential noise and environmental impacts and provides respite periods, together with implementing land use planning controls and other relevant operating practices.

Noise impacts associated with aircraft operations at the proposed airport would likely be monitored using the noise and flight path monitoring system operated by Airservices Australia.

32. Air quality

32.1. Introduction

This chapter considers the potential local and regional air quality impacts and the anticipated greenhouse gas emissions associated with the long term development of the proposed airport. It builds on the consideration of potential air quality impacts associated with the Stage 1 development presented in Chapter 12 of Volume 2 and is based upon technical reports in relation to local air quality and greenhouse gas emissions (included as Appendix F1 in Volume 4) and regional air quality (included as Appendix F2 in Volume 4).

The assessment of the air quality impacts of the Stage 1 development presented in Volume 2 includes a detailed description of the existing environment at the airport site, including a description of existing meteorological conditions and ambient air quality in the vicinity of the site.

For the purpose of the assessment, local air quality was defined as being within a five kilometre radius of the airport site and regional air quality refers to the wider Sydney basin. Regional air quality considers the formation of secondary pollutants (such as ozone (O_3) through photochemical reactions from primary emissions from the proposed airport.

32.2. Methodology

The air quality and greenhouse gases assessment includes a review of climatic data obtained from the airport site and an analysis of ambient air quality based on data collected from monitoring stations in the vicinity of the airport site. Air quality impacts associated with the operation of the airport were modelled to assess impacts at representative sensitive receivers located in the vicinity of the airport site. Other air quality parameters that were assessed include odour (from aircraft exhaust and the on-site wastewater treatment plant), regional air quality impacts (ozone) and greenhouse gas emissions. For further detail on the methodology, refer to Chapter 12 in Volume 2 and Appendix F in Volume 4.

32.3. Existing environment

Meteorological conditions such as wind speed and direction, temperature and humidity affect the potential dispersion of air emissions. Climatic data recorded at the airport site across the five year period 2010–2014 indicated:

- average wind speed of 2.6 metres per second, with calm conditions (winds less than 0.5 metres per second) about nine per cent of the time;
- wind direction typically from the south-west, followed by the south-south-west and north;
- annual average temperature of 17 degrees Celsius;
- January as the hottest month, averaging 23 degrees Celsius;
- June/July as the coldest months, averaging 11 and 10 degrees, respectively; and
- average annual relative humidity of 73 per cent.

Ambient air quality was measured at Bringelly, in the vicinity of the airport site. Measurements were undertaken for a number of key parameters including nitrogen dioxide, particulate matter and ozone. Air quality data over the 10 year period 2005–14 indicated:

- nitrogen dioxide (and other nitrogen oxides) levels were well below the relevant criteria;
- particulate matter (PM_{10}) occasionally exceeding the relevant criteria, likely to be associated with bushfire and surrounding population centres; and
- ozone exceeding the relevant criteria on multiple occasions.

More information on ambient air quality in the vicinity of the airport site is provided in Chapter 12 of Volume 2.

32.4. Assessment of impacts during operation

This section describes the results of the emission calculations and air dispersion modelling for the long term operation of the airport.

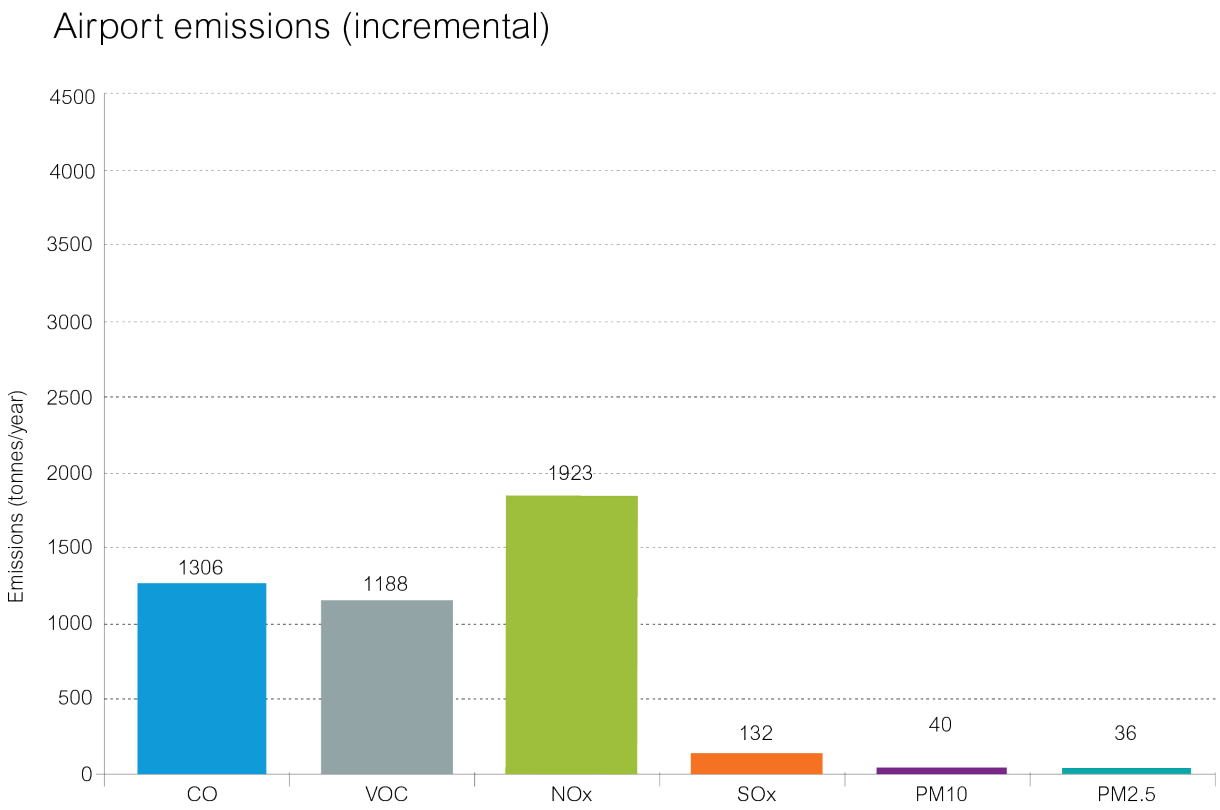
32.4.1. Emissions

The emissions of criteria pollutants (as defined in Chapter 12) from the long term development are presented in Figure 32-1. Incremental emissions comprise emissions from aircraft, auxiliary power units, ground support equipment, parking facilities, terminal traffic, stationary sources and training fires. Cumulative emissions include background pollutant concentrations, modelled emissions from the airport and other projects in addition to vehicular emissions from external roadways in the study area.

The emissions inventory for the long term development in 2063 is presented by source type in Table 32–1. The anticipated percentage contribution of each source category is shown alongside the emission value. Emissions totals have been provided with and without the cumulative contributions from external roadways within the study area.

Review of the incremental emissions (that is, those emissions from within the airport site only) show that aircraft engines would generally be the most significant source of emissions. Aircraft would generate approximately 56 per cent of carbon monoxide emissions and approximately 91 and 88 per cent respectively of nitrogen oxides and sulfur dioxide emissions on the airport site. Auxiliary power units, ground support equipment, parking facilities and terminal traffic would also be significant emissions sources.

Figure 32-2 shows the proposed airport emissions and emissions from traffic on external roads as a percentage of the total modelled emissions within the study area. The cumulative contributions from traffic on the external roadways account for an estimated 82 per cent of PM_{10}, 75 per cent of $PM_{2.5}$, 69 percent of carbon monoxide and 28 per cent of nitrogen oxides emissions. The relative contribution of nitrogen oxides and volatile organic compounds from airport sources increases significantly in comparison to the Stage 1 development and in comparison to the growth in vehicles on the surrounding road network.



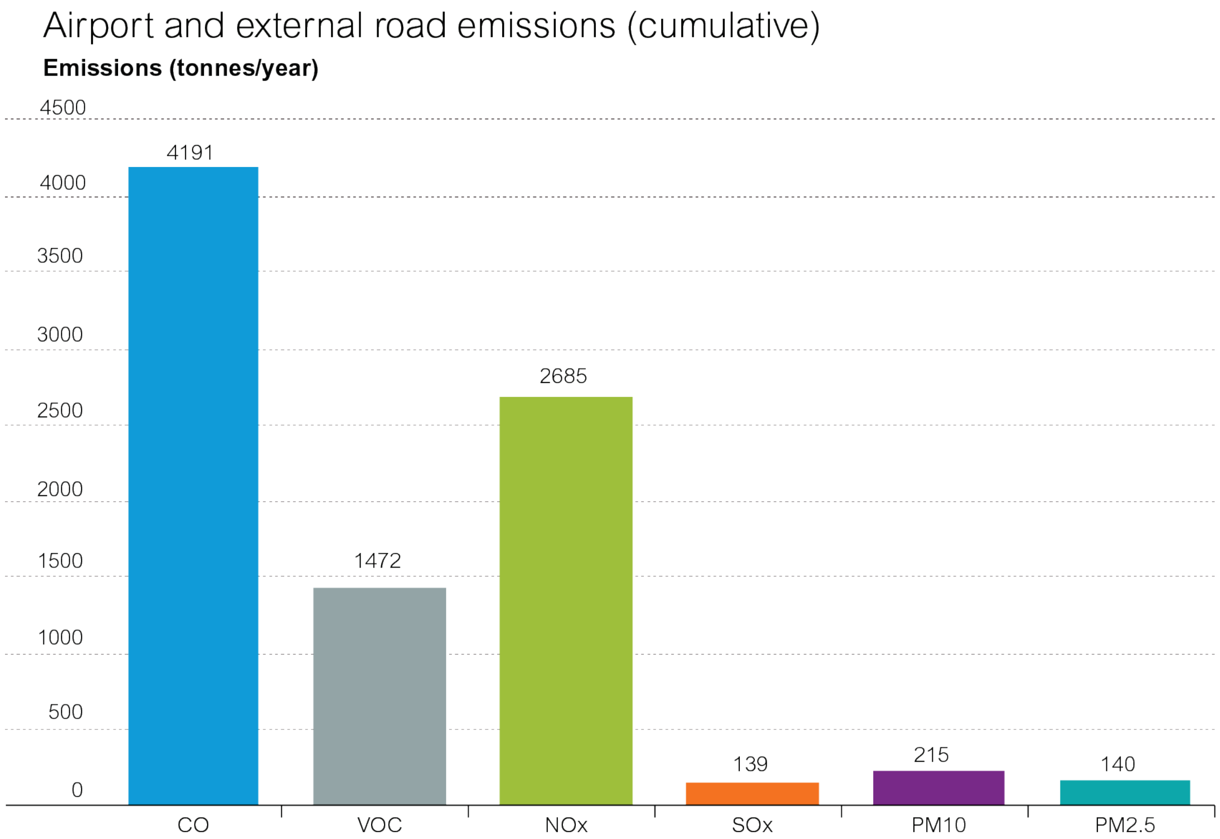
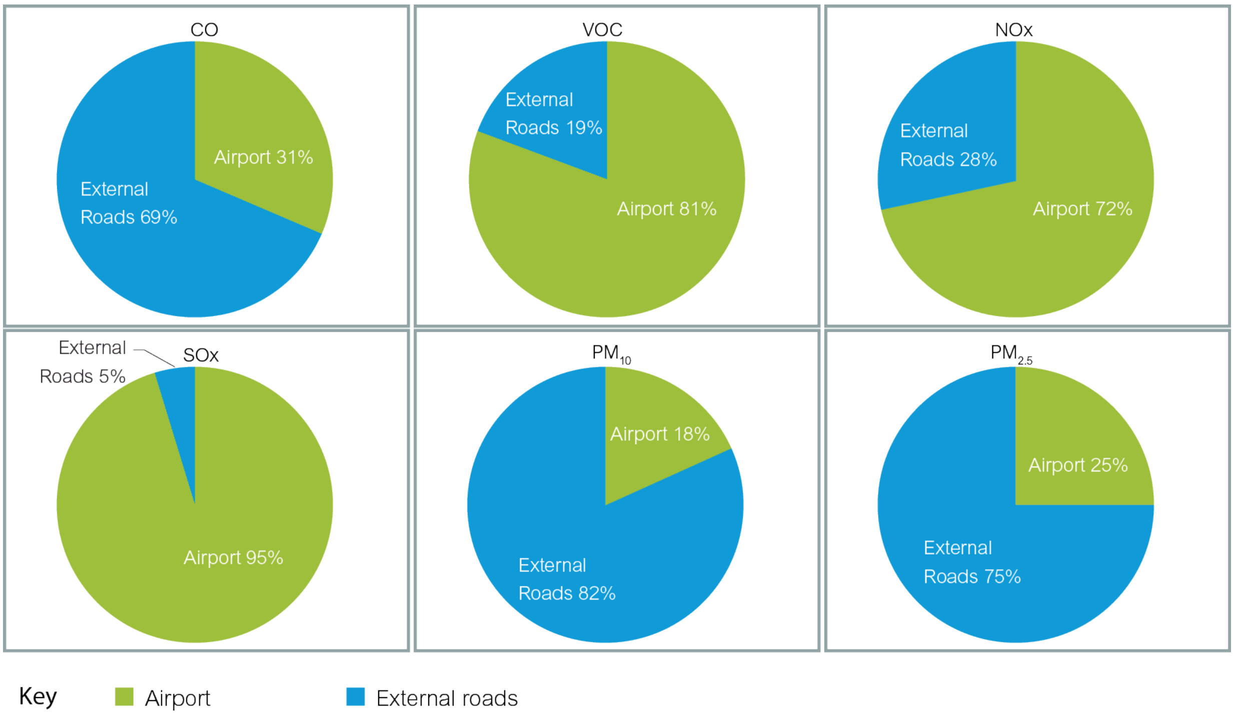


Figure 32-1 – Total estimated emissions for criteria pollutants (long term development)

Table 32–1 – Proposed airport emission inventory for criteria pollutants (long term development)

Category	Emissions (tonnes per year)											
	CO		VOC		NO_x		SO_2		PM_{10}		$PM_{2.5}$	
Aircraft	729	56%	131.9	11%	1,756	91%	116	88%	7.8	20%	7.8	22%
Ground support equipment	159	12%	7.2	1%	15.0	1%	1.7	1%	1.0	3%	1.0	3%
Auxiliary power units	18	1%	1.8	0%	64.4	3%	6.6	5%	3.9	10%	3.9	11%
Parking facilities	127	10%	13.7	1%	5.7	0%	0.1	0%	0.3	1%	0.2	0%
Terminal traffic	182	14%	17.8	2%	38.1	2%	0.3	0%	8.3	21%	4.7	13%
Stationary sources	15.3	1%	507	43%	21.6	1%	6.5	5%	1.6	4%	1.6	4%
Boilers	14.5	1%	1.0	0%	17.8	1%	0.1	0%	1.3	3%	1.3	4%
Engine tests	0.0	0%	1.2	0%	0.0	0%	0.0	0%	0.0	0%	0.0	0%
Fuel tanks	-	-	441	37%	-	-	-	-	-	-	-	-
Generators	0.8	0%	0.2	0%	3.8	0%	0.3	0%	0.3	1%	0.3	1%
Paint and solvent	-	-	63.2	5%	-	-	-	-	-	-	-	-
Training fires	61.1	5%	2.0	0%	0.5	0%	0.1	0%	14.9	38%	14.9	42%
Total incremental (airport only)	**1,306**	**100%**	**1,188**	**100%**	**1,923**	**100%**	**132**	**100%**	**40**	**100%**	**36**	**100%**
External roadways	2885	69%	283	19%	762	28%	6.5	5%	176	82%	105	75%
Airport	1,306	31%	1,188	81%	1,923	72%	132	95%	40	18%	36	25%
Total including external roadways	**3,820**	**100%**	**938**	**100%**	**2,609**	**100%**	**130**	**100%**	**204**	**100%**	**133**	**100%**

Note: CO = Carbon monoxide, VOC = Volatile organic compounds, NO_x = Nitrogen oxides, SO_x = Sulfur oxides, PM_{10} and $PM_{2.5}$ = Particulate matter

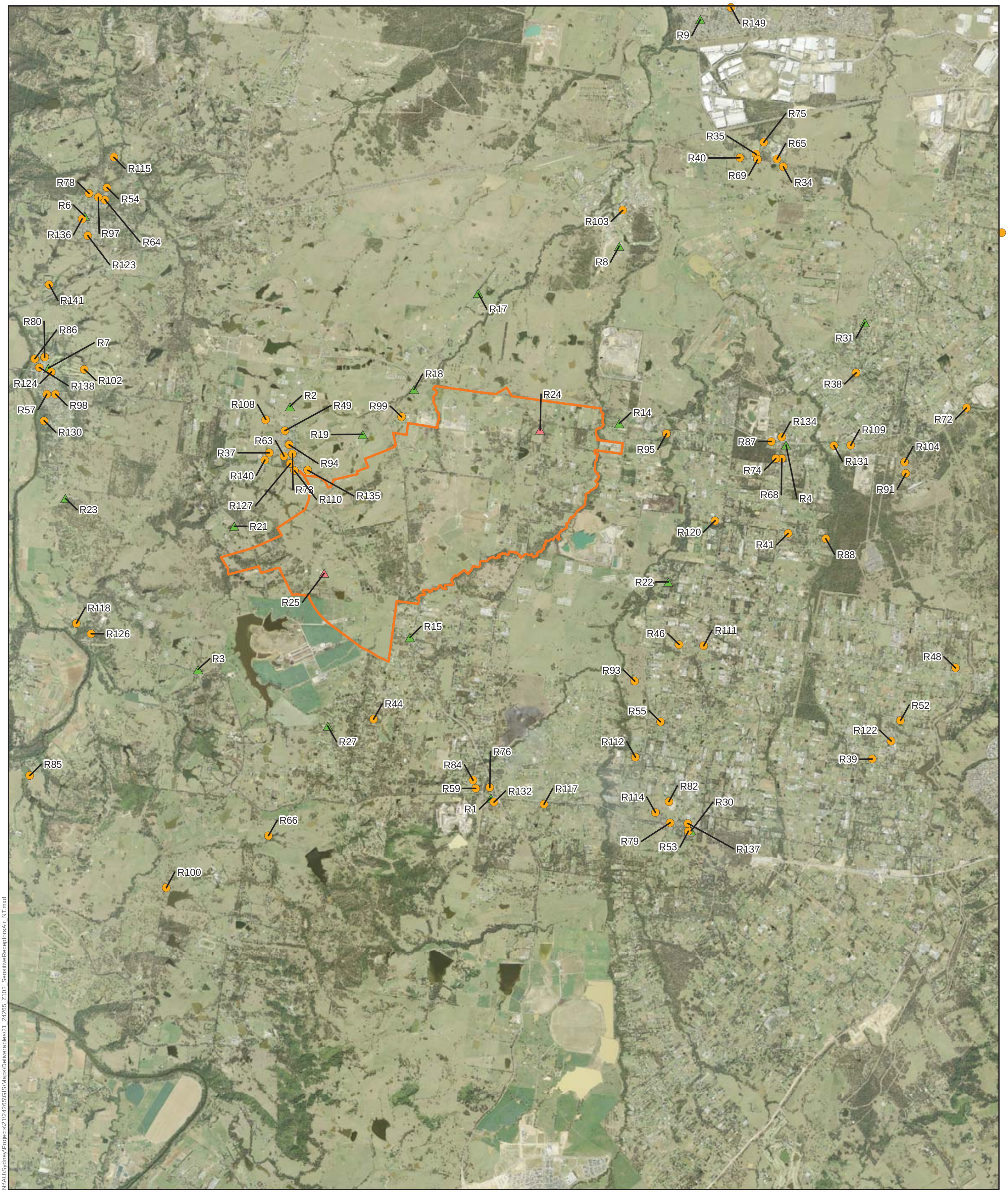


Note: CO = Carbon monoxide, VOC = Volatile organic compounds, NO_x = Nitrogen oxides, SO_x = Sulfur oxides, PM_{10} and $PM_{2.5}$ = Particulate matter

Figure 32-2 – Estimated airport and external roads emissions as a percentage of total modelled for criteria pollutants (long term development)

32.4.2. Dispersion modelling results

Given the uncertainty regarding the future reduction in vehicular and aircraft engine emissions and the anticipated general reduction in background emissions over time, ground level concentration predictions were assessed only for the key criteria pollutants such as nitrogen dioxide and particulate matter (PM_{10} and $PM_{2.5}$) for the long term development. Figure 32-3 shows the location of representative sensitive receptors in the vicinity of the airport site.



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LEGEND

- Airport site
- Community
- Residential
- Airport site

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

0 0.5 1 2
Kilometres

N

Figure 32-3 - Location of sensitive receptors in the vicinity of the airport site

32.4.2.1. Oxides of nitrogen

The dispersion modelling results for maximum one hour and annual average nitrogen dioxide are presented in Table 32–2. Exceedances of the air quality assessment criteria are shown in bold text. The results of the dispersion modelling show predicted nitrogen dioxide concentrations are expected to be below the air quality assessment criteria at all residential receptors for annual average nitrogen dioxide concentrations when considering the proposed airport in isolation (incremental) and in combination with the external roadways and background sources (cumulative) within the study area.

Exceedances of the one hour average air quality assessment criteria may be experienced at seven of the 20 selected sensitive residential and on-site receptors. These elevated concentrations are predicted to occur for between one and two hours per year. The maximum one hour nitrogen dioxide concentration is predicted to occur at receptor R14, located to the north-west of the airport site.

Table 32–2 – Predicted incremental and cumulative nitrogen dioxide concentrations (long term development)

Receptor	Receptor description	Airport (µg/m³)			Cumulative (µg/m³)		
		One hour		Annual	One hour		Annual
Assessment criteria		*320*	*Number of hours > 320*	*62*	*320*	*Number of hours > 320*	*62*
R1	Bringelly	237	0	17	246	0	25
R2	Luddenham	111	0	22	112	0	24
R3	Greendale, Greendale Road	**347**	1	22	**368**	1	24
R4	Kemps Creek	223	0	17	244	0	31
R6	Mulgoa	188	0	18	189	0	19
R7	Wallacia	241	0	17	243	0	18
R8	Twin Creeks, corner of Twin Creek Drive and Humewood Place	155	0	21	164	0	26
R14	Badgerys Creek, Lawson Road,	**517**	1	34	**519**	1	45
R15	Greendale, Mersey Road	**343**	2	31	**349**	2	34
R17	Luddenham Road	310	0	22	313	0	26
R18	Corner of Adams and Elizabeth Drive	229	0	38	229	0	43
R19	Corner of Adams and Anton Road	211	0	47	211	0	50
R21	Corner of Willowdene Avenue and Vicar Park Lane	**408**	1	24	**424**	1	27
R22	Rossmore, Victor Avenue	242	0	18	246	0	23
R23	Wallacia, Greendale Road	**342**	1	15	**347**	1	17
R24	Greendale, Dwyer Road	**335**	1	55	**337**	1	57

Receptor	Receptor description	Airport (µg/m³)			Cumulative (µg/m³)		
		One hour		Annual	One hour		Annual
R25	Rossmore residential	281	0	23	287	0	26
R27	Mt Vernon residential	116	0	14	117	0	16
R30	Bringelly	312	0	14	319	0	36
R31	Luddenham	**345**	1	22	**355**	1	26

32.4.2.2. Particulate matter (PM_{10})

The dispersion modelling results for maximum 24 hour average and annual average PM_{10} are presented in Table 32–3. Exceedances of the air quality assessment criteria are shown in bold text. PM_{10} concentrations are predicted to exceed the 24 hour air quality assessment criteria at one sensitive receptor (R24). This receptor is located within the airport site and represents the air quality conditions that would be likely to be experienced on-site (that is, by both staff and passengers of the proposed airport). For the remaining sensitive receptors, there are no predicted exceedances of the air quality assessment criteria.

There are no exceedances of the annual average air quality assessment criteria at any of the sensitive residential receptors.

Table 32–3 – Predicted incremental and cumulative PM_{10} concentrations (long term development)

Receptor	Receptor description	Airport (µg/m³)		Airport + external roadways (µg/m³)		Cumulative – airport + external roadways + existing background (µg/m³)	
		24 hour	Annual	24 hour	Annual	24 hour	Annual
Assessment criteria		n/a	n/a	n/a	n/a	50	30
R1	Bringelly	3.7	0.1	13.7	1.9	46	19
R2	Luddenham	1.7	0.3	3.6	0.7	43	18
R3	Greendale, Greendale Road	5.7	0.3	7.3	0.6	43	18
R4	Kemps Creek	2.6	0.2	14.7	3.7	48	21
R6	Mulgoa	1.8	0.1	4.5	0.4	43	17
R7	Wallacia	1.3	0.1	2.6	0.4	43	17
R8	Twin Creeks, corner of Twin Creek Drive and Humewood Place	2.2	0.2	4.4	1.2	45	18
R14	Badgerys Creek, Lawson Road	9.6	0.7	15.8	3.1	47	20
R15	Greendale, Mersey Road	6.1	0.5	8.6	1.3	46	18
R17	Luddenham Road	3.4	0.2	6.9	1.2	45	18

Receptor	Receptor description	Airport (µg/m³)		Airport + external roadways (µg/m³)		Cumulative – airport + external roadways + existing background (µg/m³)	
		24 hour	Annual	24 hour	Annual	24 hour	Annual
R18	Corner of Adams and Elizabeth Drive	5.3	0.6	9.4	1.7	46	19
R19	Corner of Adams and Anton Road	5.3	0.8	6.9	1.4	45	18
R21	Corner of Willowdene Avenue and Vicar Park Lane	5.9	0.3	6.9	0.9	44	18
R22	Rossmore, Victor Avenue	4.1	0.2	7.7	1.3	46	18
R23	Wallacia, Greendale Road	2.3	0.1	3.7	0.4	43	17
R24	Greendale, Dwyer Road	31.6	8.9	40.9	11.2	72	28
R25	Rossmore residential	3.6	0.5	5.1	1.2	43	18
R27	Mt Vernon residential	1.4	0.1	2.6	0.4	43	17
R30	Bringelly	1.7	0.1	24.0	5.0	49	22
R31	Luddenham	4.2	0.2	6.5	1.1	44	18

32.4.2.3. Particulate matter ($PM_{2.5}$)

The dispersion modelling results for maximum 24 hour average and annual average $PM_{2.5}$ are presented in Table 32–4. Exceedances of the air quality assessment criteria are shown in bold text. It is predicted that $PM_{2.5}$ concentrations would be above the air quality assessment criteria of 25 µg/m^3 and 8 µg/m^3 for the 24 hour and annual averaging periods at a number of receptors. This is not unexpected for receptor R24, given that it is located within the airport site. The annual criteria are predicted to be exceeded at four other receptors. This is also not unexpected, given that the background contributes almost 90 per cent of the criteria.

The contour plots show that in addition to the proposed airport, the contribution from traffic on external roadways would play a significant role in the ground level concentrations of $PM_{2.5}$ (refer to Appendix F1).

Table 32–4 – Predicted incremental and cumulative $PM_{2.5}$ concentrations (long term development)

Receptor	Receptor description	Airport (µg/m3)		Airport + external roadways (µg/m3)		Cumulative – airport + external roadways + existing background (µg/m3)	
		24 hour	Annual	24 hour	Annual	24 hour	Annual
Assessment criteria		n/a	n/a	n/a	n/a	25	8
R1	Bringelly	2.4	0.1	9.1	1.2	16	8
R2	Luddenham	1.5	0.2	2.4	0.5	14	8
R3	Greendale, Greendale Road	4.3	0.2	5.8	0.4	14	7
R4	Kemps Creek	2.0	0.1	8.4	2.1	18	**9**
R6	Mulgoa	1.6	0.1	3.2	0.3	13	7
R7	Wallacia	1.1	0.1	1.8	0.3	14	7
R8	Twin Creeks, corner of Twin Creek Drive and Humewood Place	1.6	0.2	2.8	0.8	15	8
R14	Badgerys Creek, Lawson Road,	6.8	0.6	11.3	2.1	18	**9**
R15	Greendale, Mersey Road	4.6	0.5	6.6	1.0	16	8
R17	Luddenham Road	2.8	0.2	4.4	0.8	15	8
R18	Corner of Adams and Elizabeth Drive	3.8	0.5	6.6	1.1	16	8
R19	Corner of Adams and Anton Road	4.0	0.6	5.1	1.0	15	8
R21	Corner of Willowdene Avenue and Vicar Park Lane	4.0	0.2	4.7	0.6	14	8
R22	Rossmore, Victor Avenue	2.9	0.2	4.8	0.9	16	8
R23	Wallacia, Greendale Road	1.7	0.1	2.5	0.3	14	7
R24	Greendale, Dwyer Road	18.6	5.3	24.7	6.8	**34**	**14**
R25	Rossmore residential	2.3	0.4	3.3	0.9	14	8
R27	Mt Vernon residential	1.1	0.1	1.6	0.3	13	7
R30	Bringelly	1.2	0.1	15.9	3.4	23	**10**
R31	Luddenham	2.9	0.2	4.5	0.7	14	8

The above assessment of the long term development forecasts emissions approximately 50 years into the future and assumes no improvement in background air quality conditions. Further, the assessment also assumes there is limited improvement in aircraft emissions. On these two points, it can be concluded that the emission estimates are conservative.

32.4.3. Fuel jettisoning

As discussed in Chapter 7 and Chapter 12 in Volume 2, the effects of fuel jettisoning on local air quality would be limited due to the rarity of the activity, the inability of many aircraft to jettison fuel, the rapid vaporisation and wide dispersion of jettisoned fuel, the strict guidelines on fuel jettisoning altitudes and locations and the anticipated reduction in fuel jettisoning events and volumes in the future. For these reasons, fuel jettisoning is not considered likely to have a significant immediate or future impact on local air quality or human health.

32.4.4. Regional air quality (ozone)

Regional air quality considers the formation of secondary pollutants (such as ozone (O_3)) through photochemical reactions from primary emissions of precursor gases including nitrogen oxides, volatile organic compounds and carbon monoxide.

International studies have shown that emissions from airport operations are small in the context of regional emissions inventories (Ratliff et al, 2009). This is supported by data presented in the *Air Emissions Inventory for the Greater Metropolitan Region in New South Wales* (EPA 2012) which shows that emissions from existing airport operations in Sydney are less than three per cent of total emissions for the Sydney region.

Future projected emissions for sources other than the proposed airport (such as commercial, industrial, on-road mobile) are not available for the 2063 scenario, therefore, the long term development scenario becomes a hypothetical scenario of the long term airport development occurring within the context of 2030 base case emissions. Twelve days with high observed ozone (one hour ozone concentrations greater than 70 parts per billion and four hour ozone concentrations greater than 65 parts per billion) were selected for detailed modelling analysis, as described in Chapter 12 of Volume 2. Historical dates in January and February 2009 were selected to represent the meteorological conditions that have historically led to peak ozone formation and which the model has effectively captured for peak ozone formation with the addition of future emissions.

The daily maximum predicted one hour ozone concentrations are presented in Table 32–5. The maximum predicted one hour ozone concentration was unchanged between the 2030 base case and the 2063 airport case for eight of the analysis days. On four days, the peak predicted one hour ozone concentration increased by a maximum of 0.2 parts per billion. Both the 2030 base case and the 2063 airport case were above the NEPM criterion of 100 parts per billion for all but one day of analysis.

Table 32–5 – Maximum daily predicted one hour ozone concentration (parts per billion) – 2063

Date	2030 future base case peak value	2063 airport case peak value	2063 airport case – 2030 future base case largest difference
06/01/2009	149.1	149.2	2.0
07/01/2009	129.8	130.0	12.3
14/01/2009	106.6	106.6	5.6
29/01/2009	124.1	124.1	1.6
30/01/2009	107.4	107.4	2.3
31/01/2009	109.4	109.4	2.2
04/02/2009	103.8	103.8	3.3
05/02/2009	119.6	119.6	1.6
06/02/2009	112.5	112.5	3.3
07/02/2009	133.7	133.7	1.7
08/02/2009	148.6	148.7	2.5
20/02/2009	98.3	98.4	4.5

Larger ozone increases were modelled for the 2063 airport case than for the 2030 airport case. The average of the second to fourth highest increases in daily maximum one hour ozone rose from 1.1 parts per billion for 2030 to 4.5 parts per billion for 2063. This would be significantly above the maximum allowable increment of one part per billion defined in the NSW tiered procedure for ozone assessment. However, it should be noted that the increase is a hypothetical scenario of the long term airport development occurring within the context of 2030 environmental baseline and, therefore, does not reflect a direct comparative increase as the 2063 ozone concentrations are unknown.

The daily maximum predicted four hour ozone concentrations are presented in Table 32–6. The peak predicted four hour ozone concentration would be unchanged in seven of the days analysed and increased in five of the days by a maximum of 0.2 parts per billion. The highest change in daily maximum four hour ozone concentration, from the addition of 2063 airport emissions, was 6.3 parts per billion, while the second highest was 5.8 parts per billion. The average of the second to fourth highest increases in daily maximum four hour ozone is 3.7 parts per billion, which would be significantly above the maximum allowable increment of one part per billion defined in the NSW tiered procedure for ozone assessment.

Table 32–6 – Maximum daily predicted four hour ozone concentration (parts per billion) – 2063

Date	2030 future base case peak value	2063 airport case peak value	2063 airport case – 2030 future base case largest difference
06/01/2009	126.2	126.5	1.9
07/01/2009	115.3	115.6	5.8
14/01/2009	98.7	98.9	1.6
29/01/2009	95.9	95.9	2.2
30/01/2009	78.2	78.2	2.4
31/01/2009	99.9	99.9	2.3
04/02/2009	97.3	97.3	3.0
05/02/2009	108.7	108.7	1.6
06/02/2009	92.4	92.4	1.7
07/02/2009	121.0	121.0	2.4
08/02/2009	129.9	130.0	2.3
20/02/2009	83.9	84.2	6.3

In the 2063 airport case, reductions in daily maximum ozone, due to ozone suppression by nitrogen oxide emissions, would occur in the vicinity of the airport site and on some days extend to the aircraft flight corridor and areas downwind of the airport site. Areas of ozone reduction would be more expansive for the 2063 airport case than for 2030 airport case because nitrogen oxide emissions from the proposed airport would be higher in 2063. Increases in ozone occurring downwind of the airport site would also be larger in 2063 than in 2030.

It is noted that the emissions data provided for airport operations assumes worst case operations, for example by including emissions from on-board auxiliary power units rather than the use of mains powered auxiliary power units at the airport gates. Furthermore, for the long term airport development there was no accounting for future changes in emissions from all other sources (such as commercial, industrial, on-road vehicles), some of which may increase and some of which may decrease. The modelling predictions for the long term development should, therefore, be viewed in this context.

32.5. Greenhouse gas assessment

Greenhouse gas emissions that are forecast to be generated during the operation of the long term development are presented in Table 32–7. As shown in Table 32–7, electricity consumption would account for around 80% of Scope 1 and 2 greenhouse gas emissions during the long term operation of the airport. Electricity is a Scope 2 emission. Scope 1 emissions would account for only 20 per cent of greenhouse gas emissions from the airport site.

It is not commonplace to report Scope 3 emissions because of the potential of double counting greenhouse gas emissions. Nevertheless, as they are considered significant for the proposed airport, the most probable primary contributor (jet fuel), has been quantified in Table 32–7. It must be noted that this quantity involves only those emissions from departing planes during their entire flight (those departing from the proposed airport). This method assumes the arriving planes emissions are accounted for by the preceding airport, and is a common approach taken internationally. This method has been recommended by the Airport Cooperative Research Program (ACRP) (ACRP 2009).

Table 32–7 – Summary of estimated annual Scope 1, 2 and 3 greenhouse gas emissions (long term development)

Scope	Source	Fuel type	Annual quantity	Units	Annual emissions (t CO_2 e)
1	Ground support equipment	Transport diesel oil	6	ML	16,910
		Transport gasoline	13	ML	30,728
1	Auxiliary power unit	Stationary gasoline (jet fuel)	33	ML	88,566
1	Boilers	Stationary natural gas	11,735,513	m^3	23,674
1	Generators	Stationary diesel oil	0.05	ML	143
1	Fire training	Stationary kerosene	0.03	ML	74
1	Wastewater treatment plant	N/A	9,782	ML	6,092
1	Fugitive emissions	Transport gasoline (jet fuel)	8030	ML	846
1	Fugitive emissions	Transport diesel oil	6	ML	0.7
1	Fugitive emissions	Transport gasoline	13	ML	1
2	Electricity	N/A	755,112,000	kWh	649,396
Total Scope 1 and 2					**816,430**
3	In flight aviation fuel	Transport gasoline (jet fuel)	8,030	ML	20,570,033

Note: Fuel Type reflects the categories in DoE (2014b)

Assumptions made within the greenhouse gas calculations are provided within Appendix F1.

Emissions factor was not available for jet fuel, emissions have been assumed to be the same as Avgas.

32.6. Considerations for future development stages

Air quality impacts and greenhouse gas emissions generated during construction and operation of the long term development would generally be managed in accordance with best management practices, similar to those outlined in Chapter 12 of Volume 2. Air quality matters associated with the proposed airport would also be regulated under the Airports (Environment Protection) Regulations.

32.7. Summary of Findings

Operation of the long term development would result in an increase in emissions of nitrogen dioxide, PM_{10}, $PM_{2.5}$, carbon monoxide, sulfur dioxide and air toxics. Given the uncertainty regarding the future reduction in vehicular and aircraft engine emissions and the anticipated general reduction in background emissions over time, ground level concentration predictions were assessed only for the key criteria pollutants (nitrogen dioxide, PM_{10} and $PM_{2.5}$) for the long term development.

The results of the dispersion modelling for nitrogen dioxide are as follows.

- *Annual average*: There would be no exceedances of the annual average air quality assessment criteria at any of the sensitive residential receptors; and
- *One hour average*: There would be seven residential receptors predicted to exceed the one hour air quality assessment criteria. These elevated concentrations are predicted to occur for between one and two hours per year. The maximum one hour nitrogen dioxide concentration is predicted to occur at receptor R14, located to the north-west of the airport site.

The results of the dispersion modelling for PM_{10} are as follows.

- *Annual average:* There would be no exceedances of the annual average air quality assessment criteria at any of the residential receptors; and
- *24 hour average:* There would be one on-site receptor predicted to exceed the 24 hour air quality assessment criteria. For the residential receptors, there would be no predicted exceedances of the air quality assessment criteria.

The results of the dispersion modelling for $PM_{2.5}$ are as follows.

- *Annual average:* The air quality assessment criteria would be predicted to be exceeded at four receptors, including one on-site receptor; and
- *24 hour average:* There would be one on-site receptor predicted to exceed the air quality assessment criteria. For the residential receptors there would be no predicted exceedances of the criteria.

The local effects of fuel jettisoning at or near the airport site would be limited due to the inability of many aircraft to jettison fuel, the quick vaporisation and dispersion of aircraft fuel, the strict guidelines on fuel jettisoning altitudes and locations, and the anticipated reduction in fuel jettisoning events and volumes in the future. For these reasons, fuel jettisoning is not considered likely to have a significant future impact on local air quality or human health.

The maximum predicted one hour and four hour ozone concentrations increased by a maximum of 0.2 parts per billion during the operation of the long term development. Both the predicted base case and the long term development were generally above the NEPM criteria. Larger ozone incremental increases in the surrounding localities were recorded for the long term development, driven primarily by the increase in nitrogen oxides and volatile organic compound emissions sources.

Actual air emissions from the operating long term development may be lower than predicted given the use of mains powered auxiliary power units at the airport gates (instead of on-board auxiliary power units), increased use and optimisation of proposed rail connections (instead of motor vehicles) and progressive improvements in aircraft technology.

33. Traffic, transport and access

33.1. Introduction

An assessment of potential traffic and transport impacts of the indicative long term development of the proposed proposed airporthas been undertaken.

This chapter builds upon the consideration of potential traffic and transport impacts associated with the Stage 1 development presented in Chapter 15 of Volume 2. It is based upon a comprehensive Surface Transport and Access Study provided in Appendix I in Volume 4.

33.2. Methodology

The methodology used for assessment of the long term development was consistent with that used for the Stage 1 development. Two modelling 'scenarios' were developed for the purpose of this assessment.

- 'Do Minimum' represents the minimum transport network improvements required to maintain the status quo, without consideration of the expected additional demand generated by the proposed airport.
- 'With Airport' includes consideration of the expected additional demand generated by the proposed airport.

The NSW Bureau of Transport Statistics Strategic Travel Model (Version 3) was used and the assessment was undertaken in four main stages:

1. trip generation, or travel frequency (how many trips would occur to and from a nominated travel zone with regard to the demographics and land uses of that zone);
2. trip distribution (where these trips are likely to go);
3. travel mode choice (car, bus, rail, ferry or a combination); and
4. assignment (route chosen for each trip, for each mode, between each origin-destination pair). This stage provides the detail for the number of vehicles on each road and people on each public transport service

Assessment of the long term concept for the proposed airport is based on the year 2063, when forecast passenger movements are expected to be approximately 82 million annual passengers, with demand serviced by approximately 59,500 employees.

The assumed road network for the 2063 assessment year is generally consistent with the 2031 model used to assess the Stage 1 development, with the addition of the proposed Castlereagh Highway between Bells Line of Road at Kurrajong, and the north-western section of the M7 Motorway near Dean Park.

With the exception of a rail connection to the proposed airport (through a possible extension of the South West Rail Link to the airport site and on to St Marys), the assumed public transport network is also similar to that modelled as part of the assessment of Stage 1.

It should be noted that the NSW and Australian governments have not commenced planning any road or transport upgrades beyond 2041. As information about the transport network beyond 2041 is not available, the 2063 airport demand forecasts have been assigned to a 2041 transport network.

33.2.1. Assessment criteria

Assessment of the potential traffic, transport and access impacts has been undertaken with reference to the *Guide to Traffic Generating Developments* (RTA 2002). This guideline suggests a process and methodology to undertake the assessment which would be familiar to NSW stakeholders and the community. The operational traffic assessment process outlined in the guidelines stipulates that the operating characteristics need to be compared with agreed performance criteria.

33.2.1.1. Midblock capacity

The capacity of urban roads is generally determined by the capacity of the intersections or the 'midblock' capacity (the sections of roads between intersections). The mid-block capacities for roads can be estimated and compared to the existing traffic volumes in terms of volume to capacity ratios (VCR).

The VCR is a measure of the amount of traffic carried by a section of road compared to its nominal capacity. As volume/capacity nears one, the speed on the link decreases and both the likelihood and the duration of flow breakdowns increase.

The Austroads *Guide to Traffic Management*[1] outlines Level of Service (LoS) criteria for mid-block sections of road based on the VCR. A summary of these Levels of Service is presented in Table 33–1.

[1] *Part 3: Traffic Studies and Analysis (2009)*

Table 33–1 – Level of Service descriptions for roads

Level of Service (LoS)	Uninterrupted flow facilities (Motorways)	Uninterrupted flow facilities (Arterial and collector roads)	Volume/capacity ratio
A	Free flow conditions in which individual drivers are unaffected by the presence of others in the traffic stream. Freedom to select desired speeds and to manoeuvre within the traffic stream is extremely high, and the general level of comfort and convenience provided is excellent.	Primarily free flow operations at average travel speeds, usually about 90% of the free flow speed (FFS) for the given street class. Vehicles are completely unimpeded in their ability to manoeuvre within the traffic stream. Control delay at signalised intersections is minimal.	0.00 to 0.34
B	Zone of stable flow and drivers still have reasonable freedom to select their desired speed and to manoeuvre within the traffic stream, although the general level of comfort and convenience is less than with LoS A.	Reasonably unimpeded operations at average travel speeds, usually about 70% of the FFS for the street class. The ability to manoeuvre within the traffic stream is only slightly restricted and control delays at signalised intersections are not significant.	0.35 to 0.50
C	Also in the zone of stable flow, but most drivers are restricted to some extent in their freedom to select their desired speed and to manoeuvre within the traffic stream. The general level of comfort and convenience declines noticeably at this level.	Stable operations; however ability to manoeuvre and change lanes in mid-block locations may be more restricted than at LoS B, and longer queues, adverse signal coordination or both may contribute to lower average travel speeds of about 50% of the FFS for the street class.	0.51 to 0.74
D	Close to the limit of stable flow and is approaching unstable flow. All drivers are severely restricted in their freedom to select their desired speed and to manoeuvre within the traffic stream. The general level of comfort and convenience is poor, and small increases in traffic flow will generally cause operational problems.	A range in which small increases in flow may cause substantial increases in delay and decreases in travel speed. LoS D may be due to adverse signal progression, inappropriate signal timing, high volumes or a combination of these factors. Average travel speeds are about 40% of FFS.	0.75 to 0.89
E	Occurs when traffic volumes are at or close to capacity, and there is virtually no freedom to select desired speeds or to manoeuvre within the traffic stream. Flow is unstable and minor disturbances within the traffic stream will cause breakdown.	Characterised by significant delays and average travel speeds of 33% of the FFS or less. Such operations are caused by a combination of adverse progression, high signal density, high volumes, extensive delays at critical intersections and inappropriate signal timing.	0.90 to 0.99
F	In the zone of forced flow. With LoS F, the amount of traffic approaching the point under consideration exceeds that which can pass it. Flow breakdown occurs and queuing and delays result.	Characterised by urban street flow at extremely low speeds, typically 25% to 33% of the FFS. Intersection congestion is likely at critical signalised locations, with high delays, high volumes and extensive queuing.	1.0 or greater

Source: Adapted from Austroads Guide to Traffic Management – Part 3: Traffic Studies and Analysis.

33.3. Assessment of impacts during operation

To assess the potential transport network impacts of the indicative long term airport development, consideration was given to the travel demand that would be created by passengers, employees and freight. The expected trip generation for each of these groups is considered in Sections 33.3.1, 33.3.2 and 33.3.3 respectively. The overall expected impacts on network performance are discussed in Section 33.3.6.

The assessment has not considered traffic associated with future commercial development. While the proposed airport includes authorisation for future non-aeronautical commercial development, the details of such development would be developed by the ALC and would be subject to authorisation under the Airports Act.

33.3.1. Passenger trips

In 2063, it is estimated that the proposed airport would be operating to support an anticipated demand of 82 million annual passengers. As explained in Chapter 15 of Volume 2, to understand the transport impact these passenger movements may have, they need to first be translated into trips and then assigned to the surrounding road network using the Strategic Transport Model. The process of determining passenger trips from flight movements, passenger movements and an assignment to different transport modes is discussed below.

Flight movements

A passenger flight profile for the indicative long term development was developed based on the number of daily and peak hour passenger flights. The profile for 2063 is shown in Figure 33-1.

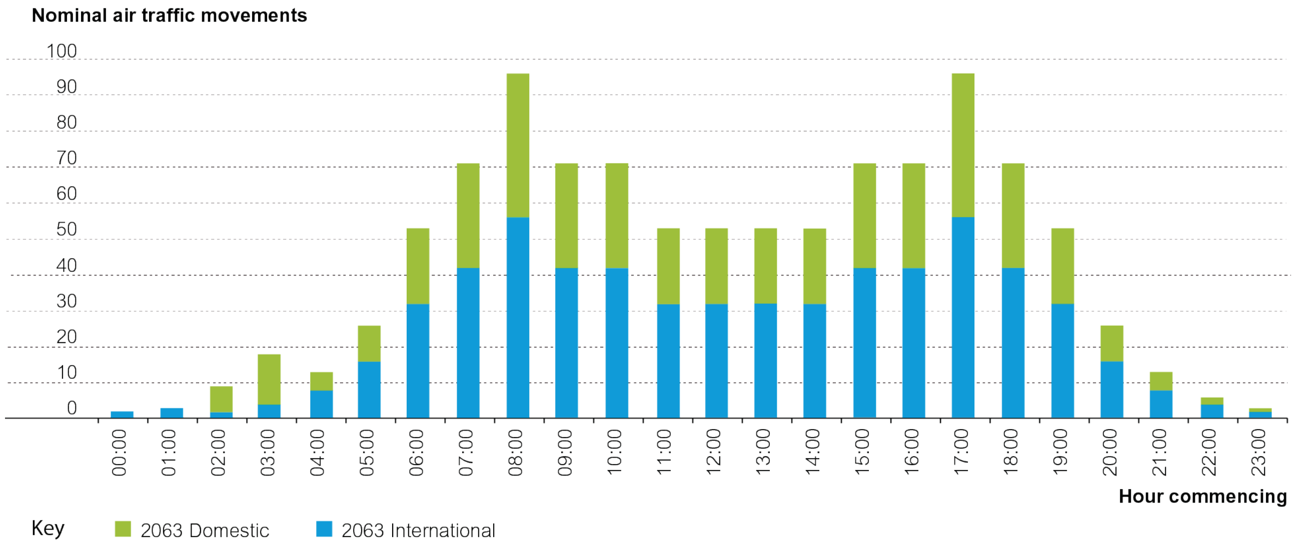


Figure 33-1 – Hourly flight arrivals / departures – 2063

In 2063, there are expected to be a total of 1,001 passenger flights per day of which 604 are expected to be domestic and 397 are expected to be international. During the peak hour, there are expected to be 94 passenger flights of which 46 are expected to be arrivals (domestic and international) and 48 are expected to be departures (domestic and international).

33.3.1.1. Passenger movements

For each domestic and international flight in 2063, a profile of the passengers expected to be entering and exiting the proposed airport was determined to generate a ground transport demand profile. The profile is shown in Figure 33-2.

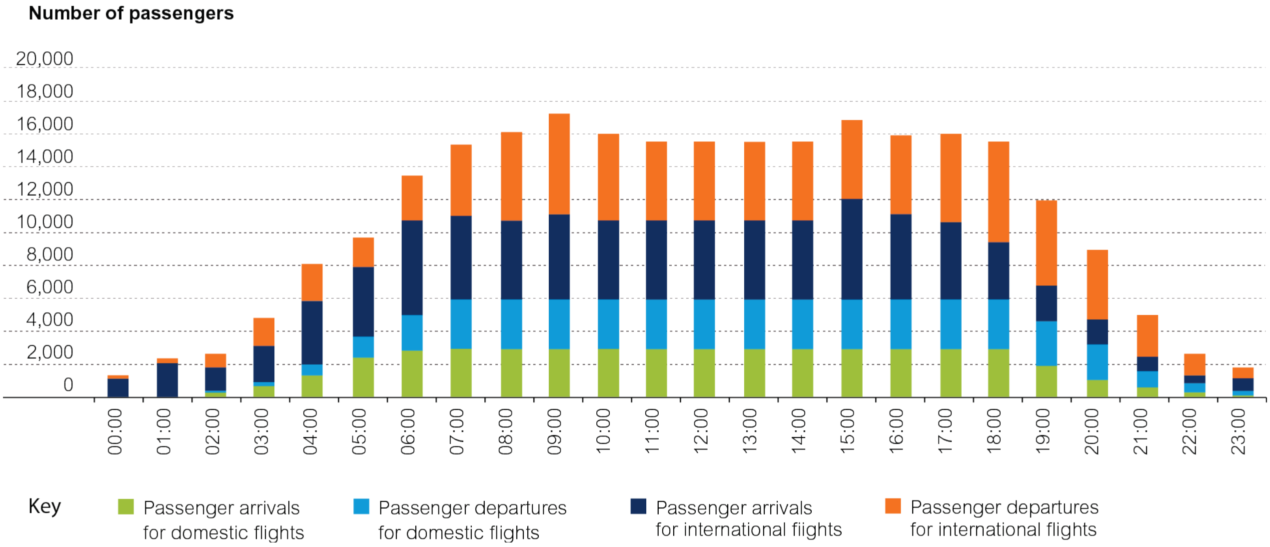


Figure 33-2 – 2063 ground transport demand per hour

33.3.1.2. Transport mode split

The Sydney Airport Land Transport Model and its assumed mode split were used to assign the calculated ground transport demand to the modes listed in Table 33–2.

Table 33–2 – 2063 assumed mode split

Mode	2063 assumed mode split			
	Domestic		International	
	Drop-off	Pick-up	Drop-off	Pick-up
Kiss ‘n’ fly	22%	22%	26%	26%
Park ‘n’ fly	20%	20%	18%	18%
Taxi	20%	20%	20%	20%
Shuttles	5%	5%	5%	5%
Bus	13%	13%	13%	13%
Train	20%	20%	18%	18%

Suitable dwell times for each transport mode were applied (e.g. longer dwell times were assumed for international kiss ‘n’ fly passengers when compared to their domestic counterparts).

Figure 33-3 shows the number of passenger arrivals via ground transport at the proposed airport that would be expected in 2063. Figure 33-4 shows the total departures that would be expected from the proposed airport via ground transport in 2063.

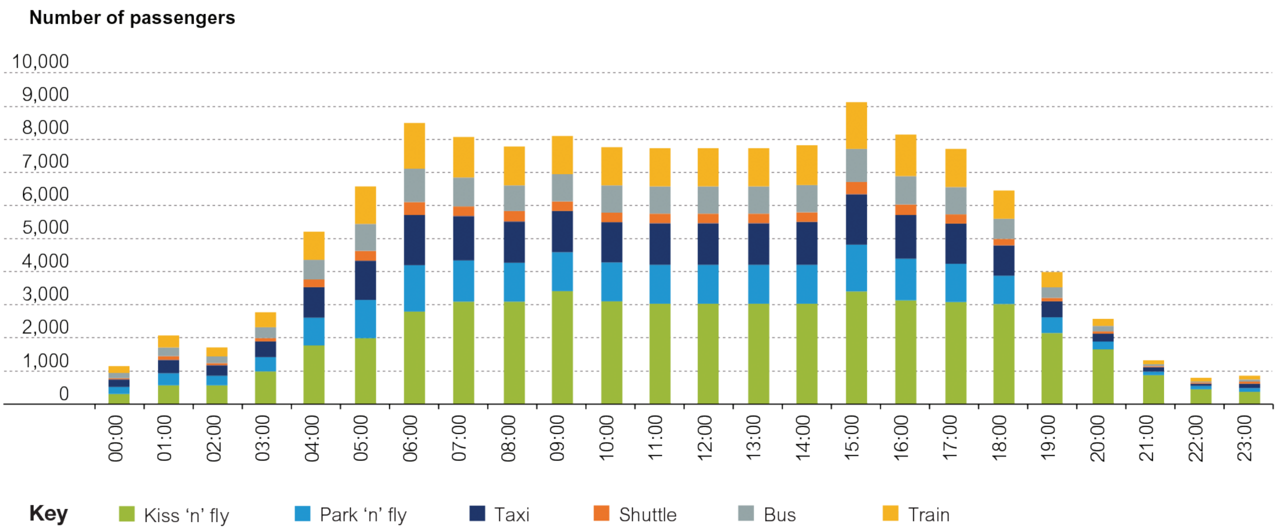


Figure 33-3 – Total passenger arrivals at the airport by ground transport mode

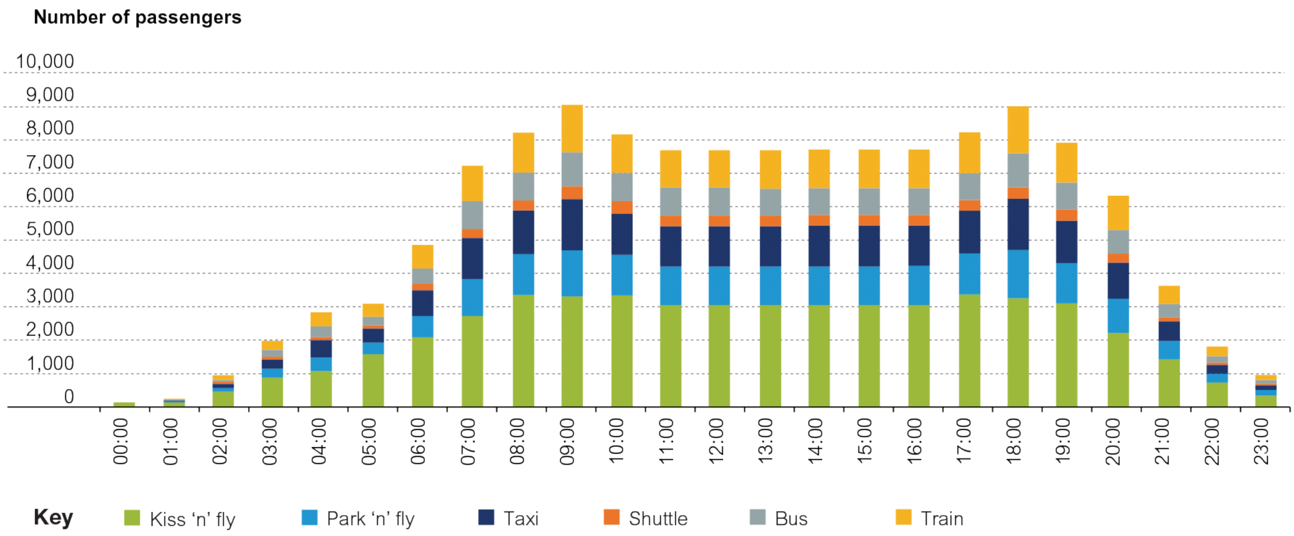


Figure 33-4 – Total passenger departures at the airport by ground transport mode

33.3.1.3. Traffic generation

The trips (by mode) shown in Figure 33-3 and Figure 33-4 were assigned to vehicles entering / exiting the airport site to determine the passenger related traffic generation (excluding vehicles such as taxis circulating internally within the site).

Figure 33-5 shows that in 2063, 4,332 vehicles are expected to enter the airport site during the AM traffic peak and 4,152 vehicles are expected to enter the airport site during the PM traffic peak period. Figure 33-6 shows that in 2063, 4,361 vehicles are expected to leave the proposed airport during the AM traffic peak and 4,492 are expected to leave the proposed airport during the PM traffic peak.

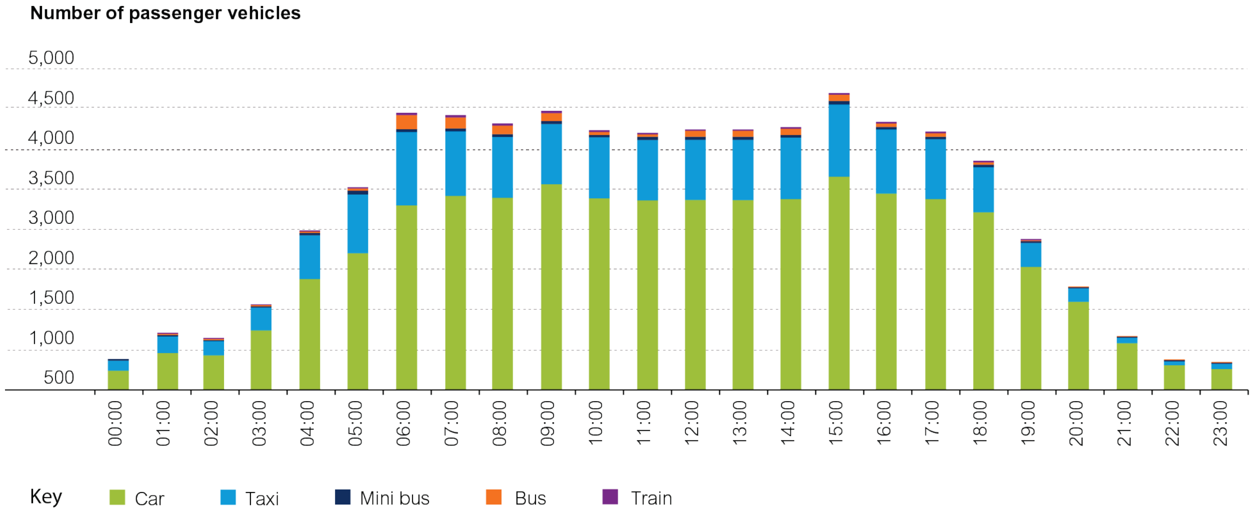


Figure 33-5 – Passenger vehicles entering the airport site (2063)

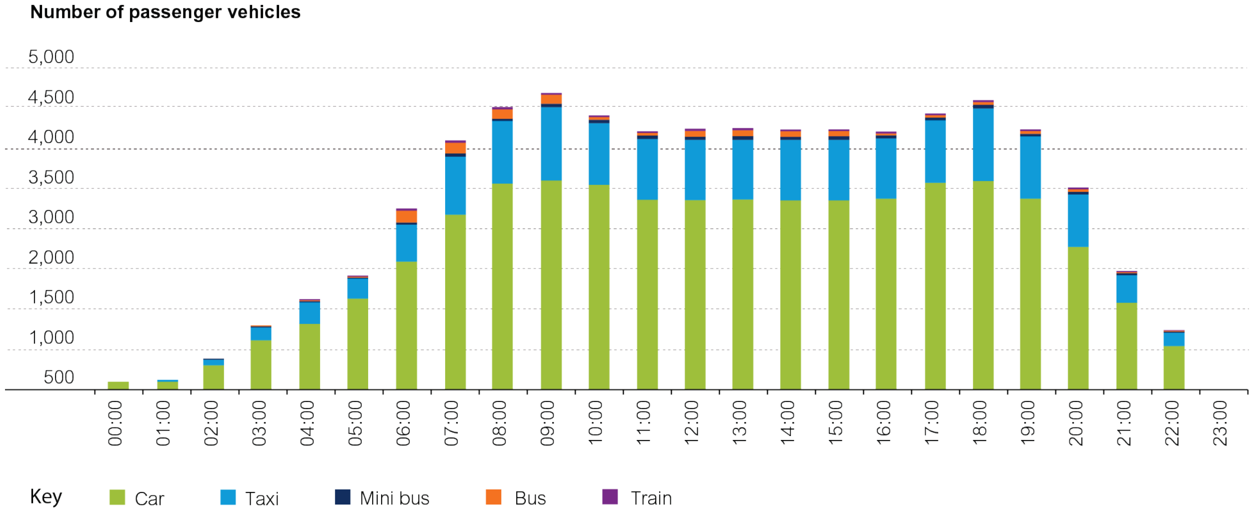


Figure 33-6 – Passenger vehicles leaving the airport site (2063)

33.3.2. Employee trips

33.3.2.1. Employees and shifts

Based on a ratio of 750 workers per one million annual passengers, the number of employees required at the proposed airport in 2063 is estimated to be 59,500. Consistent with the experience of Sydney Airport and other international airports, it was assumed that up to 80 percent of employees (47,392) would be on-site on any given day. Table 33–3 shows how the proposed airport employees were categorised.

Table 33–3 – Proposed 2063 employee shift profiles

Employee type	Start	Finish	% total employees	Employees on site
Airfield overnight	21:00	05:00	2	1,700
Airfield day	05:00	13:00	3	950
Airfield afternoon	13:00	21:00	3	950
Terminal support morning	06:00	13:00	10	4,760
Terminal support afternoon	13:00	20:00	10	5,712
Terminal supplementary morning	06:00	10:00	14	6,664
Terminal supplementary afternoon	15:00	19:00	14	5,712
Office early start	07:00	17:00	21	9,996
Office later start	09:00	19:00	23	10,948
			Total	**47,392**

33.3.2.2. Employee arrival and departure profiles

A profile for employee arrivals and departures prior to and after their shifts was developed and is illustrated by Figure 33-7. The profile acknowledges that some employees will arrive in the hour before their shift starts and/or leave in the hour after their shift finishes.

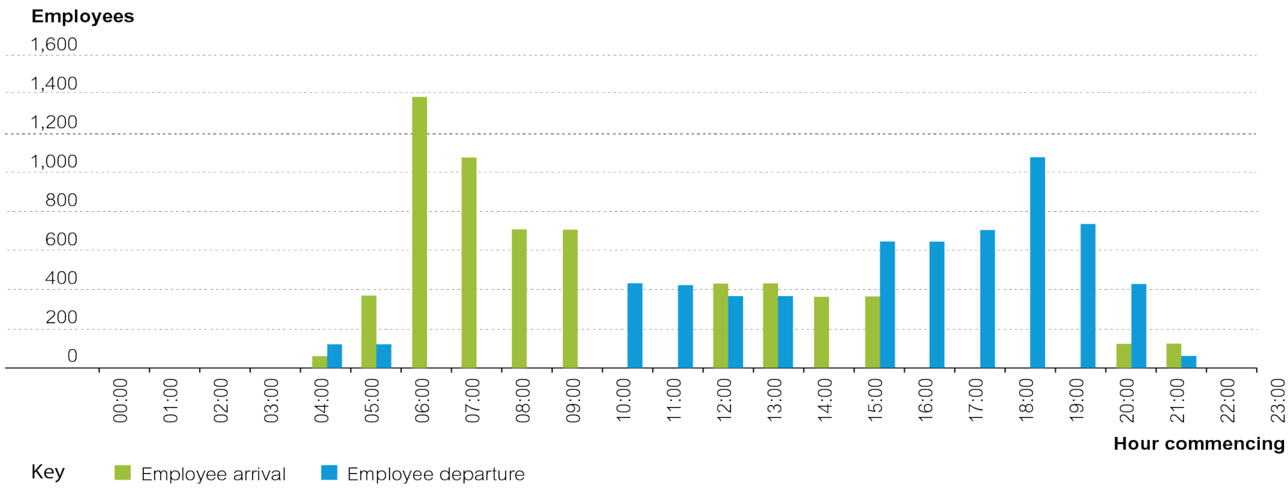


Figure 33-7 – 2063 Employee arrival and departure profile

Figure 33-7 shows that the peak arrival for the AM peak period would be 10,710 employees and the PM peak departure for employees (between 7pm and 8 pm) would be 8,330 employees.

33.3.2.3. Mode split

The employee mode spilt for the indicative long term development was determined by taking the base mode split used for Stage 1 operations and modifying it as follows:

- modifying the split for car modes to reflect the potential capacity of a staff car park; and
- distributing the staff trips to bus and rail modes.

Figure 33-8 and Figure 33-9 show the calculated distribution of arrivals and departures respectively. It can be seen that the AM peak arrival volume for cars would be 3,213, while the PM peak departure volume for cars would be 3,332.

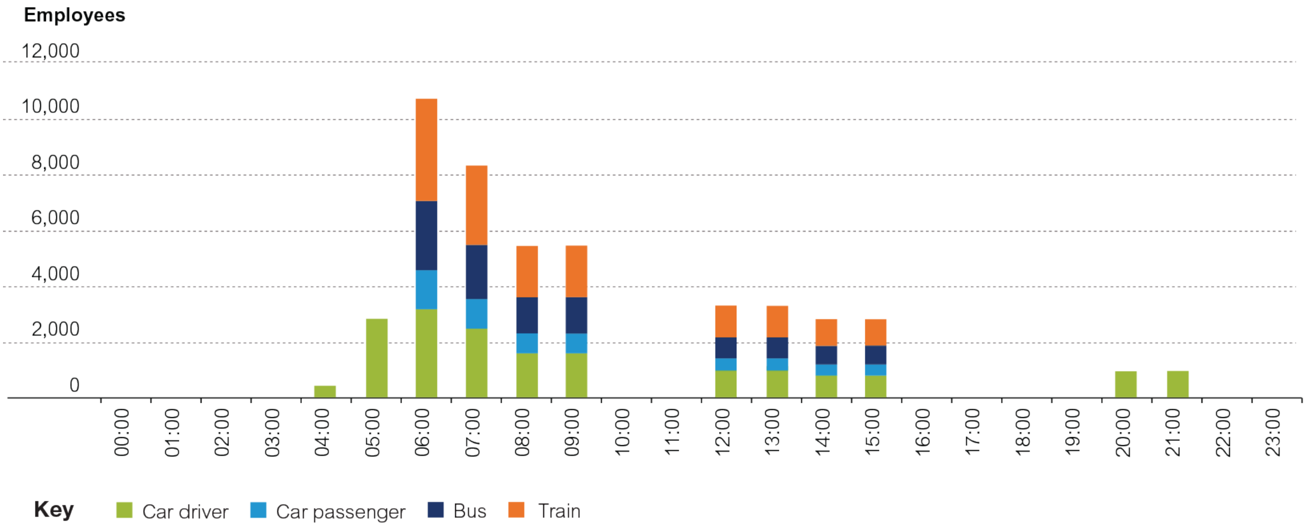


Figure 33-8 – 2063 employee arrivals by mode and time of day

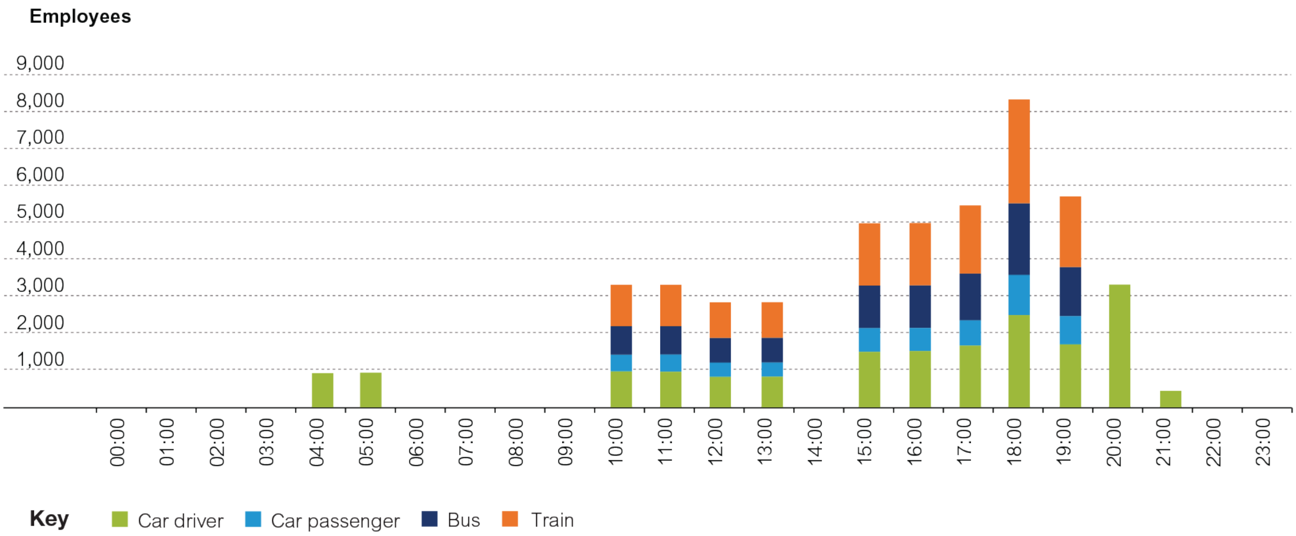


Figure 33-9 – 2063 employee departures by mode and time of day

33.3.2.4. Traffic generation

The calculated employee arrivals and departures were assigned to vehicles to determine the number of vehicles entering and leaving the airport site throughout the 24 hour operational period. The results are shown in Figure 33-10 for arrivals and Figure 33-11 for departures. Employee traffic generation peaks are expected to be outside the main traffic peaks of 7am to 9am, and 4pm to 6pm for the arrival and departure of employees.

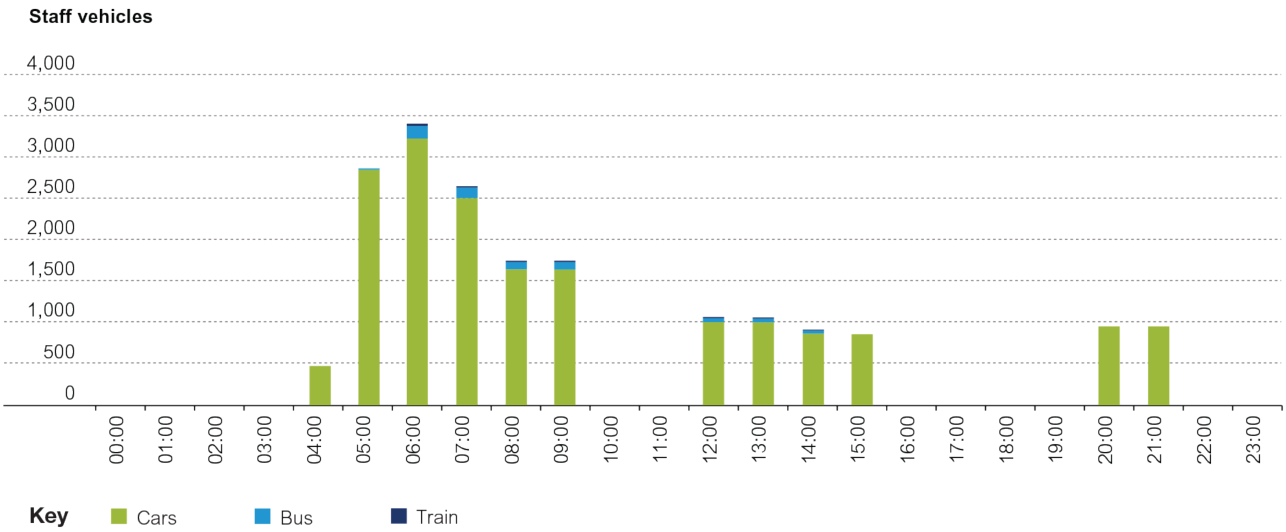


Figure 33-10 – 2063 employee arrivals by mode

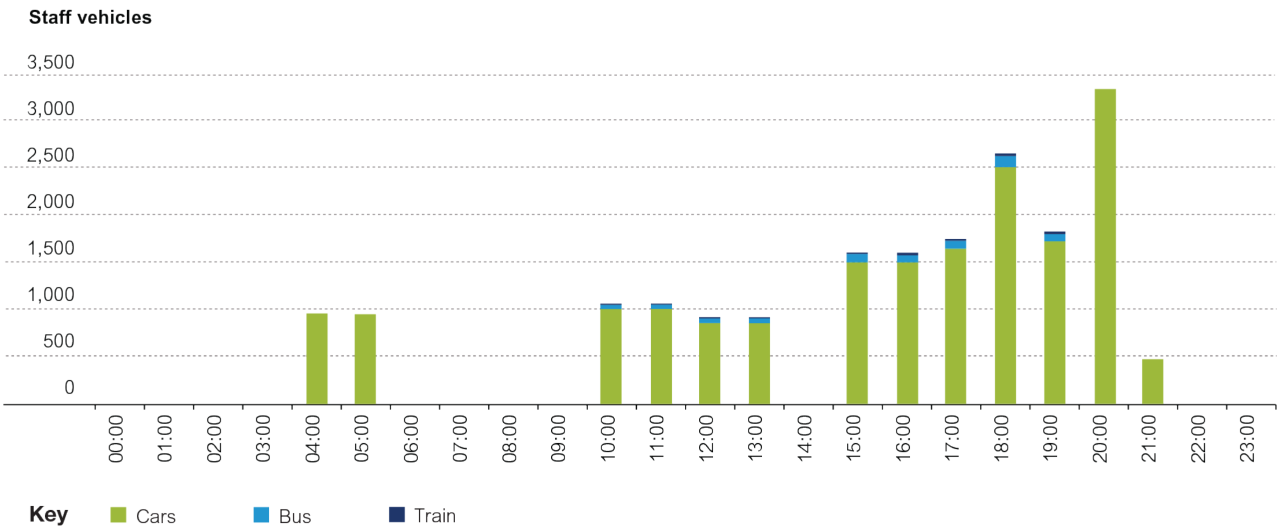


Figure 33-11 – 2063 employee departures by mode

33.3.3. Freight trips

Freight demand has been identified for air freight cargo. Demand estimates for airport consumables (e.g. food, retail items) or waste removal cannot be calculated before a detailed terminal plan is developed and have therefore been excluded from the assessment.

The freight demand for air cargo is estimated to be 1,021,210 tonnes in 2063. It has been assumed that the cargo freight arrives and departs the proposed airport on heavy rigid trucks, semi-trailers and B-doubles. Table 33–4 gives the estimated heavy vehicle volumes (and car equivalents).

Table 33–4 – 2063 two-way truck movements

Vehicle type	2063 Annual movements	2063 Daily movements	2063 Hourly movements	2063 Car equivalents per hour
Heavy Rigid Truck (12.5 metres long)	112,603	308.50	12.85	25.71
Semi-Trailer (19 metres long)	13,534	37.08	1.54	4.63
B-Double (23 -26 metres long)	3,867	10.59	0.44	2.21

It is anticipated that a fuel pipeline to the proposed airport would be completed by 2063, which would significantly reduce the number of B-double movements each day compared to similar assumptions for the Stage 1 development. This is reflected in Table 33–4.

33.3.4. Total airport traffic generation estimate

A total airport trip generation for 2063 has been calculated using the totals for passengers, employees and freight provided in the previous sections. Table 33–5 presents the results divided into representative two hour periods, with a 24 hour total.

Table 33–5 – Total modelled traffic to / from the proposed airport in 2063

	AM Peak 2 hour	Interpeak 2 hour	PM Peak 2 hour	Evening 2 hour	24 Hour
Accessing Airport					
Passengers	8,034	7,969	8,351	7,345	66,504
Airport Workers	4,141	1,499	571	2,748	17,739
Freight (TNR)	26	79	39	171	834
Total (Accessing)	**12,201**	**9,547**	**8,962**	**10,263**	**85,077**
Egressing from Airport					
Passengers	7,887	8,121	8,071	7,342	66,385
Airport Workers	0	1,237	3,094	3,240	18,072
Freight (TNR)	26	79	39	171	834
Total (Egressing)	**7,914**	**9,437**	**11,205**	**10,753**	**85,291**

Note: TNR – The Northern Road

33.3.5. Background traffic growth

As a result of existing and future planned developments in the Western Sydney region, there is expected to be considerable development growth in the coming years: Examples include:

- South West Priority Growth Area;
- Western Sydney Employment Area;
- Greater Macarthur Investigation Area;
- proposed Western Sydney Airport; and
- smaller growth centres.

In the context of these development areas, Figure 33-12 provides a summary of vehicles generated in the vicinity of the proposed airport and shows the potential growth to 2063. The data in Figure 33-12 assumes that the proposed South West Rail Link Extension from Leppington to St Marys via the airport site is operational.

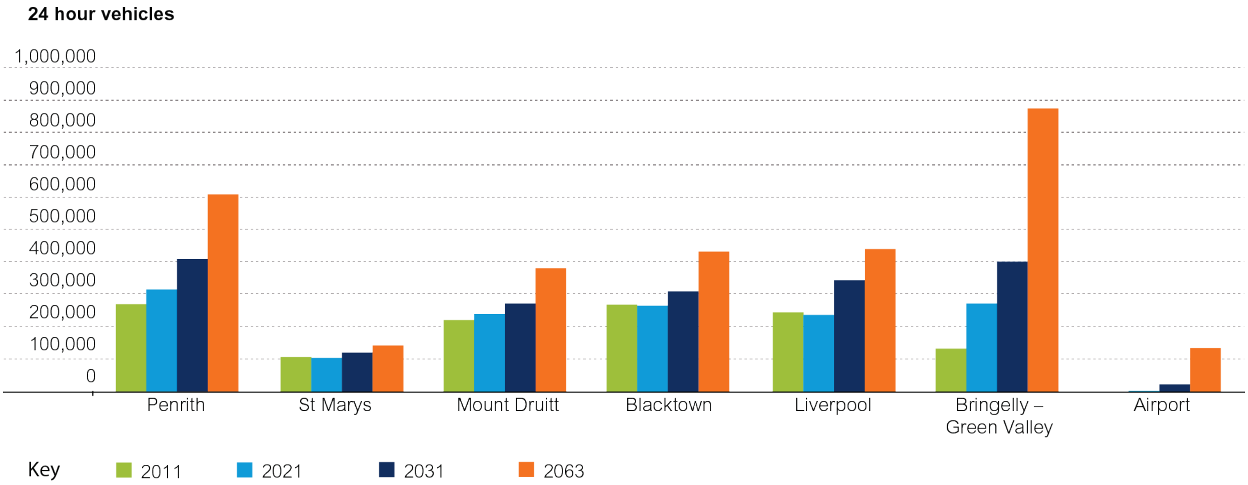


Figure 33-12 – Vehicle movements originating in the vicinity of the airport site (24 hour)

Figure 33-12 illustrates that the proposed airport represents a very small component of overall trip demand in 2031, but this would increase substantially from 2031 to an expected 130,000 trips in each direction by 2063. This would however occur in the context of much larger growth in other areas, particularly the Greater Macarthur Investigation Area (Bringelly/Green Valley).

33.3.6. Effect on network performance

As noted in Section 37.4.4, the long term operation of the proposed airport would be expected to result in 85,077 vehicles accessing the airport site each day, with 85,291 vehicles leaving the airport site.

Table 33–6, Figure 33-13 and Figure 33-14 show the 2063 network conditions for the Do Minimum and With Airport assessment scenarios, for the respective AM and PM peak periods. With or without the proposed airport, the road network is forecast be considerably congested by 2063. The assessment indicates that:

- the M4, M5 and M7 motorways have high volume/capacity ratios in both peak periods in both directions;
- Bringelly Road is congested eastbound in the AM peak and westbound in the PM peak; and
- Narellan Road is considerably more congested than in 2031.

When the expected level of traffic associated with the proposed airport is added to the network in 2063, the following additional effects would be expected:

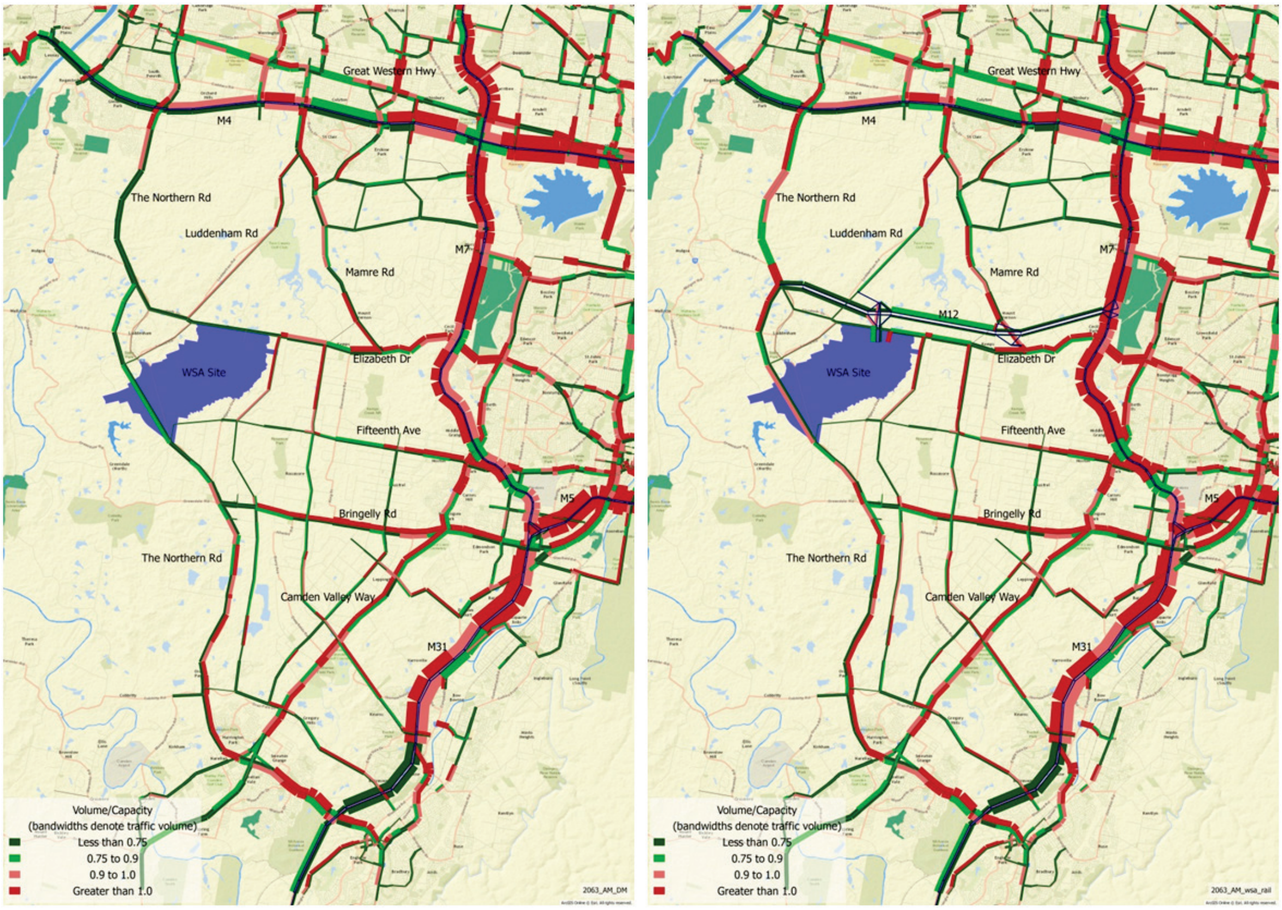
- north-south links between Elizabeth Drive and Fifteenth Avenue would be more congested with the proposed airport, rising to LoS F in both peak periods;
- The Northern Road would carry more traffic with the proposed airport and M12 Motorway in place, approximately 1000 vehicles per hour in the PM peak, north of the intersection with the M12 Motorway. By 2063, with the proposed airport, it would reach capacity;
- The M12 Motorway would form an important link to alleviate congestion on Elizabeth Drive and would continue to have spare capacity in 2063; and
- The M4 Motorway would show a lower LoS in certain sections as a result of diversion to the M12 Motorway.

Table 33–6 – Level of Service for 2063 With and Without Western Sydney Airport

Id	Road	Location	Do Minimum				With Airport			
			AM Peak		PM Peak		AM Peak		PM Peak	
			Nbd/Ebd	Sbd/Wbd	Nbd/Ebd	Sbd/Wbd	Nbd/Ebd	Sbd/Wbd	Nbd/Ebd	Sbd/Wbd
1	The Northern Road	North of Elizabeth Drive	C	C	C	C	F	F	E	E
2	The Northern Road	South of M4	F	D	D	F	F	D	F	F
3	The Northern Road	South of Bringelly Road	D	C	C	F	E	D	D	F
4	M4	West of Mamre Road	F	E	E	F	F	D	E	F
5	M4	West of M7	F	E	D	F	F	E	D	F
6	M7	South of M4	F	F	F	F	F	F	F	F
7	M7	South of Elizabeth Drive	F	E	D	F	F	F	E	F
8	M5	East of M7	F	F	F	F	F	F	F	F
9	M31	South of Campbelltown Road	F	F	F	F	F	F	F	F
10	Narellen Road	North of Tramway Drive	F	F	F	E	F	F	F	E
11	Bringelly Road	West of Cowpasture Road	F	D	D	F	F	D	D	F
12	Cowpasture Road	At M7	F	F	E	F	F	F	E	F
13	Elizabeth Drive	East of M7	F	F	E	E	F	F	F	F
14	Elizabeth Drive	West of M7	F	E	D	F	F	D	D	D
15	Elizabeth Drive	West of Mamre Road	F	C	C	F	F	C	C	E
16	Elizabeth Drive	East of the Northern Road	C	A	A	C	B	A	A	A
17	Mamre Road	North of Elizabeth Drive	F	C	C	F	F	F	D	F
18	Mamre Road	South of M4	F	F	F	E	F	F	F	E
19	Luddenham Drive	West of Mamre Road	F	C	C	F	F	F	D	F
20	Lawson Road	South of Elizabeth Drive	F	A	B	F	F	C	C	F
21	Western Road	South of Elizabeth Drive	F	B	C	F	F	C	C	F
22	Fifteenth Avenue	West of Cowpasture Road	F	B	B	E	F	B	B	E
23	M12	West of M7	-	-	-	-	B	A	A	C

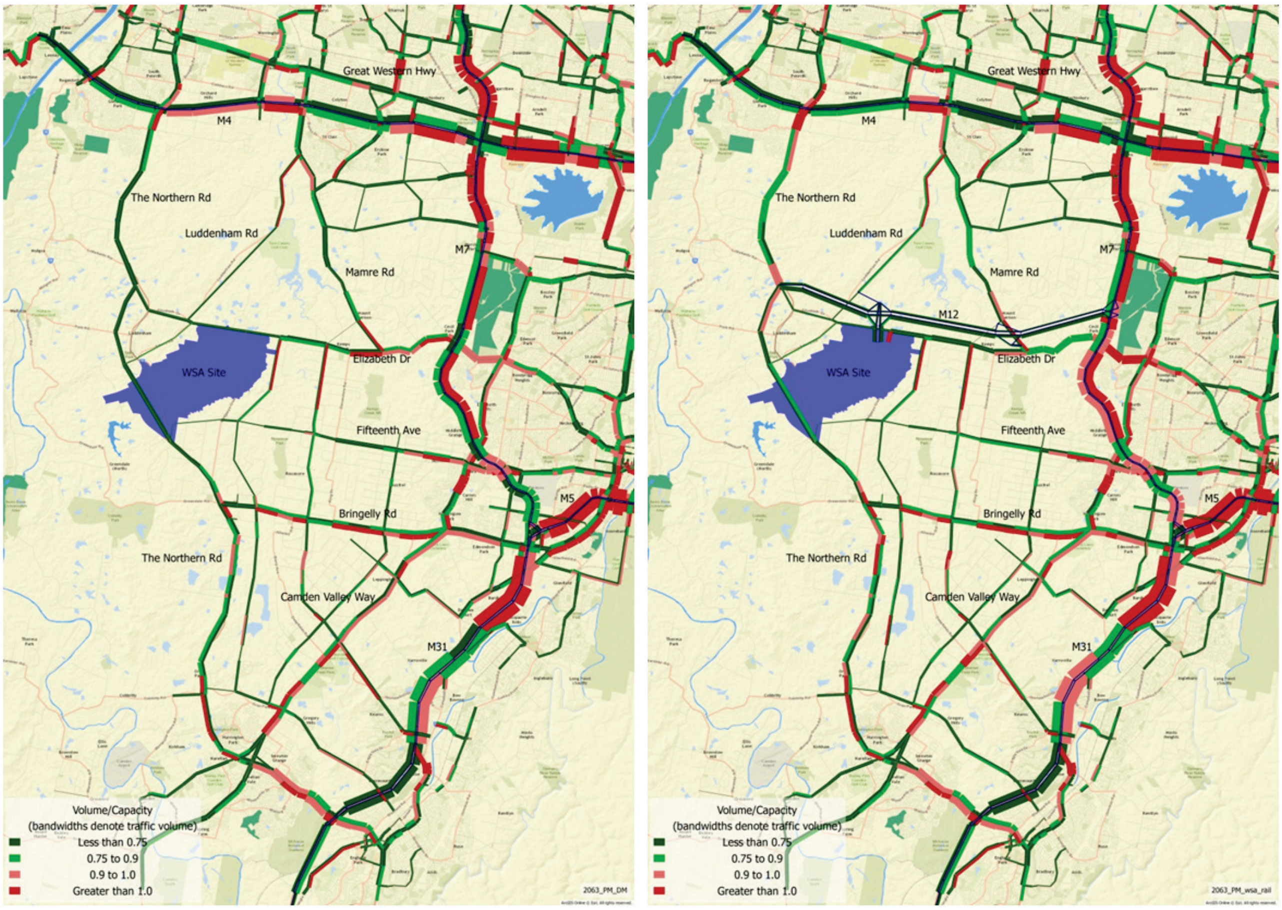
Id	Road	Location	Do Minimum				With Airport			
			AM Peak		PM Peak		AM Peak		PM Peak	
			Nbd/Ebd	Sbd/Wbd	Nbd/Ebd	Sbd/Wbd	Nbd/Ebd	Sbd/Wbd	Nbd/Ebd	Sbd/Wbd
24	M12	West of Mamre Road	-	-	-	-	D	A	A	C
25	M12	East of The Northern Road	-	-	-	-	C	C	A	C

Note: Improvements are indicated in **green bold**. Deteriorations are indicated in **red bold**.



Note: Volume/capacity ratio bandwidth definitions are outlined in Table 33–1

Figure 33-13 – 2063 AM Peak Volume/Capacity – Do Minimum (Left), with Proposed Airport (Right)



Note: Volume/capacity ratio bandwidth definitions are outlined in Table 33–1

Figure 33-14 – 2063 PM Peak Volume/Capacity – Do Minimum (Left), with Proposed Airport (Right)

33.4. Considerations for future development stages

Table 15-9 in Chapter 15 (Volume 2) sets out the broad mitigation/management measures that are proposed to address the potential transport impacts associated with construction and operation of the Stage 1 development. These measures would also generally apply to the progressive development of the long term development.

The trips that would be generated by the operation of the initial operation of the proposed airport would be largely addressed by the substantial package of road improvements proposed as part of the Western Sydney Infrastructure Plan, in addition to those identified in the Western Sydney Employment Area and the South West Priority Growth Area.

In the long term, additional transport infrastructure, including the South West Rail Link extension, would be needed to address projected travel demand associated with the proposed airport and surrounding urban development. Integral to achieving this will be detailed and early planning to preserve necessary corridors and identify the necessary infrastructure upgrades to cater for the expected population and development growth associated with the proposed airport and related development.

33.5. Summary of findings

The proposed operation of the long term development is expected to result in 85,077 vehicles accessing the airport site each day, with 85,291 leaving the airport site. These additional trips would be generated in the context of substantial urban growth in Western Sydney, particularly the development of the Greater Macarthur Investigation Area.

Travel demand generated by the proposed airport and the substantial forecast development growth in Western Sydney would have a significant combined effect on the road and public transport systems. Additional transport infrastructure, including the South West Rail Link extension, would be needed to address projected travel demand.

Long term operation of the proposed airport would be reliant on the introduction of the South West Rail Link extension after 2031. Even with the South West Rail Link extension in operation, the assessed increases in demand for 2063 show that detailed planning would be required to preserve additional corridors and transport upgrades to cater for the population and development growth associated with the proposed airport and surrounding urban development.

34. Surface water and groundwater

34.1. Introduction

This chapter provides an analysis of the surface water and groundwater resources affected by the indicative long term development of the proposed airport. It draws on technical assessments of hydrology and geomorphology (Appendix L1), surface water quality (Appendix L2) and groundwater (Appendix L3) in Volume 4. The assessment contained in this chapter builds on the assessment of impacts associated with the Stage 1 development (refer Chapter 18).

34.2. Methodology

A range of quantitative and qualitative assessment approaches were adopted to consider the impact of the proposed airport on surface and groundwater resources at the airport site.

Predictive models were used to consider the impact of the change in landform characteristics on runoff volumes and the subsequent impacts on stream flow, flooding, groundwater recharge and water quality. Potential impacts on the environmental values and beneficial uses of surface and groundwater resources were identified, and options for future management practices were considered as part of the assessment.

Full assessment methodologies are described in the respective technical papers presented in Appendix L. A summary of the regulatory and policy settings relevant to the management of water resources at the airport site is presented in Chapter 18.

The hydrologic, hydraulic and water quality models used in the assessment include representations of the drainage system incorporated into the concept design of the indicative long term development. This drainage system would comprise a series of channels and basins to direct and contain flows prior to discharge (refer Figure 34-1).

The drainage system would be largely constructed during the Stage 1 development and would be expanded to cater for the long term development. Notably, the capacity of the basins would be increased and an additional basin would be established in the south-west of the site.

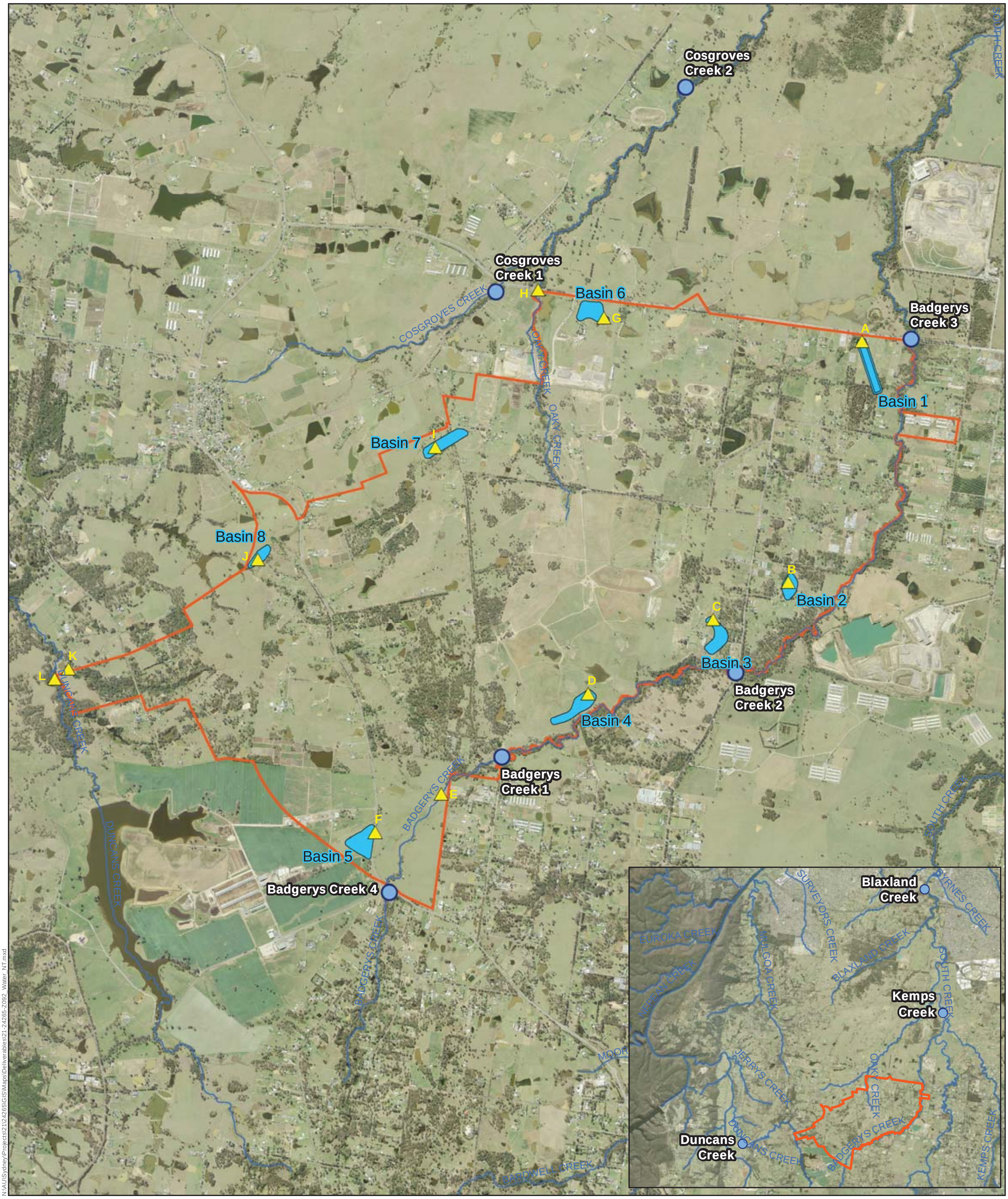
The basins would be situated at key locations where surface water flows off the airport site, and would be designed to release water at controlled velocities. The basins would also have the effect of improving the quality of the surface water prior to release to receiving waters.

The results of the models were analysed to identify impacts on waterways, people and property and thereby assess the effectiveness of the drainage system. The drainage system has been designed to contain flows up to the 100 year average recurrence interval (ARI) event.

The capacities of the basins to store surface water flows are presented in Table 34–1.

Table 34–1 – Indicative detention basin attenuation volumes

Basin	Volume (kilolitres)	Discharge
Basin 1	80,000	Badgerys Creek
Basin 2	27,000	Badgerys Creek
Basin 3	53,000	Badgerys Creek
Basin 4	82,000	Badgerys Creek
Basin 5	65,000	Badgerys Creek
Basin 6	75,000	Oaky Creek
Basin 7	82,000	Oaky Creek (via tributary)
Basin 8	41,000	Duncans Creek (via tributary)



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

LEGEND

- Airport site
- Watercourses
- Detention ponds
- Hydrology assessment reporting locations
- Water quality sampling sites
- Watercourses

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0 0.25 0.5 1
Kilometres

N

Figure 34-1 - Surface water drainage system and sample sites

34.3. Existing environment

The airport site lies in the north-east of the Hawkesbury-Nepean catchment and contains 64 kilometres of watercourses. The main watercourses at the airport site are Badgerys Creek, Cosgroves Creek and Duncans Creek. Other tributaries include Oaky Creek and a number of unnamed drainage lines and depressions. Clearing, agriculture and the construction of in-stream dams have affected the physical stability of the creeks and drainage channels, with bank erosion evident on the major watercourses despite their having well vegetated riparian zones.

Existing surface water flows at the airport site during one and 100 year ARI storms were simulated in hydrologic and hydraulic models. In the one year ARI event, flooding is mostly confined to main watercourse channels and dams, while considerable out-of-bank flooding is expected in a 100 year ARI event.

Water quality modelling simulations at locations in and around the airport site indicate that water quality is relatively degraded, with high nutrient levels that are attributable to existing land uses at the airport site and broader catchment. These results are consistent with surface water quality sampling at the airport site and prior data (PPK 1997; SMEC 2014).

Groundwater at the airport site is generally of poor quality, with limited beneficial use or environmental value. The aquifers at the airport site include:

- shallow alluvium of the main watercourses at the airport site;
- weathered clays overlying the Bringelly Shale (intermittent);
- an aquifer within the Bringelly Shale; and
- an aquifer within the Hawkesbury Sandstone.

The varying respective depths of the each aquifer and their limited hydraulic conductivity mean there is low potential for connectivity between groundwater systems or surface water interaction.

Groundwater bores in the vicinity of the airport site are understood to target the Hawkesbury Sandstone aquifer. This aquifer is significantly deeper than the other aquifers at the airport site.

A more detailed description of the existing environment of the airport site and surrounding area with regard to surface water and groundwater is presented Chapter 18.

The implementation of the Stage 1 development would transform the northern portion of the airport site from a rolling grassy and vegetated landscape to an essentially built environment. These changes would alter the catchment areas within the airport site and the permeability of the ground surface, which in turn would alter the duration, volume and velocity of surface water flows. The baseline environmental conditions for the long term development would therefore be representative of already modified environmental conditions.

34.4. Assessment of impacts during operation

34.4.1. Watercourses and flooding

The long term development would modify the topography and permeability of catchment areas within the airport site. These changes would affect site run-off and receiving water flow patterns and increase the potential for flooding. The long term development would also involve the removal of watercourses. The total length of watercourses that would be removed is approximately 20 kilometres, the majority being minor drainage lines and valley fills with less defined channels. It is anticipated that Badgerys Creek would be preserved along the south-eastern boundary of the airport site.

The concept design of the long term development includes expanding the drainage system to control the flow of surface water (refer Table 34–1). The assessment considers the effectiveness of this system in avoiding potential impacts on waterways, people and property.

A summary of changes to catchment areas as a result of the long term development is provided in Table 34–2. The long term changes to catchment areas and impervious surfaces are based on comparison with existing conditions, and incorporate the persistent effects of the Stage 1 development and the progressive implementation of the long term development.

Table 34–2 – Catchment area comparison

Location	Catchment area (existing)	Catchment area (long term)	Impervious area (existing)	Impervious area (long term)
Badgerys Creek at Elizabeth Drive	2052 ha	2394 ha ↑	12%	↑30%
Oaky Creek at Elizabeth Drive	361 ha	289 ha ↓	10%	↑53%
Cosgroves Creek at Elizabeth Drive	536 ha	600 ha ↑	14%	↑29%
Badgerys Creek at South Creek	2799 ha	2831 ha ↑	12%	↑27%
Cosgroves Creek at South Creek	2163 ha	2142 ha ↓	14%	↑24%
Duncans Creek at Nepean River	2379 ha	2360 ha ↓	14%	↑17%

The long term development would result in substantial increases in impervious areas and modification to sub-catchment flows within the airport site. An increase in catchment area or impervious surfaces would typically increase runoff volumes and the timing of peak flows at the airport site.

The proposed drainage system has been designed to mitigate the increased runoff associated with the altered catchment conditions at the airport site. As a result, modelling of stream flows indicates that duration, volume and velocity of surface water flows in watercourses would generally be similar or reduced when compared to existing flow conditions.

Hydrology and flooding in and around the airport site during the one year ARI and 100 year ARI storms was simulated using hydrologic and hydraulic models. Peak flow rates for a range of reporting locations are summarised in Table 34–3, and demonstrate the basins are generally effective in restricting the peak flows to the equivalent of, or less than, existing flows. Flood extents and depths for a one year ARI and 100 year ARI storm event show minimal change from the existing catchment characteristics. No changes to flood levels are expected to occur at dwellings or other infrastructure surrounding the airport site.

Increased stream depths of up to 100 mm may occur at Cosgroves Creek, and up to 250 mm in limited reaches of its tributary, Oaky Creek. These changes have the potential to affect the physical stability of watercourses through bed or bank erosion, particularly at Oaky Creek.

Localised changes in flow duration, volume and velocity would be expected at locations where basins release surface water. These basin outlets would be designed to avoid the associated potential impacts of localised scour and erosion.

Table 34–3 – Peaks flows at the airport site with long term development

Location	Basin	1 year ARI peak flows (m^3/s)			100 year ARI peak flows (m3/s)		
		Existing	Basin inflow	Outflow	Existing	Basin inflow	Outflow
Location A	Basin 1	8.4	10.8	8.0	33.5	72.8	29.9
Location B	Basin 2	1.9	2.3	1.7	8.2	15.6	5.1
Location C	Basin 3	3.2	5.0	2.6	12.9	33.2	8.8
Location D	Basin 4	2.3	8.8	5.3	9.1	58.1	17.3
Location E/F	Basin 5	6.5[a]	3.5	2.6[b]	26.3[a]	23.1	7.6[b] 3.9
Location G/H	Basin 6	8.9[d]	8.4[c]	6.8[c] 8.4[d]	37.6[d]	56[c]	24.6[c] 30.7[d]
Location I	Basin 7	4.1	6.9	4.2	16.5	46.2	12.4
Location J	Basin 8	3.3	3.7	2.2	10.9	24.9	7.3
Location K	–	2.1	–	2.0	9.6	–	13.3
Location L	–	4.6	–	4.2	19.8	–	18.0

[a] Location E

[b] Location F

[c] Location G

[d] Location H

34.4.2. Surface water quality

Existing surface water quality was modelled at upstream, downstream and major outflow locations in and around the airport site. The model results show that actual pollutant concentrations would decrease at most downstream locations (see Table 34–4). The reduction in pollutant concentrations is a function of their dilution in surface water flows leaving the airport site. The volume of surface water flows leaving the airport site would increase in proportion to changes in catchment areas and increases in impervious surfaces at the airport site. Despite the long term development leading to general improvements in pollutant concentrations locally and regionally, the improvements would not be sufficient to meet ANZECC guidelines.

Notwithstanding the general decrease in pollutant concentrations, the indicative long term development would result in increased loads of phosphorous and nitrogen. The increase in pollutant loads would also be a function of the increased surface water flows leaving the airport site. Increases in phosphorous and nitrogen loads would be most pronounced at basin outlets where surface water flows leave the airport site. Relative increases in loads, as a proportion of existing conditions, would decrease progressively downstream of the airport site as surface water flows are received from the wider catchment. Though loads would be volumetrically higher, actual pollutant concentrations would be generally improved compared with existing water quality conditions.

The operation of the proposed airport would involve the use of a range of fuels and chemicals. These substances may be released to the environment in the event of a mishap during refuelling, maintenance or general storage and handling.

Releases would be avoided with the implementation of Australian Standards for the storage and handling of hazardous materials. In the unlikely event of a significant leak or spill of contaminants, remediation would be implemented as soon as practicable.

Table 34–4 – Surface water quality at the airport site

	Existing (mg/L)			Long term development (mg/L)		
Location	Suspended solids	Phosphorous	Nitrogen	Suspended solids	Phosphorous	Nitrogen
ANZECC criteria	**40**	**0.05**	**0.5**	**40**	**0.05**	**0.5**
Basin 1	22.1	0.14	1.54	↓12.4	↓0.11	↓0.90
Basin 2	22.1	0.09	1.25	↓14.7	↑0.11	↓0.96
Basin 3	21.9	0.09	1.26	↓10.5	↑0.11	↓0.84
Basin 4	20.7	0.38	2.91	↓8.24	↓0.12	↓0.78
Basin 5	23.0	0.17	1.72	↓13.2	↓0.11	↓0.94
Basin 6	22.5	0.15	1.60	↓7.43	↓0.12	↓0.77
Basin 7	22.3	0.14	1.46	↓10.9	↓0.12	↓0.83
Basin 8	23.2	0.13	1.51	↓12.8	↓0.11	↓0.92
Badgerys Creek 1	21.5	0.14	1.47	↓14.4	↓0.11	↓1.02

	Existing (mg/L)			Long term development (mg/L)		
Location	Suspended solids	Phosphorous	Nitrogen	Suspended solids	Phosphorous	Nitrogen
Badgerys Creek 2	21.8	0.15	1.54	↓11.4	↓0.12	↓0.93
Badgerys Creek 3	21.9	0.14	1.53	↓12.0	↓0.12	↓0.94
Cosgroves Creek 1	22.7	0.14	1.54	↓11.0	↓0.12	↓0.91
Duncans Creek	10.3	0.06	0.70	↑13.6	↑0.11	↑0.98
Kemps Creek	20.9	0.13	1.34	↓13.2	↓0.12	↓0.98
Blaxland Creek	20.8	0.12	1.31	↓13.4	0.12	↓0.97

34.4.3. Reclaimed water irrigation

An estimated 14.4 ML of domestic wastewater per day would be generated during operation of the long term development. The wastewater may be treated and recycled through irrigation at the airport site, or transferred to an offsite sewage treatment system.

Specific treatment and irrigation methods would be determined during detailed design. Wastewater treatment at the airport site would be expected to utilise membrane biological reactor technology, which produces high quality reclaimed water suitable for beneficial reuses including irrigation.

The key risks to surface water and groundwater associated with the irrigation of reclaimed water would be runoff to surface water, or infiltration to groundwater. These risks would be limited in the first instance because the reclaimed water would be relatively high quality. Runoff would be avoided because the irrigation scheme would be optimised to prevent excessive irrigation.

34.4.4. Groundwater

The long term development would have the potential to affect groundwater conditions through changes to groundwater recharge, groundwater drawdown and impacts on groundwater quality.

Groundwater drawdown would be anticipated as a result of airport site re-profiling and dewatering of excavations beneath the water table. The re-profiling would result in a lowering of groundwater levels in areas that currently have higher topographical elevation, and is anticipated to result in a slight reduction in groundwater flow rates. The re-profiling would not result in dewatering of the groundwater system below the level of the surrounding creeks, and there would be no potential for drying up of the creeks from this activity.

The peripheries of the re-profiled area and establishment of basement levels in terminal buildings would result in exposed cuttings that would seep and require dewatering and management. Seepage volumes would be relatively small as a result of the inherent low hydraulic conductivities in the local geology.

Overall there is anticipated to be minimal change to local groundwater recharge or drawdown associated with the long term development of the site. The minor modification to groundwater conditions is not anticipated to result in impacts on any sensitive ecological receptors or beneficial uses of the groundwater system.

Groundwater seepage into building basements would need to be managed by pumping any seepage to stormwater management facilities or other suitable treatment systems. Chemicals of concern in groundwater seepage include total dissolved solids, metals, total nitrogen, phosphorus and sulphate. Significant groundwater inflows to underground infrastructure would not be expected and would be controlled, if necessary, through the use of lining or other engineering controls.

The operation of the proposed airport would involve the use of a range of fuels and chemicals. These substances may be released to the environment in the event of a mishap during refuelling, maintenance or general storage and handling.

Releases would be avoided with the implementation of Australian Standards for the storage and handling of hazardous materials. In the unlikely event of a significant leak or spill of contaminants, remediation would be implemented as soon as practicable.

Groundwater bores in the vicinity of the airport site are understood to target the Hawkesbury Sandstone aquifer. Direct impacts on this aquifer are not predicted as a result of the construction of the proposed airport. As such, there are no impacts during the long term development predicted to groundwater bore users.

34.5. Considerations for future development stages

Measures to manage potential impacts on surface water and groundwater would be similar to those implemented for the Stage 1 development, being adjusted or expanded as necessary according to the detailed assessment which would be undertaken for the long term development. Some of the key proposed measures include:

- investigation and refinement of the surface water drainage system, including outlet structures, during detailed design to improve flood and water quality performance as far as practicable;
- implementation of erosion controls in line with industry practice at the time of construction;
- design and operation of waste water treatment and reclaimed water reuse scheme in accordance with relevant guidelines at the time of operation, or transport of waste water off site and treatment within the Sydney Water system;
- regular inspection and maintenance of the surface water drainage system to ensure all components are functioning as designed;
- implementation of standards for storage and handling of fuels or chemicals with the potential to contaminate surface water or groundwater; and
- baseline and ongoing monitoring of surface water and groundwater.

Water quality matters associated with the proposed airport would also be regulated under the Airports (Environment Protection) Regulations or equivalent legislation in place at the time.

34.6. Summary of findings

The long term development would transform the southern portion of the airport site from a rolling grassy and vegetated landscape to an essentially built environment. These changes would alter the catchment areas within the airport site and the permeability of the ground surface, which in turn would alter the duration, volume and velocity of surface water flow. The long term development would generally represent a continuation of the impacts identified for the Stage 1 development.

Hydrologic and hydraulic modelling of the airport site during operation indicates that there is a degree of variation in how the drainage system would respond to different storm events. The drainage system would generally be effective at mitigating watercourse and flooding impacts; however, refinement of the drainage system would occur during the detailed design.

Minor alterations to local groundwater recharge and drawdown are anticipated to occur at the airport site, along with the need for minor dewatering as a result of the establishment of building basements. Changes to groundwater conditions at the airport site are anticipated to be minor and are not expected to impact any sensitive ecological receptors or beneficial uses of the groundwater system.

35. Planning and land use

35.1. Introduction

This chapter assesses the planning and land use impacts of the indicative long term development of the proposed airport.

Planning undertaken by governments over the last three decades for land use change, including for the South West Priority Growth Area and the Western Sydney Employment Area, has taken into account the likely impacts of the proposed airport.

This assessment builds upon previous studies and considers how the proposed airport would affect rural, agricultural, employment and recreational lands. Development controls have been considered for the management of aircraft safety, noise, lighting and air quality impacts from airport operations at the proposed airport. The need for local traffic and transport improvements has been identified, and considerations for future land acquisition have been recommended.

For this chapter, the long term development of the proposed airport is assumed to occur in progressively staged increments beyond 2030. The baseline position, for the purposes of considering the "existing environment" and therefore the impact of the long term development, is an airport catering for approximately 10 million annual passengers (Stage 1 development).

35.2. Methodology

A specialist report on planning and land use impacts of the proposed airport was prepared for this EIS (refer Appendix N in Volume 4). The broad methodology adopted for the preparation of the assessment included:

- inspection and analysis of the key characteristics of the airport site and surrounding land;
- review of existing Commonwealth and NSW legislation applying to the airport site and surrounding land;
- review of strategic land use plans relevant to the airport site and surrounding land to identify NSW Government objectives for development of the area;
- consultation with planning staff in local councils in the vicinity of the airport site to confirm applicable land use plans, policies and assessment considerations;
- review of relevant sections of other technical reports prepared for the draft EIS;
- assessment of the likely impacts of the airport proposal on surrounding land uses; and
- recommendations for mitigation measures to reduce the impacts of the proposed development.

35.3. Existing environment

35.3.1. Airport site

Existing rural residential and agricultural land uses on the airport site would be discontinued and replaced by the Stage 1 development.

Badgerys Creek flows along the southern and eastern boundary of the airport site, and Oaky Creek originates in the centre of the site and flows northwards. Both creeks drain to South Creek and the Hawkesbury River.

The airport site is contained within the Cumberland Plain Mitchell Landscape. This landscape comprises low rolling hills and valleys in a rain shadow area between the Blue Mountains and the coast. Vegetation is characterised by grassy woodlands and open forest dominated by Grey Box (*Eucalyptus moluccana*) and Forest Red Gum (*Eucalyptus tereticornis*) and poorly drained valley floors with forests of Cabbage Gum (*Eucalyptus amplifolia*) and Swamp Oak (*Casuarina glauca*).

Vegetation within the construction impact zone for the Stage 1 development would have been removed, although vegetation in the remainder of the airport site would be retained until the area is required for future use. Local roads within the airport site would be decommissioned following the Stage 1 development in preparation for the long term development. Following the Stage 1 development, the major roads in the vicinity of the site would be:

- The M12 Motorway – linking M7 (Westlink) Motorway and The Northern Road; and
- The Northern Road – which would be realigned to the west of the airport site.

35.3.2. Surrounding land

The airport site is located within Liverpool Local Government Area (LGA), with the northern airport site boundary coinciding with the Penrith LGA. Beyond the immediate LGAs, Blue Mountains LGA lies to the west; Wollondilly, Camden and Campbelltown LGAs lie generally to the south; and Bankstown, Fairfield and Blacktown LGAs lie generally to the east of the airport site.

Following the implementation of the strategic plan for the South West Priority Growth Area and the Western Sydney Employment Area, the existing rural character of the land surrounding the airport site will have transitioned to urban use.

35.4. Land use planning and regulation

35.4.1. Australian Government

35.4.1.1. Legislation and regulation

Under current law, the long term development stages of the proposed airport would continue to require approval under the Airports Act (refer to Chapter 3 Volume 2 for further discussion on how Commonwealth legislation applies to the airport development).

The airport master plan and environment strategy would also be revised every five years. The specific regime which applies to the long term development would depend on the nature of that development, and the long term planning would need to have regard to the Airports Act and any master plan.

Australian Standard *2021:2015 – Acoustics – Aircraft noise intrusion – Building siting and construction* (Australian Standard 2015) would continue to provide guidance on the siting and construction of buildings in the vicinity of airports to minimise aircraft noise intrusion. The guidance provided by AS 2021 is based on the level of potential aircraft noise exposure at a given site using the Australian Noise Exposure Forecast (ANEF) system.

35.4.1.2. National Airport Safeguarding Framework

The National Airports Safeguarding Framework (NASF) is a national land use planning framework agreed to by Commonwealth, State and Territory Transport and Infrastructure Ministers in 2012. The NASF recognises that responsibility for land use planning rests with State, Territory and local governments, but that a national approach can assist in improving planning outcomes on and near airports and flight paths.

The framework aims to:

- improve safety outcomes by ensuring aviation safety requirements are recognised in land use planning decisions;
- improve community amenity by minimising noise sensitive developments near airports including through the use of additional noise metrics; and
- improve aircraft noise disclosure (public notification) mechanisms.

The NASF would be integral to safeguarding operations at the proposed airport into the future, as it expands in stages over the long term.

35.4.2. NSW Government

35.4.2.1. Legislation

The NSW planning legislative framework consists primarily of the *Environmental Planning and Assessment Act 1979* (the EP&A Act) and the Environmental Planning and Assessment Regulation 2000. Within this structure are the following three key instruments:

- State environmental planning policies (SEPPs) – these policies outline the NSW Government's approach to dealing with more specific planning issues. They can be either site or issue specific, and may control land zoning and development controls, or ensure the establishment of a development process;
- local environmental plans (LEPs) – each LGA has a LEP to guide development and protect natural resources within LGAs. LEPs are prepared by local councils; and
- local planning directions – issued by the Minister for Planning under section 117 of the EP&A Act, these provide direction on matters which planning proposals need to address.

Relevant provisions would need to be maintained and revised in applicable NSW environmental planning instruments for development surrounding the proposed airport, to continue to safeguard airport operations, and protect the safety and amenity of surrounding residents and employees.

35.4.2.2. Strategic documents

South West Priority Growth Area

The South West Priority Growth Area is located directly to the south-east and east of the airport site, with Badgerys Creek as the border. The area is about 17,000 hectares in size and incorporates land in Liverpool, Camden and Campbelltown LGAs. The South West Priority Growth Area will provide 110,000 new dwellings and capacity for at least 22,000 jobs over the long term. The proposed extension of the South West Rail Link from Leppington to the proposed airport and further north to the Western Line would also pass through the South West Priority Growth Area. The area directly south and south-east of the airport site is identified in the South West Priority Growth Area Structure Plan as future industrial and employment lands.

Western Sydney Employment Area

The NSW Government established the Western Sydney Employment Area (WSEA) to provide businesses in Western Sydney with land for industry and employment generating uses, including transport and logistics, warehousing and commercial office space. In January 2015, the WSEA SEPP was amended to extend the boundaries to include land next to the airport site (known as the Western Sydney Employment Area Extension). The Western Sydney Employment Area amendment allows for even closer links between employment generating land uses and the proposed airport. The amendment identifies a further 4,573 hectares of land for future employment uses. The Western Sydney Employment Area is expected to accommodate more than 36,000 industrial jobs and 21,000 office jobs over the next 30 years.

35.5. Assessment of impacts during operation

Having regard to the existing environment, strategic planning at the local and regional scale, and the scope of the proposal, the following likely impacts on land use and planning from the proposed airport have been identified.

35.5.1. Land use impacts

35.5.1.1. Rural residential and agricultural lands

As the proposed airport continues to develop in incremental stages beyond 2030, (following the implementation of strategic planning for the South West Priority Growth Area and the Western Sydney Employment Area) much of the existing rural residential and agricultural lands that surround the airport site are likely to have transitioned to alternative land uses. Given the likely absence of rural residential land use by the time the long term airport would be in operation, impacts on rural residential land from either the construction or operation of the indicative long term development would likely be minimal.

35.5.1.2. Employment lands

The continued expansion of the proposed airport development following the Stage 1 development would continue to support the development of the adjacent South West Priority Growth Area employment lands. The proposed airport would be a mutually beneficial land use, creating demand for employment generating activities and providing transport infrastructure required for freight and logistics.

The draft Land Use Plan (part of the draft Airport Plan) identifies land use zones for retail and commercial development within the airport site. While specific businesses activities are yet to be confirmed, the impacts of these proposals on the proposed airport and surrounding lands would be considered in accordance with the provisions of the Airports Act.

35.5.1.3. Recreational lands

On the basis of the indicative aircraft flight paths outlined in this report, visual and noise impacts would result at the following recreational reserves:

- to the north – Twin Creeks Country Club, Ropes Creek Reserve (Erskine Park), Eastern Creek Raceway, Sydney International Equestrian Centre (Horsley Park), Western Sydney Parklands (Horsley Park), and Calmsley Hill City Farm (Abbotsbury); and
- to the south – Sales Park (Luddenham), Bent Basin State Conservation Area (Greendale), and Burragorang Recreation Area (Silverdale).

Actual impacts sustained as a result of the future airport would depend on the final flight paths developed prior to Stage 1 operation by Airservices Australia.

Long term noise modelling (see Chapter 31) identifies potential noise impacts on these locations. While long term operations may have impacts on the amenity of these sites, impacts on recreational lands are not currently addressed under AS2021.

Impacts on the Greater Blue Mountains World Heritage Area are assessed in Chapter 40.

35.5.2. Airport operations

35.5.2.1. Airspace development controls

During the development of Stage 1, Obstacle Limitation Surfaces (OLS) and the Procedures for Air Navigation Systems Operations Surface (PANS-OPS) would be identified for the proposed airport as part of ongoing operations planning.

For long term operations, it is anticipated that the Department of Infrastructure and Regional Development would liaise with NSW Department of Planning and Environment and relevant local councils to adopt the necessary additional OLS and PANS-OPS guidelines in applicable environmental planning instruments. This would ensure future development does not impede safe aircraft operations for the expanded airport operations.

35.5.2.2. Aircraft noise

Over the long term development of the airport, land use changes resulting from the South West Priority Growth Area and Western Sydney Employment Area would have largely provided a buffer to sensitive land uses.

Aircraft noise impacts are measured using the ANEF measure. Table 35–1 identifies the recommended development types within ANEF zones, as outlined in the AS2021. The noise technical report prepared for the draft EIS (see Appendix E1) provides Australian Noise Exposure Concept (ANEC) contour maps which use indicative data on aircraft types, aircraft operations and flight paths to forecast the aircraft noise levels that would be expected as a result of the proposed airport operations. Final ANEF contours will not be produced until subsequent regulatory processes have been undertaken, including the preparation of a plan for aviation airspace management that would detail final airspace management arrangements.

Table 35–1 – Building site acceptability based on ANEF zone (AS 2021)

Building type	ANEF zone		
	Acceptable	Conditionally acceptable	Unacceptable
House, home unit, flat, caravan park	Less than 20 ANEF	20 to 25 ANEF	Greater than 25 ANEF
Hotel, motel, hostel	Less than 25 ANEF	25 to 35 ANEF	Greater than 35 ANEF
School, university	Less than 20 ANEF	20 to 25 ANEF	Greater than 25 ANEF
Hospital, nursing home	Less than 20 ANEF	20 to 25 ANEF	Greater than 25 ANEF
Public building	Less than 20 ANEF	20 to 30 ANEF	Greater than 30 ANEF
Commercial building	Less than 25 ANEF	25 to 35 ANEF	Greater than 35 ANEF
Light industrial	Less than 30 ANEF	30 to 40 ANEF	Greater than 40 ANEF
Other industrial	Acceptable in all ANEF		

A number of areas surrounding the airport site are expected to be affected by noise generated by aircraft overflights and operations of the proposed airport, as identified in Chapter 31. The NSW Department of Planning and Environment and relevant local councils would be consulted to ensure applicable environmental planning instruments are amended to include a revised ANEF forecast and supporting AS2021 compliant building siting and development controls.

The implementation of *Guideline A: Measures for Managing Impacts of Aircraft Noise* under the NASF would be instrumental in managing potential future operational noise impacts for future land use planning and development around the proposed airport.

35.5.2.3. Lighting

The proposed runway orientation limits the possible areas that would be affected by approach lighting and runway lighting. The location of buildings between the two runways also provides a buffer for the potential impact of the airport lighting on surrounding sensitive land uses. Light emitting diode apron lighting and directional external lighting would minimise potential impacts on surrounding land. The proposed airport lighting would likely have minimal impact on the surrounding land uses. See Chapter 38 for further details relating to the assessment of light spill and sky glow.

35.5.2.4. Air quality

Modified land use zoning for employment generation and other less sensitive land uses would likely result in a reduction of local air quality impacts on sensitive receivers in the vicinity of the airport site. The regional impacts on air quality from the proposed airport would be a cumulative effect of aircraft operations, road traffic, industrial emissions and other regional sources.

An air quality assessment was prepared for the EIS to forecast the air quality impacts on the surrounding areas. Potential impacts from the proposed airport include a slight degradation in local and regional air quality, impacts on human health and impacts on the environment (refer to Chapters 32 and 39).

35.5.2.5. Traffic and transport

As outlined in Chapter 33, changes to the road network on, and in the vicinity of the airport site would be required to cater for the continued expansion of operations at the proposed airport beyond Stage 1. This includes closure of Badgerys Creek Road (onsite) and all pre-existing onsite roads as required.

The Northern Road would already be realigned before the start of Stage 1 operations, outside the western boundary of the airport site. The M12 would also be constructed by the commencement of Stage 1 operations to link The Northern Road and the M7 (Westlink) Motorway while providing a direct route and access to the airport.

The proposed South West Rail Link Extension, which would include a new railway station for the airport site, is anticipated to be constructed to cater for the long term airport development.

35.5.3. Additional land acquisition

While a fuel pipeline may service the proposed airport in the future, it is important to note that a fuel pipeline corridor has not yet been identified. A route for a fuel pipeline will be determined by the entity or organisation responsible for providing fuel to the airport. Arrangements for access to the fuel pipeline, which may involve an easement, would be required along the pipeline corridor alignment to ensure maintenance access and as a public safety measure. This may include planning controls restricting development on, and adjacent to, the pipeline.

35.6. Considerations for future development stages

Having regard to the planning and land use impact assessment, Table 35–2 summarises the considerations identified to address planning and land use issues for the long term development of the airport site.

Table 35–2 – Considerations for future development stages

Issue	Recommended considerations	Comment
Operational airspace	Liaise with Airservices Australia, the Department of Planning and Environment and relevant local councils to implement appropriate OLS and PANS-OPS requirements in applicable environmental planning instruments to reflect prescribed airspace under the Airports (Protection of Airspace) Regulations 1996.	This would ensure OLS and PANS-OPS requirements are implemented in applicable environmental planning instruments.
Noise	Liaise with the Department of Planning and Environment and relevant local councils to implement appropriate noise management controls in applicable environmental planning instruments with reference to AS 2021 and *Guideline A: Measures for Managing Impacts of Aircraft Noise under the National Airports Safeguarding Framework*.	As the airport continues to expand with long term operations, applicable environmental planning instruments may need to be amended to reflect the revised ANEF for Liverpool, Penrith, Wollondilly, Camden, Blacktown and Fairfield LGAs.

35.7. Summary of findings

Construction and operation of the proposed airport would change the rural character of Badgerys Creek and surrounding land uses. This land use outcome has been anticipated in government strategic planning for the area over several decades.

The proposed airport would be a key driver for employment generating development in Western Sydney, creating jobs for the new residents of the South West Priority Growth Area.

36. Landscape and visual amenity

36.1. Introduction

An assessment of potential visual impacts due to the long term development of the airport site was undertaken based on indicative concept designs with the proposed airport operating two runways at close to maximum capacity. This is anticipated to occur in approximately 2063. The indicative flight paths were used in the assessment to provide an idea of the extent of impacts that could arise from the future development of the airport site.

It would be expected that there would be progressive development of the airport site as part of the long term development. Such development may modify the environmental conditions at and around the airport site beyond what has been assessed for the proposed Stage 1 development. However, such development has not been considered as part of this strategic level assessment of the indicative long term development.

36.2. Methodology

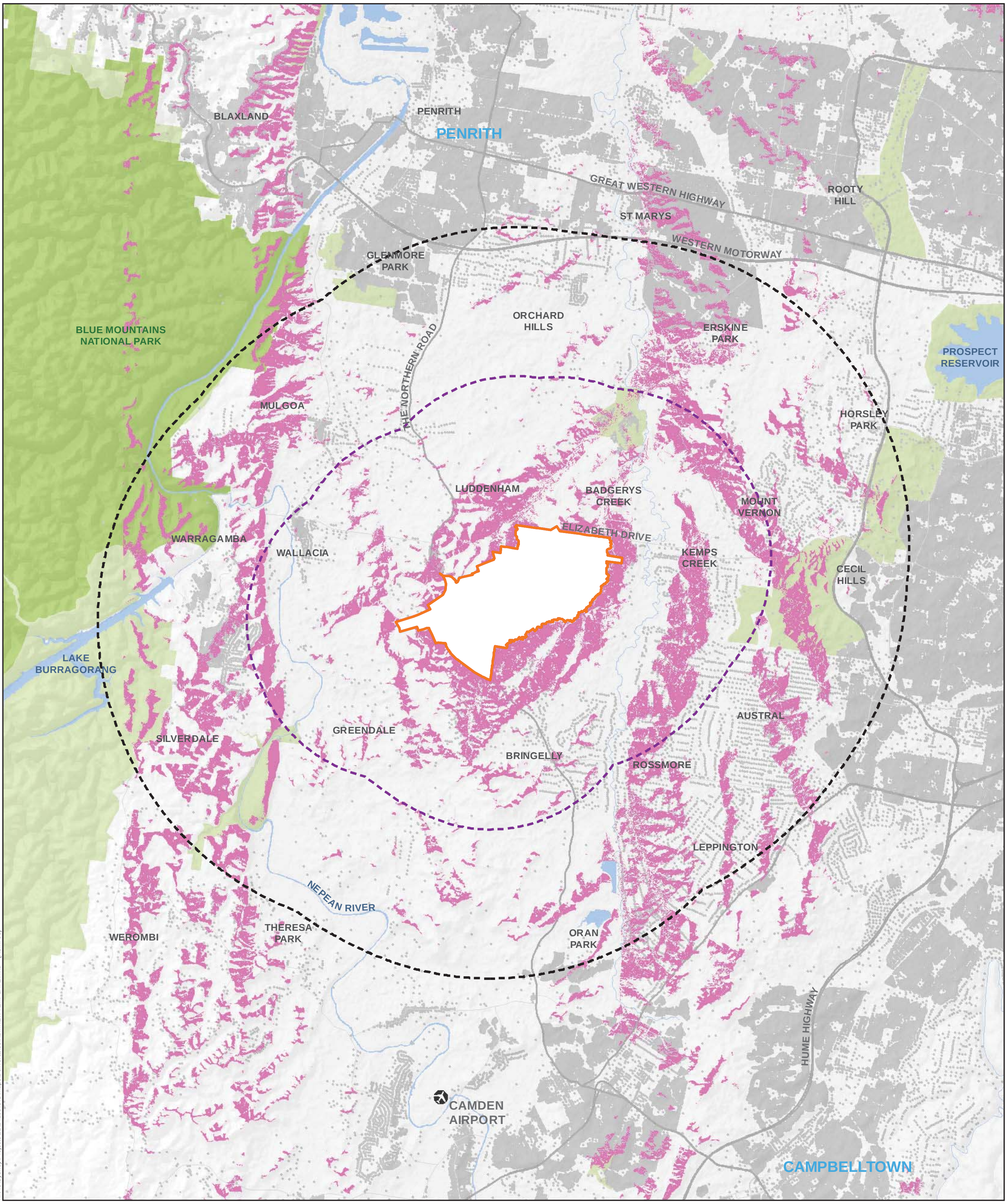
Consistent with the approach adopted for the Stage 1 development, the methodology for the long term landscape and visual amenity assessment has been adapted from the approach set out in the NSW Roads and Maritime Services document *Environmental Impact Assessment Practice Note – Guideline for Landscape Character and the Visual Impact Assessment and Guidelines for Landscape Visual Impact Assessment* (RMS 2013).

The assessment focuses on the effect on visual amenity, including specific viewpoints in the surrounding area, and considers both the sensitivity of the area and the magnitude (or visual effect) of the long term development in that area. Because of uncertainty about the long term visual environment, ratings for each viewpoint have not been assigned for sensitivity, magnitude and visual impact. A discussion of these aspects is provided instead.

36.3. Visual context

The existing visual context for the airport site is described in Chapter 22. The existing environment is expected to undergo significant change over the 40 years from the commencement of operations of the proposed airport. Changes would occur both on the airport site and in the surrounding area more broadly, with further development of the South West Priority Growth Area, development in line with the Western Sydney Infrastructure Plan and the establishment of the Western Sydney Employment Area, as well as the potential development of the South West Rail Line extension and the Outer Sydney Orbital. The result would be a substantial transition of the area surrounding the airport site from a predominantly rural character to an urban character where the proposed airport would be integrated into its surroundings. It is also expected that future development of the surrounding area would be undertaken with the proposed airport in place and therefore would consider the visibility of the proposed airport in any necessary development decisions.

Figure 36-1 illustrates the visibility of the indicative long term development. Theoretically, the airport site would be visible from the pink shaded areas, based on existing topography and the maximum allowable heights of key buildings and structures on the airport site such as the air traffic control tower, terminal buildings and other major structures. Existing structures or vegetation in the surrounding areas were not taken into account but their presence would further reduce visibility from surrounding sensitive viewpoints.



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

LEGEND
- Airport site
- 5km Site Buffer
- 10km Site Buffer
- Areas of no theoretical visibility
- Areas of theoretical visibility

0 1 2 4
Kilometres

N

Figure 36-1 - Visibility of the Long Term Development

36.4. Assessment of impacts during operation

As outlined in Chapter 7, the proposed airport would operate on a 24 hour basis with flights expected to occur during the day and night. Chapter 30 outlines the indicative flight paths for the long term operation of dual runways in the preferred 05/23 orientation.

There is expected to be a substantial increase in the number of aircraft using the proposed airport from its predicted usage of 10 million annual passengers in 2030 to an anticipated 82 million annual passengers in 2063. This would equate to an increase in aircraft movements as shown in Table 36–1.

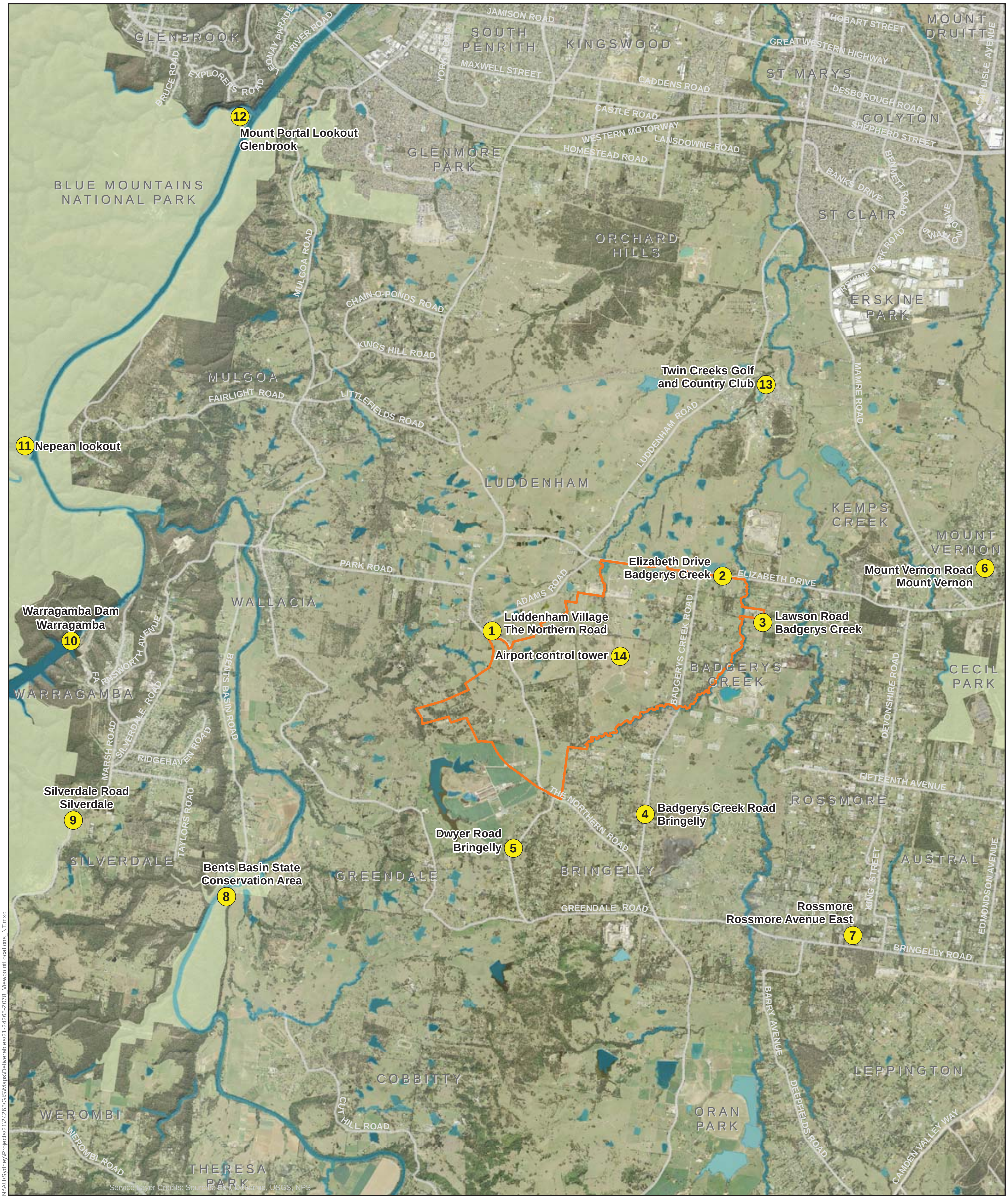
Table 36–1 – Predicted aircraft movements

Year	Aircraft Movements Per Day		
	Freight	Passenger	Total
2030	28	170	198
2050	74	480	554
2063	104	1006	1110

As discussed in Chapter 30, it is difficult to accurately determine the likely flight paths and airport modes of operation so far into the future. However, as demand and the number of aircraft using the airport increases, the general visibility of aircraft over surrounding suburbs would also increase. This increase would be different from the initial commencement of operations as it would happen incrementally over a long period, and future developments would occur with knowledge of the likely impact.

As the proposed airport grows beyond Stage 1, Airservices Australia would likely be required to conduct further detailed analysis of the Sydney basin airspace, particularly upon commissioning of the second runway. The visual impact of aircraft overflights would be one consideration among others in the development and approval of any new airspace architecture required.

An assessment of likely visual impacts at particular viewpoints during operation of the long term development is presented in Table 36–2. The location and orientation of each viewpoint is shown on Figure 36-2. Further details of the assessed viewpoints are provided in Chapter 22.



LEGEND

- Badgerys Creek site boundary
- Waterways
- Parks and reserves
- Roads
- Viewpoints

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

0 1 2 4
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Figure 36-2 - Viewpoint location plan

Table 36–2 – Operation impact assessment from representative viewpoints

Viewpoint	Assessment
1. Luddenham Village, east of The Northern Road, Luddenham	**Sensitivity** The rural character of the broader area is expected to change from rural and become more urban with development in line with the Western Sydney Infrastructure Plan, the Western Sydney Employment Area and the South West Priority Growth Area, as well as the proposed South West Rail Link extension and the Outer Sydney Orbital. In this context, the sensitivity of viewers would be expected to decrease. **Magnitude** There would be an increased visual prominence caused by the expansion of the airport terminal complex, the second runway, and maintenance, cargo, commercial and car parking facilities. There would likely also be an increased number of aircraft taking off and landing from the second runway and a general overall increase in air traffic. The magnitude of the visual impact would therefore likely increase.
2. Elizabeth Drive, Badgerys Creek	**Sensitivity** Minimal increases to sensitivity could be expected to occur over time with higher air traffic levels. **Magnitude** The context of the view would change over time with areas north of Elizabeth Drive expected to be developed as part of the Western Sydney Employment Area and future construction of the M12 Motorway. However, it is also expected that aircraft would become more visually prominent due to expected increases in aircraft movements over Elizabeth Drive. The magnitude of the visual impact would likely increase.
3. Lawson Road, Badgerys Creek	**Sensitivity** The character of the broader area is expected to change from rural and become more urban with the development of the industrial precincts and employment areas as part of the South West Priority Growth Area and Western Sydney Employment Area and the upgrade of key roads such as Lawson Road and Elizabeth Drive. In this context, it could be expected that the sensitivity of viewers would decrease over time. **Magnitude** There would be a significant increase in the visual prominence of the proposed airport through the expansion of the terminal complex, maintenance, cargo, commercial and long term employee car park and the second runway one and a half to two kilometres to the east. Aircraft are expected to be prominent with aircraft movements over Lawson Road and an increased number of aircraft taking off from the second runway. The magnitude of the visual impact would likely increase.
4. Badgerys Creek Road, Bringelly	**Sensitivity** The character of the broader area is expected become more urban with the development of the industrial precincts and employment areas as part of the South West Priority Growth Area, the Western Sydney Infrastructure Plan and the proposed South West Rail Link extension. In this context, the sensitivity of viewers would be expected to decrease over time. **Magnitude** There would be a significant increase in the visual prominence of the proposed airport through the expansion of the terminal complex, maintenance, cargo, commercial and other airport facilities as well as a second runway. There would also likely be continued increase in the number of aircraft taking off and landing after the second runway commences operations and an overall increase in visible aircraft with aircraft movements over Badgerys Creek Road on an east-west flight path. The magnitude of the visual impact would likely increase.

Viewpoint	Assessment
5. Dwyer Road, Bringelly	**Sensitivity** The landscape character south of the airport site is expected to change over time. The urbanisation of these areas would decrease the sensitivity for visual receivers in the area. **Magnitude** Increased development in the region of the airport site as part of the planned South West Priority Growth Area, the Western Sydney Infrastructure Plan and the proposed South West Rail Link extension would further reduce the relative prominence of the proposed airport and decrease the magnitude of its visual impact.
6. Mount Vernon Road, Mount Vernon	**Sensitivity** The character of the broader area is expected to become more urban with the development of the Western Sydney Employment Area, particularly to the north of the airport site and the future implementation of the M12 Motorway. In this context, the sensitivity of viewers would be expected to decrease over time. **Magnitude** There would be an increased visual prominence of the airport site through the expansion of the terminal complex, the additional second runway, maintenance, cargo, commercial development and car parking facilities. There would also likely be a continued increase in the number of aircraft taking off and landing after the second runway commences operations and an overall increase in air traffic orientated north-east. The magnitude of the visual impact would likely increase.
7. Rossmore, Rossmore Avenue East	**Sensitivity** The character of the broader area is expected to become more urban with the development of the industrial precincts and employment areas as part of the South West Priority Growth Area, development in line with the Western Sydney Infrastructure Plan and the proposed South West Rail Link extension. In this context, the sensitivity of viewers would be expected to decrease over time. **Magnitude** There would be an increased visual prominence of the airport site through the expansion of the terminal complex, the additional second runway, maintenance, and cargo facilities in the southern half of the airport site. There is expected to be an increased number of aircraft taking off and landing from the second runway and overall increase in air traffic with the flight paths from the second runway orientated north-west over Bringelly Road. The magnitude of the visual impact would therefore likely increase.
8. Bents Basin State Conservation Area	**Sensitivity** The location is expected to remain a state recreation area and it is assumed that there is significant value placed on the natural landscape by visitors. Additional recreation activity could be expected in the future. In this context an increase in sensitivity is expected. **Magnitude** There would be no direct views of the proposed airport operation, however, aircraft would be more prominent, with the location of an indicative flight path over the recreation area and an expected increase in air traffic having a greater visual impact. The magnitude of the visual impact would likely increase.

Viewpoint	Assessment
9. Silverdale Road, Silverdale	**Sensitivity** The sensitivity of this view is expected to remain similar to that considered for the Stage 1 development because the number of viewers and the duration of the views would be unlikely to change. Further development of the areas both north and south of the airport site is expected to alter the existing visual landscape from rural/semi-rural to increasingly urbanised. This change to a more urban character is likely to result in a decrease in the sensitivity of visual receivers in this area. **Magnitude** The overall landscape would have greater capacity to absorb views with the expected urbanisation of areas north and south of the airport site. After the opening of the second runway, views of aircraft are expected to be more prevalent and closer to viewers at this viewpoint resulting in a greater degree of visual impact.
10. Warragamba Dam Recreation Area	**Sensitivity** Increased recreational visitors over time would increase the visual sensitivity. It is unlikely that the use or function of this location would change or that development would occur in the immediate surrounding area. **Magnitude** There would be no direct views of the airport site and aircraft. However, increased aircraft movements would be expected at a distance of approximately three kilometres to the north and five kilometres to the south from the recreation areas and visitors centre. There would be a potential minor increase in the magnitude of visual impact.
11. Glenbrook Nepean Lookout	**Sensitivity** The value placed on the visual qualities of the natural landscape at this location would be expected to remain or possibly increase over time. Visitors to the lookout would also be expected to increase, thereby slightly increasing the level of sensitivity. **Magnitude** There would be no views of the proposed airport's features; however, it would be expected that there would be views of aircraft overflights. There would be a potential minor increase in the magnitude of visual impact.
12. Mount Portal Lookout	**Sensitivity** Increased population and visitation of the lookout would be expected to increase use and therefore visual sensitivity. However, it is also expected that the character of the areas within the broader views would change from rural to more urban with the development of the Western Sydney Employment Area, particularly to the north between the airport site and lookout. **Magnitude** The visibility of the airport site would be unlikely to change, however, flight paths may bring aircraft closer to the lookout. An increase in aircraft visibility has the potential to result in a greater visual impact and reduced visual amenity.
13. Twin Creeks Golf and Country Club	**Sensitivity** The Twin Creeks Golf and Country Club is likely to perform a similar role into the future. Development of the residential estate is expected to continue, thereby increasing visual sensitivity. **Magnitude** There would be no direct views likely of the proposed airport's features; however, visual receivers would be expected to be affected by increased air traffic. The magnitude of the visual impact would likely increase.

36.5. Considerations for future development stages

Chapter 22 sets out the broad mitigation and management measures that are proposed to address the visual impacts of the Stage 1 development. These measures would also generally apply to the construction and operation of the long term development. Mitigation for future stages of development would be considered as part of any future design and approval process. A key consideration would be the mode of operation for the proposed airport which would have an impact on the visibility of overflight aircraft on different communities. Where appropriate, strategies to minimise visual impact of overflight aircraft would be considered.

36.6. Summary of findings

Future development of the areas surrounding the airport site through the Western Sydney Infrastructure Plan, the Western Sydney Employment Area and the South West Priority Growth Area, as well as the proposed South West Rail Link extension and Outer Sydney Orbital, would lead to a significant transition from an environment that is predominantly rural in character to one that has a more urban form. In general terms, this is expected to reduce the visual impact of the proposed airport development, including night-time lighting effects, as the proposed airport is integrated into the changing urban visual character of the area.

While the increasingly urban character of the area would contribute to reduced visual sensitivity, visual impacts have nonetheless been identified for the viewpoints at Elizabeth Drive and Lawson Road in Badgerys Creek; Badgerys Creek Road in Bringelly; and Bents Basin State Conservation Area. All these areas would have higher levels of visual sensitivity, with visual impacts that would largely be the result of views of aircraft taking off and landing, as well as a larger number of overflights.

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37. Social and economic

37.1. Introduction

This chapter considers the long term social and economic impacts of the proposed airport. Specifically, the impact assessment considers how the proposed airport could affect existing population, employment and land use across Sydney. This chapter draws on the social impact assessment and economic analysis undertaken (refer Appendix P1 and P3).

The long term development of the proposed airport would result in significant opportunities for regional economic benefits through direct, indirect and induced spending. Benefits would be accrued beyond the aviation industry, and extend to businesses and employees in industries such as construction, utilities, trade, transport, accommodation, retail professional services, tourism and hospitality, and administration. Long term impacts on the amenity of Western Sydney are expected to vary between communities, depending on proximity to the airport site, and their location with respect to flight paths.

37.2. Methodology

37.2.1. Social

The following tasks were undertaken in the preparation of the social impact assessment:

- identification and definition of the social area of influence (the study area) including communities and regions likely to be affected by the proposed airport;
- development of an appreciation of the existing social, economic and cultural characteristics of the communities within the study area to establish a baseline on which potential impacts could be predicted;
- identification of potential benefits and impacts of the proposed airport on the study area communities and an assessment of these impacts in terms of the likelihood and consequence of their occurrence; and
- development of mitigation and management strategies to avoid or minimise potential adverse impacts and maximise benefits to the stakeholders and communities.

37.2.2. Economic

As part of the preparation of the EIS, two key economic models were used to identify the economic impacts of the proposed airport, a spatial computable general equilibrium model (SCGE) and a land use econometric model.

37.2.3. Spatial computable general equilibrium model

The SCGE model was used to identify the potential economic impacts of the proposed airport on the wider economy. The SCGE model assists in the translation of benefits and costs into real economic impacts accrued through time, cost savings to individuals and businesses, and accessibility gains into area-specific changes in wages, productivity, incomes, value add, and prices. Metrics to describe the economic impact of the proposed airport through the SCGE model include:

- Increased value add – value add is the value of output produced less the cost of intermediate inputs used in the production of that output and expresses the net wealth generated by the activity. The proposed airport will result in higher value-add per year by supporting productivity and growth, delivering benefits to businesses and workers alike.
- Gross business profits – the share of an increase in value-add that is retained as real returns to owners, investors and others who finance businesses.
- Gross household labour incomes – the share of an increase in value-add that is enjoyed by households through an increase in real wages.
- Enhanced productivity per worker – this is change in real value-add per worker per year. The proposed airport enables workers in Sydney to be more productive due to a reduction in the cost of aviation services.
- Net imports – the balance of the real value of exports and imports in a region, representing both domestic, inter-regional trade and international trade.

The SCGE model is intended to represent transactions taking place between individuals, businesses and government agencies in terms of consumption, labour, capital, real estate and trade. Households provide labour and capital to firms and use the income generated to purchase goods and services. Firms use inputs sourced from other firms, as well as labour and capital, to produce goods and services, which are in turn sold to households and to other firms. These transactions are represented across four spatial areas: Western Sydney, Rest of Sydney, the Rest of NSW, and the Rest of Australia.

37.2.4. Land use econometric model

The land use econometric model was developed to capture changes in land use (i.e. employment and population distributions) in surrounding areas associated with the long term development. This model was designed to measure the change in population and employment as a result of changes in accessibility driven by the development of the airport and surrounding land uses. This includes:

- employment accessibility – one of the key drivers of where people choose to live is accessibility to jobs. By facilitating new jobs in and around the site, the proposed airport has the potential to provide added employment opportunities, which are expected to attract more people to live in the region.

- population and employer accessibility – another key driver of where employers choose to locate is the accessibility to workers and suppliers/customers. The proposed airport has the potential to improve accessibility for employers in Western Sydney by providing a greater pool of workers to choose from and enhanced connectivity with other firms in the form of supply chains, customers and knowledge spill-overs. This would be expected to make Western Sydney (and particularly the area immediately surrounding the airport) a more viable location for employers, attracting more businesses to set up there.
- other factors – in addition to accessibility to jobs, individuals value being close to various amenities and attractions (e.g. shopping and recreational opportunities, schools, greenspace, and hospitals). Firms value proximity to other firms, workers, key infrastructure and clients and customers.

To test these interrelationships, econometric modelling was used to understand the likely scale of the response in residential and business location due to each of these factors, in addition to the changes in accessibility.

37.2.5. Airport employment estimate

The proposed airport is expected to support a substantial number of jobs on the airport site. Specifically, these jobs can be divided into direct airport jobs and non-aeronautical jobs at the proposed on-site business park.

To identify the total number of direct airport jobs which could be supported by the proposed airport development, a benchmarking exercise was used to determine the relationship between the passenger throughput at domestic and international airports and the number of direct employees at each airport. In light of the results of this analysis, a ratio of 750 employees to one million annual passengers was applied to passenger demand forecasts to identify expected direct employees at the proposed airport. This ratio is consistent with analysis from the Bureau of Infrastructure, Transport and Regional Economics (BITRE) which found that major Australian airports typically generate between 200 and 1,500 jobs per million passengers (BITRE 2013).

The number of non-aeronautical jobs supported by the proposed on-site business park was based on the size of the business park site. This considered the proposed scale of the business park, forecast land use (i.e. allocation of office, commercial and warehousing space), floor space to site ratios and benchmarked space requirements per employee (i.e. number of square metres of floor space per employee), based on industry benchmarks.

37.3. Assessment of impacts

37.3.1. Social

The impacts of the long term development of the proposed airport on lifestyle and social amenity due to noise, visual and air quality impacts have been addressed in the following EIS chapters:

- Noise (see Chapter 31);
- Air quality (see Chapter 32);
- Traffic, transport and access (see Chapter 33);

- Landscape and visual (see Chapter 36); and
- Health (see Chapter 39).

37.3.1.1. Noise

The communities that may be most impacted as a result of the indicative long term noise scenarios include Luddenham, Badgerys Creek, Bringelly, Greendale, and Wallacia, St Marys, Erskine Park, Greendale, Silverdale, Horsley Park, and parts of Blacktown. The broad area of exposure to aircraft noise includes a range of social infrastructure including childcare centres, schools, churches, parks and recreation facilities, hospitals and other health care facilities, particularly in Luddenham and Mulgoa.

Based on the outcomes of the aircraft and ground-based noise study, the proposed airport may lead to a reduction in social amenity and impacts on the existing lifestyle of people living and working in above mentioned communities, depending on the final flight paths and preferred airport operating modes.

37.3.1.2. Air quality

Long term operation could lead to changes in air quality for communities close to the airport, including the townships and surrounding areas of Luddenham, Wallacia, Mulgoa, Greendale, Badgerys Creek, Rossmore, Mt Vernon and Kemps Creek. This predicted change in air quality may reduce the amenity of residents and other sensitive receivers in these localities.

It is noted that the predicted minor exceedances of air quality criteria are limited to a small number of receivers in the immediate vicinity of the airport.

37.3.1.3. Traffic and access

The proposed airport may lead to an increase in traffic on roads surrounding the site. This is expected to impact the social amenity and lifestyle of these semi-rural areas. However with the planned upgrades of surrounding roads and introduction of new roads in areas surrounding the site, the increase in traffic is not expected to result in major capacity issues.

The long term operation would lead to an increase of traffic on roads in Western Sydney, which along with future population growth, may lead to road capacity issues if planning is not undertaken sufficiently early. This would require future planning beyond current road upgrade plans and the potential extension of the South West Rail Link to reduce impacts on Western Sydney communities.

37.3.1.4. Impacts on social infrastructure

The long term operational workforce, coupled with the projected increase in population, would result in additional demand on social infrastructure in areas near the airport (e.g. medical centres, dentists, pharmacies, child care centres) and recreational facilities (e.g. swimming pools, gymnasiums, public parks). This may affect access to these services and facilities by nearby residents. However it is anticipated that by 2063, there will be more social infrastructure facilities and services available in Western Sydney to cater for the population increase in the area.

Long term airport operations and increased road vehicle traffic are likely to generate visual and noise impacts on social infrastructure facilities such as schools, educational institutions, hospitals, recreational spaces and places of worship.

37.3.1.5. Impacts on recreational assets

The following recreational spaces are identified to be within the regional study area:

- Twin Creeks Country Club;
- Ropes Creek Reserve (Erskine Park);
- Eastern Creek Raceway;
- Sydney International Equestrian Centre (Horsley Park);
- Western Sydney Parklands (Horsley Park);
- Calmsley Hill City Farm (Abbotsbury);
- Sales Park (Luddenham);
- Bent Basin State Conservation Area (Greendale);
- Burragorang Recreation Area (Silverdale);
- Gulguer Nature Reserve (Greendale);
- Mulgoa Nature Reserve;
- Warragamba Sportsground; and
- Greater Blue Mountains World Heritage Area.

The long term operation of the proposed airport, and associated increases in overflight noise, may reduce the amenity of these recreational areas over time. However, as aircraft overflights in the Greater Blue Mountains Area will be at relatively high altitude (typically over 5000 feet), maximum noise levels are anticipated to be less than 55 dBA. They may also be reasonably expected to reduce over time as a result of improved engine design and technology advancements which would further limit potential amenity impacts.

37.3.2. Economic analysis

37.3.2.1. Regional benefits

The long term development of the proposed airport would result in significant economic benefits for Western Sydney and the wider region. Benefits would extend to businesses and employees in industries such as construction, utilities, trade, transport, accommodation, retail professional services, tourism and hospitality, and administration. These benefits would have flow-on effects to individuals through increased household income and greater access to employment opportunities.

Table 37–1 provides an overview of the predicted economic impacts associated with the long term development under the SCGE model.

Table 37–1 – Long term economic impacts in 2063 (undiscounted 2015 real values)

Metric (per year)	Western Sydney	Rest of Sydney	Rest of NSW	Rest of Australia	Total
Value add ($ millions)	$1,507	$4,640	$506	-$815	$5,838
Business profits ($ millions)	$541	$1,372	$248	-$138	$2,023
Productivity per worker ($/worker)	$941	$1,613	$225	-$42	$252
Household income ($ millions)	$869	$1,580	$333	$670	$3,452

In 2063, the proposed airport would generate an additional $5.8 billion in value-add. Approximately $1.5 billion of this value-add would be generated in Western Sydney. There is a reduction in value-add in the Rest of Australia (outside NSW), reflecting the proposed airport's role in attracting economic activity to the region. The increase in value-add is supported by increases in productivity per worker, averaging $941 in Western Sydney and $1,613 per worker in the Rest of Sydney.

The long term development would also result in significant economic benefits for business in the regions surrounding the airport site. In 2063, the proposed airport would generate an additional $541 million in profits for businesses in Western Sydney and an additional $1.3 billion in profits for the Rest of Sydney. There are smaller positive benefits to the Rest of NSW with some of these benefits potentially drawn from the Rest of Australia, reflecting the proposed airport's role in redistributing economic activity to Western Sydney and the broader metropolitan area.

In relation to household income, the proposed airport would generate $869 million and $1.5 billion in additional household income for Western Sydney and the Rest of Sydney. It is expected there would be significant regional spill-overs, with a substantial share of the total gains falling to the Rest of Australia.

37.3.3. Employment growth at the airport

In 2063, the operation of the long term development is expected to generate approximately 98,650 jobs on the airport site. This would include 61,500 jobs directly associated with the operation of the proposed airport, and 27,000 jobs in the manufacturing, business services and consumer services sectors as part of the non-aeronautical developments in the proposed business park.

A breakdown of the expected employment opportunities can be seen in Table 37–2 below.

Table 37–2 – Long term employment at the airport in 2063

Category	Employment in 2063
Direct airport	61,500
Business park	27,000
Proposed airport (total)	88,500

37.3.4. Regional employment growth

While the proposed airport will require a significant workforce and provide the region with increased employment opportunities, for the purposes of the land use econometric model, it was assumed that there would be no net new employment in Sydney as a result of the proposed airport. Instead, the model assumed that future regional employment growth would be redistributed across Sydney after the development of the proposed airport and the associated changes in accessibility. The estimated change in regional employment growth is incremental on the base case (do nothing). Accordingly, areas that see a reduction in employment in the analysis do not necessarily decline in absolute terms. Rather they do not grow by as much as they would have otherwise without the proposed airport.

For the purposes of this assessment, the following Western Sydney subregions are defined according to local government areas (LGAs):

- Sydney South West – Liverpool, Fairfield, Camden, Campbelltown and Wollondilly LGAs;
- Sydney West – Penrith, Hawkesbury and Blue Mountains LGAs; and
- Sydney West Central – Auburn, Bankstown, Blacktown, Holroyd, Parramatta and the Hills Shire LGAs.

As outlined in Table 37–3, the analysis found that by 2063, the proposed airport would provide for additional job growth of 29,200 jobs in Western Sydney. As part of this, the Sydney West subregion is anticipated to see the largest increase in population with 14,300 additional jobs. The Sydney South West and West Central subregions would also experience additional growth in employment in 2063. It is assumed in the econometric land use model that additional job growth in Western Sydney would be redistributed from the Rest of Sydney. As explained previously, this does not necessarily mean a decline in absolute employment but rather a reduction in employment growth. Regional employment growth identified in the land use econometric excludes employment growth at the airport.

Table 37–3 – Long term employment changes in 2063 as a result of the proposed airport

Region/Year	2063
Sydney South West	10,600
Sydney West	14,300
Sydney West Central	4,300
Total Western Sydney	29,200
Rest of Sydney	-29,800
Rest of NSW	600

Across Sydney, the strongest employment growth increases associated with the long term development are estimated to occur within the following LGAs:

- Penrith;
- Wollondilly;
- Blue Mountains;
- Camden; and
- Blacktown.

The actual location of employment growth changes over the long term are likely to be shaped by regional planning and policy directions from government agencies, as well as the decisions of private businesses and individuals.

37.3.5. Regional population change

For the purposes of the land use econometric model, it was assumed that there would be no net new population in Sydney as a result of the proposed airport. Instead, forecast population growth was assumed to be redistributed across Sydney following the development of the proposed airport and the associated changes in accessibility. The estimated change in population is incremental to the base case (do nothing). Accordingly, areas that see a reduction in population in the analysis do not necessarily decline in absolute terms. Rather they do not grow by as much as they otherwise would have without the proposed airport.

As outlined in Table 37–4, the Sydney West subregion is anticipated to see the largest additional increase in population due to the long term development of the airport. In 2063, Sydney West is expected to have an additional 63,400 people. Sydney South West is also anticipated to see strong growth relative to the base case with an additional 31,100 people in 2063. These population increases would be redistributed away from the rest of Sydney, the rest of NSW, and Sydney West Central. As mentioned earlier, the Rest of Sydney, the Rest of Sydney, the Rest of NSW and Sydney West Central would not experience a decline in population. Rather, they would not grow by as much as they otherwise would have without the proposed airport.

Table 37–4 – Long term population changes in 2063 as a result of the proposed airport

Region	2063
Sydney South West	31,100
Sydney West	63,400
Sydney West Central	-18,200
Total Western Sydney	**76,300**
Rest of Sydney	**-59,500**
Rest of NSW	**-16,800**

Across Sydney, the strongest population growth associated with the proposed airport development is estimated to occur within the following LGAs:

- Penrith;
- Blue Mountains;
- Camden;
- Wollondilly; and
- Hawkesbury.

The actual location of population growth changes over the long term are likely to be shaped by regional planning and policy directions from government agencies, as well as the decisions of private businesses and residents.

37.4. Summary of findings

The long term development of the proposed airport would result in significant economic, employment and social opportunities for the Western Sydney region. It would also provide wider benefits to other areas of Sydney, NSW and Australia. Economic benefits would accrue beyond the aviation industry, and extend to business and employees in industries such as construction, utilities, trade, transport, accommodation, retail professional services and administration.

The proposed airport would make it more attractive for people to live in Western Sydney by virtue of having a greater access to jobs and wanting to be closer to an airport. This would lead to a relatively higher population density in areas like Penrith, the Blue Mountains, Blacktown, Wollondilly and Camden. These people would otherwise have continued living in the rest of Sydney, in places like Randwick, Hornsby and Canterbury, and also other parts of Sydney West Central such as Parramatta and Bankstown.

The proposed airport would also create better business development opportunities in Western Sydney as employers would have access to a large labour pool and proximity to markets and supporting businesses. Therefore there would be relatively higher employment densities in areas like Penrith and Blacktown, but also in Liverpool, Fairfield and Camden and across the rest of Western Sydney.

The long term development would change the amenity of communities and recreational areas in proximity to the airport and aircraft flight paths as a result of noise and visual impacts.

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38. Greater Blue Mountains World Heritage Area

38.1. Introduction

This chapter considers the potential impacts of an indicative long term development of the proposed airport on the Greater Blue Mountains World Heritage and National Heritage values. The chapter builds on the consideration of potential impacts associated with the proposed Stage 1 development presented in Chapter 26 of Volume 2 and draws on detailed environmental and social assessments undertaken for the proposed airport which are included in Volume 4.

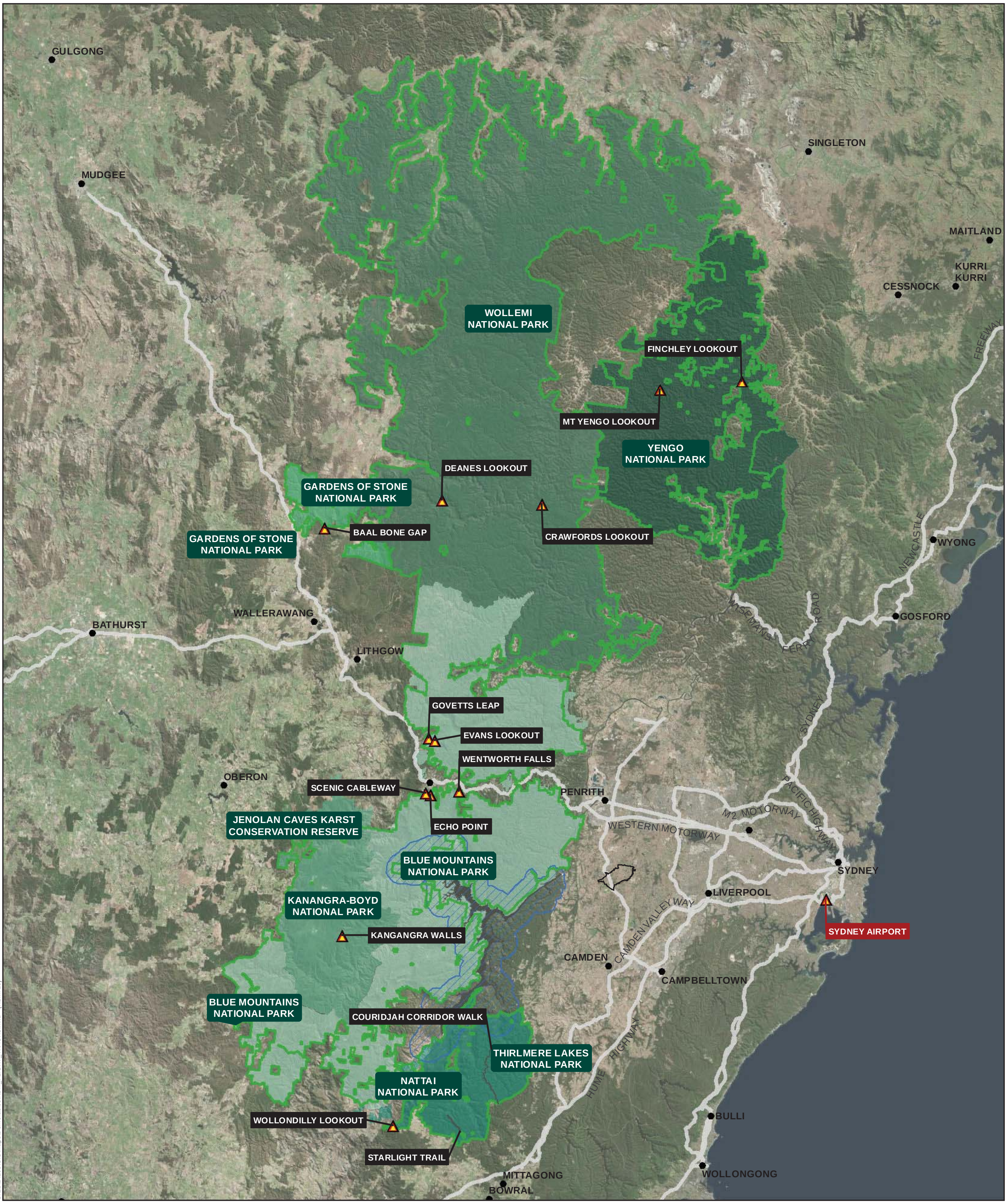
The assessment of the long term airport development recognises the uncertainty in predicting impacts that may occur nearly 50 years into the future. Flight paths and airport operating procedures that may be used in the long-term are subject to further consideration. All future development would be subject to further assessment and approval requirements under the Airports Act.

38.2. Environmental values

The Greater Blue Mountains Area (GBMA) covers 1.03 million hectares of sandstone plateaus, escarpments and gorges dominated by temperate eucalypt forest (UNESCO 2015). The site constitutes one of the largest and most intact tracts of protected bushland in Australia and is noted for its representation of the evolutionary adaption and diversification of eucalypts in post-Gondwana isolation on the Australian continent (UNESCO 2015).

The GBMA comprises eight protected areas (refer Figure 38-1):

- Blue Mountains National Park;
- Wollemi National Park;
- Yengo National Park;
- Nattai National Park;
- Kanangra-Boyd National Park;
- Gardens of Stone National Park;
- Thirlmere Lakes National Park; and
- Jenolan Caves Karst Conservation Reserve.



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

- Airport site
- Greater Blue Mountains World Heritage Area
- Drinking Water Catchment – No Entry Area

0 5 10 20
Kilometres

N

Figure 38-1 - Greater Blue Mountains World Heritage Area

The GBMA provides a significant representation of Australia's biodiversity, containing 10 percent of the country's vascular flora as well as significant numbers of rare or threatened species (UNESCO 2015). In addition to its outstanding eucalypts, the area also contains ancient, relict species of global significance including the Wollemi pine (*Wollemia nobilis*), one of the world's rarest species that was thought to have been extinct for millions of years (DoE 2015d). The few surviving trees are known only from three small populations located in remote, inaccessible gorges within the Greater Blue Mountains (DoE 2015d).

The GBMA was inscribed on the World Heritage List in 2000 because it satisfies two of the criteria for natural values of outstanding universal value: representative examples of the evolution of Eucalyptus species (Criterion ix) and diversity of habitats and plant communities (Criterion x). Further detail of the outstanding universal value recognised in the World Heritage listing is presented in Chapter 26 of Volume 2.

In addition to meeting the criteria for outstanding universal value, a world heritage property listed for natural values also needs to meet conditions of integrity. Integrity is a measure of the 'wholeness and intactness' of the natural heritage and its attributes (UNESCO 2015). The Statement of Outstanding Universal Value for the GBMA states that the eight protected areas that comprise the GBMA are of sufficient size to protect the biota and ecosystem processes, although the boundary has several anomalies that reduce the effectiveness of its one million hectare size. These anomalies are explained by historical patterns of clearing, private land ownership and topography such as escarpments that act as barriers to potential adverse impacts from adjoining land (UNESCO 2015).

A number of historical land uses have had an impact on the past integrity of the area including Warragamba Dam, cattle grazing, logging, land clearing, coal mining, oil shale mining, military activities and fire regimes (IUCN 1999). However, active management has reduced these impacts and the landscape is in recovery (IUCN 1999).

Aboriginal people from six language groups continue to have a custodial relationship with the area through ongoing practices that reflect both traditional and contemporary presence (UNESCO 2015). Aboriginal sites including important rock art sites provide physical evidence of the longevity of the strong Aboriginal cultural connections with the land. The conservation of these associations contributes to integrity of the GBMA (UNESCO 2015).

All properties inscribed on the World Heritage List must have adequate protection and management mechanisms in place, the nature of which can vary so long as they are effective (DSEWPC 2012). The GBMWHA is protected and managed under legislation of both the Commonwealth of Australia and the State of New South Wales:

- *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) (Cth);*
- *National Parks and Wildlife Act 1974 (NSW); and*
- *Wilderness Act 1987 (NSW).*

Other relevant legislation includes the NSW *Threatened Species Conservation Act 1995*, *Environmental Planning and Assessment Act 1979, Sydney Water Catchment Management Act 1998* and *Heritage Act 1977*.

The GBMWHA Strategic Plan (DECC 2009c) provides a framework for the property's integrated management, protection, interpretation and monitoring.

The key management objectives set out in the Strategic Plan provide the philosophical basis for the management of the area and guidance for operational strategies, in accordance with requirements of the World Heritage Convention and its Operational Guidelines (UNESCO 2015). These objectives are also consistent with the Australian World Heritage management principles, contained in regulations under the *EPBC Act* (UNESCO 2015).

The Strategic Plan identifies the following threats to the integrity of the area:

- uncontrolled and inappropriate use of fire;
- inappropriate recreation and tourism activities, including development of tourism infrastructure;
- invasion by pest species including weeds and feral animals;
- loss of biodiversity and geodiversity;
- impacts of human enhanced climate change; and
- lack of understanding of heritage values.

The Greater Blue Mountains National Heritage Area was included on the National Heritage Register in 2007. The National Heritage Area is the same as that listed for the World Heritage Area and the values identified for the listing are the same as those for the World Heritage Area. As such the following assessment against the heritage values is taken to address both the National and World Heritage values of the GBMA.

The GBMA has a number of other important values which complement and interact with the World Heritage values of the area (DECC 2009c). Protection of these values is considered to be integral in managing individual protected areas and the GBMA as a whole (DECC 2009c). Table 38–1 provides a summary of the values identified by the NPWS in the GBMWHA Strategic Plan which contribute to the overall values of the area.

Table 38–1 – Other important values of the GBMA

Value	Description
Geodiversity and biodiversity	In addition to the outstanding biodiversity of the GBMA, the area also has a diversity of landscapes and geological features including the most extensive sandstone canyon system in eastern Australia. The site also contains karst landscapes with several cave systems including Jenolan Caves, the world's oldest open cave system. Other features include prominent basalt-capped peaks, quaternary alluvial deposits and perched perennial freshwater lakes.
Water catchment	The GBMA protects a large number of pristine and relatively undisturbed catchment areas, some of which make a substantial contribution to maintaining high water quality in a series of water storage reservoirs supplying Sydney and adjacent rural areas.
Indigenous heritage values	Although no comprehensive surveys have been taken, known Aboriginal sites within the area are widespread and diverse including landscape features of spiritual significance and rock art sites. Given the wilderness nature of the area and the limited survey to date, there is high potential for the discovery of further significant Aboriginal sites.
Historic heritage values	The GBMA includes numerous places of historic significance some of which date back to the early years of European settlement and exploration in Australia. Recorded sites demonstrating post-1788 human use are associated with rural settlement, pastoral use, timber getting, mining, transport routes, tourism and recreation. The sites include small graziers' huts, logging roads, stock routes and the ruins of mines.

Value	Description
Recreation and tourism	The GBMA has high recreational values due to the areas' intrinsic beauty, natural features and accessibility from major population centres. Recreational opportunities are wide ranging and include canyoning, bushwalking, rock climbing, nature observation, caving, picnicking, camping and photography. The regional economy surrounding the GBMWHA is increasingly supported by tourism with the area contributing directly and indirectly to the employment, income and output of the region.
Wilderness	The high wilderness quality of much of the GBMA constitutes a vital and highly significant contribution to its World Heritage value and has ensured the integrity of its ecosystems and the retention and protection of its heritage value (DoE 2015). The wild and rugged landscapes, diverse flora and fauna, and opportunities for solitude, self-reliant recreation and reflection are attributes that promote inspiration, serenity and rejuvenation of the human mind and spirit. Such experiences are valued by individuals and society.
Research and education	The GBMA is ideal for research and educational visits due to the variety of ecological communities, landscape and associated cultural sites. The high scientific value reflects what has been discovered and what remains to be discovered as large gaps in knowledge remain in regard to Aboriginal use and occupation of the area and the ecological needs of threatened species and communities.
Scenic and aesthetic	Dramatic scenery within the GBMA includes striking vertical cliffs, waterfalls, ridges, escarpments, uninterrupted views of forested wilderness, extensive caves, narrow sandstone canyons and pagoda rock formations.

Source: NSW NPWS 2009

The following areas within the GBMA were identified as sensitive tourism and recreation areas in relation to potential impacts of the proposed long term development of the airport on noise, air quality and amenity:

- Jamison Valley south of Echo Point lookout and the Scenic Cableway at Katoomba and Wentworth Falls lookout;
- Grose Valley east of Evans lookout and Govetts Leap lookout;
- the wilderness area between Deanes lookout and Crawfords lookout within Wollemi National Park;
- the wilderness area between Mt Yengo lookout and Finchley lookout within Yengo National Park;
- Nattai wilderness area;
- Kanangra Walls and wilderness area east of Kanangra-Boyd lookout; and
- Baal Bone Gap within Gardens of Stone National Park.

38.3. Assessment of impacts during operation

38.3.1. Direct operational impacts

There would be no direct impacts on the GBMA and its associated World Heritage values due to the long term operation of the proposed airport.

38.3.2. Indirect operational impacts

The long term operation of an airport at the Badgerys Creek site may have a number of potential indirect impacts on the GBMA primarily from the overflight of aircraft. Potential impacts include:

- noise;
- air quality impacts from aircraft emissions including fuel jettisoning; and
- amenity impacts.

As noted in Chapter 30, flight paths for the long term development of the airport are indicative and were developed by Airservices Australia to demonstrate a proof of concept. As such, flight paths and airport operating procedures that may be used in the long term would be subject to detailed development and approval prior commissioning the second runway. The potential impacts on the GBMWHA would be one consideration in the development of final flight paths for the proposed airport.

38.3.2.1. Noise

Noise levels from specific aircraft have been modelled as detailed in Appendix E in Volume 4. Noise modelling methodology is described in detail in Appendix E, in regard to the GBMA the model incorporates the topography of the areas and as such the height of aircraft as they overpass the GBMA. This captures the variance in noise across peaks and valeys within the GBMA. The highest predicted noise levels are associated with a departing Boeing 747, while ‘average’ noise levels are represented by a departing Airbus 320.

The Boeing 747 represents the maximum noise event for all aircraft arriving at and departing from the proposed airport. In comparison to Stage 1 operations, noise events would be experienced over a wider area due to the additional flight paths associated with the long term development. Indicative noise exposure levels for these aircraft operations are shown in Figure 38-2 and Figure 38-3. In particular, a Boeing 747 aircraft operating on certain departure paths would be expected to produce noise levels exceeding 60 dBA over a large area of the GBMWHA. In some areas, primarily within the Warragamba exclusion zone, the maximum noise level would exceed 70 dBA. A south west departure by an Airbus A320 is predicted to produce noise levels of 60 to 65 dBA in the southern area of the Blue Mountains National Park.

It should be noted that aircraft technology is continually evolving to improve the noise performance of aircraft with the new generation of aircraft about 75 per cent quieter than those designed 40 years ago. Given that the full operating capacity of the long term development is not anticipated to be achieved for close to 50 years, it is likely that older generation aircraft, including the Boeing 747, would be replaced in this time period by quieter and more efficient aircraft as technology continues to improve.

Noise has been shown to have a variety of impacts on fauna, including changing foraging behaviour, impacting breeding success and changing species occurrences. Low-flying aircraft can give rise to flight response in some species, causing them to abandon nests, and other species are known to avoid higher elevation areas where noise levels are higher, potentially resulting in fragmentation of habitat (Ellis, Ellis, & Mindell, 1991). Most of these impacts occur when noise levels are high (greater than 65 dB).

Given the height at which flights to and from the airport site are likely to be over the GBMA, these impacts are unlikely. While noise would increase marginally above background levels on an intermittent basis directly under the flight paths, fauna are likely to become habituated to the elevated noise levels in the long term (Conomy et al 1998), particularly as aircraft would not be flying at low altitudes over the GBMA. Operation of aircraft in the long term is highly unlikely to permanently alter foraging or breeding behaviour of any fauna species. Any impacts would be localised, with impacts occurring under the main flight paths. The majority of fauna within the vast GBMA would not be impacted by aircraft noise. As such, noise would not result in a loss of biodiversity and would not interfere with the ecological viability and capacity for ongoing evolution of species within the GBMA.

38.3.2.2. Air quality

Regional air quality impacts relevant to the GBMA have been assessed in regard to three principle elements:

- regional air quality (ozone);
- contribution to climate change; and
- emissions from fuel jettisoning.

Regional air quality (ozone)

Regional air pollutants including ozone formed by the photochemical reaction of precursor emissions from the proposed airport can contribute to regional photochemical smog which may have an impact on the amenity of the GBMWHA. The National Environment Protection Measure (NEPM) ambient air quality standard for ozone is 0.10 parts per million for a one hour period (equivalent to 100 parts per billion) and 0.08 parts per million for a four hour period (equivalent to 80 parts per billion).

Future projected emissions for sources other than the proposed airport (background emissions) are not available for the 2063 scenario, therefore, assessment of the air quality impacts of the long term development becomes a hypothetical scenario of long term airport development occurring within the context of 2030 base case emissions. To assess the impact from the addition of airport emissions, 12 days were selected for detailed analysis to represent the meteorological conditions that have historically led to peak ozone formation and with strong model calibration with existing monitoring data.

The maximum predicted one hour ozone concentration was unchanged between the 2030 base case and the 2063 airport case for eight of the 12 analysis days. On four days, the peak predicted one hour ozone concentration increased by a maximum of 0.2 parts per billion.

The peak predicted four-hour ozone concentration was unchanged on seven days and increased on five days by a maximum of 0.2 parts per billion. The highest predicted change in daily maximum four-hour ozone concentration, from the addition of 2063 airport emissions, was 6.3 parts per billion, while the average of the second to fourth highest modelled increase in daily maximum four-hour ozone was 3.7 parts per billion.

The background levels for Western Sydney regularly exceed NEPM guidelines. The modelled contribution of emissions from the airport would represent an increase of less than five per cent on 2030 values in the long term. While projected emissions for other sources are not available, the modelled contribution of the airport is unlikely to be significant in the context of regional emission sources.

Contribution to climate change

In the absence of a projected greenhouse gas emissions inventory for 2063, greenhouse gas emission estimates for the long term development represent approximately 0.59 per cent of Australia's projected 2030 transport-related greenhouse gas (GHG) emission inventory. For this reason, it is concluded the GHG emissions from the airport would not be material in terms of the national inventory, or contribution to climate change.

Emissions from fuel jettisoning

Potential emissions from fuel jettisoning are assessed in Chapter 26 of Volume 2.

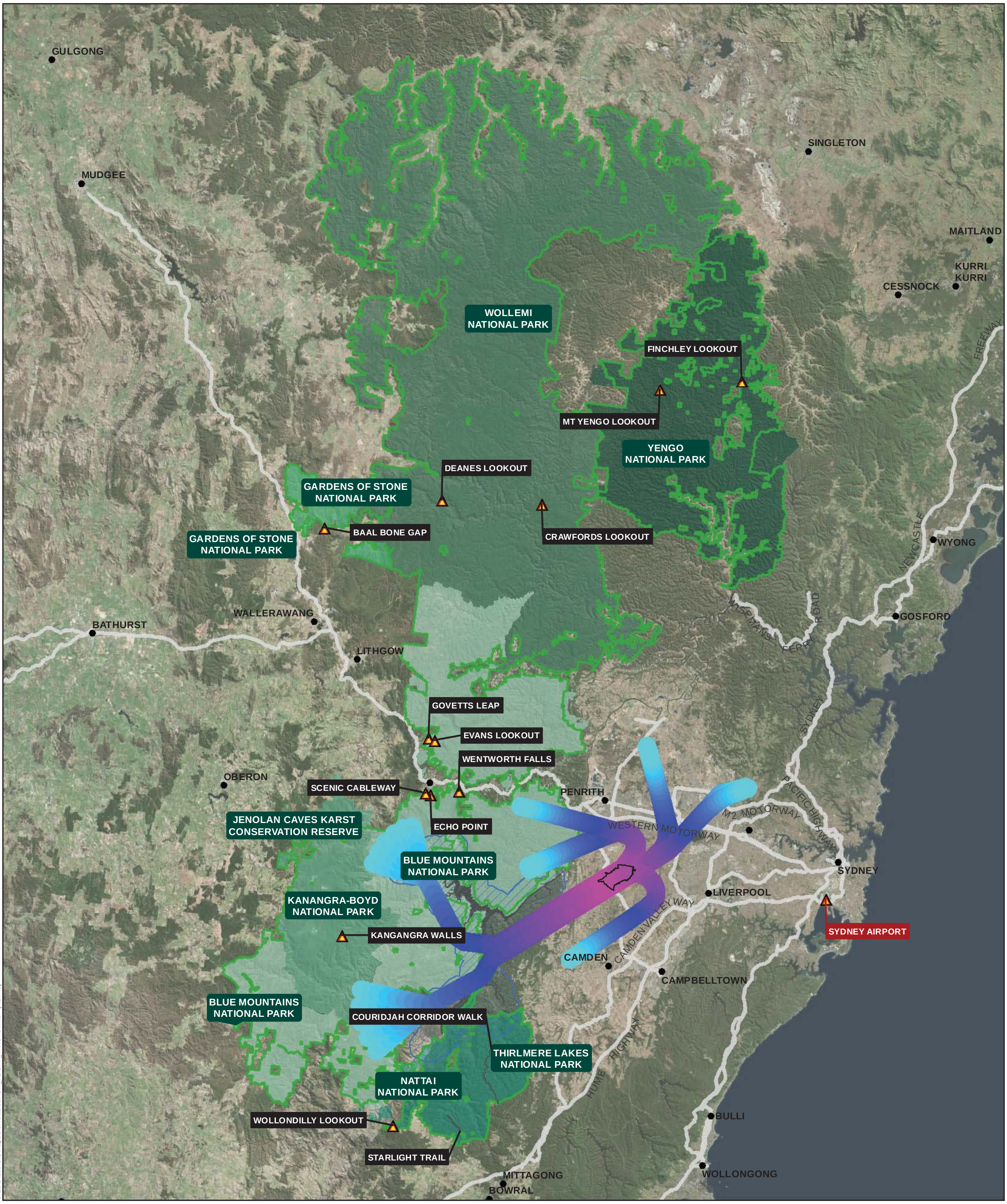
The findings of the assessment indicate that fuel jettisoning is very unlikely to have a significant impact on the GBMWHA due to the rarity of such events, the inability of many aircraft to perform fuel jettisons, the rapid vaporisation and wide dispersion of jettisoned fuel and the strict guidelines on fuel jettisoning altitudes and locations. Fuel jettisoning is not anticipated to become more prevalent during the long term operation of the airport.

38.3.2.3. Amenity

As for the indicative Stage 1 flight paths, almost all aircraft departures and arrivals in the long term would occur at an altitude of more than 5,000 feet and most would occur at more than 10,000 feet above sea level over the GBMWHA. The predicted altitudes of arriving and departing flights in the long term are shown in Figure 38-2 and Figure 38-3.

The altitude of key sensitive areas and the average altitude above ground level relevant to the sensitive areas are shown in Table 38–2. No flights are expected to occur less than 6,000 feet from ground level in the vicinity of sensitive areas.

The altitude levels for each sensitive area relate to lookout locations at high elevations within the GBMA. Some areas frequented by tourists and recreational users are at significantly lower altitudes such as the Jamison Valley walking tracks (1570 feet), the Starlights trail within the Nattai wilderness area (305 feet at Nattai River) and Wollemi Creek within the Wolllemi wilderness area (450 feet).



LEGEND

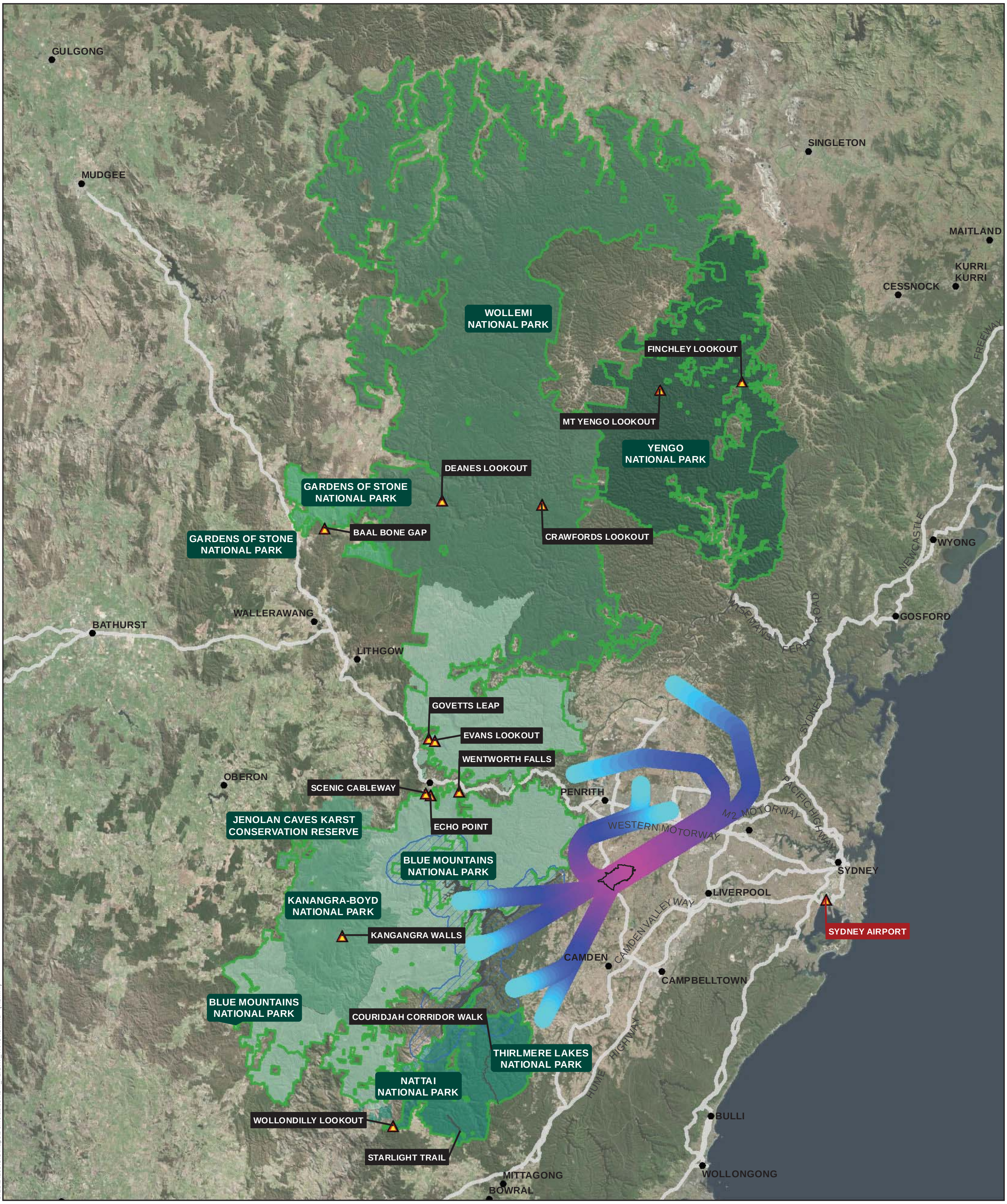
Data Source: Please refer to "Digital Data Sources" on the second page of the EIS

Airport site
Greater Blue Mountains World Heritage Area
Drinking Water Catchment – No Entry Area

Flight track altitude below 10,000 feet
10,000 ft
5,000 ft
0 ft

0 5 10 20
Kilometres

Figure 38-2 - Flight track altitude below 10,000 feet above sea level, prefer 05 dual parallel runways



LEGEND

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

- Airport site
- Greater Blue Mountains World Heritage Area
- Drinking Water Catchment – No Entry Area

Flight track altitude below 10,000 feet

- 10,000 ft
- 5,000 ft
- 0 ft

0 5 10 20 Kilometres

Figure 38-3 - Flight track altitude below 10,000 feet above sea level, prefer 23 dual parallel runways

Table 38–2 – Flight levels above sensitive areas

Area	Site altitude (~ above sea level)	Flight altitude	Flight above ground level
Jamison Valley south of Echo Point lookout and the Scenic Cableway at Katoomba and Wentworth Falls lookout	3,350 feet	> 10,000 feet	> 6,650 feet
Grose Valley east of Evans lookout and Govetts Leap lookout	3,350 feet	> 10,000 feet	> 6,650 feet
Wilderness area between Deanes lookout and Crawfords lookout within Wollemi National Park	3,000 feet	> 10,000 feet	> 7,000 feet
Nattai wilderness area	2,150 feet	> 10,000 feet	> 7,850 feet
Kanangra Walls and wilderness area east of Kanangra-Boyd lookout	3,550 feet	> 10,000 feet	> 6,450 feet
Baal Bone Gap within Gardens of Stone National Park	3,050 feet	> 10,000 feet	> 6,950 feet

As shown in Photograph 38–1, aircraft at 3,000 feet are not prominent visual features although they are visible from the ground. Aircraft viewed from a distance of between five and 10 kilometres from the airport would be at an altitude of more than 5,000 feet, increasing to more than 10,000 feet above sea level. When viewed from the key sensitive areas, this equates to approximately 6,000 feet above ground level. At 6,000 feet, aircraft are likely to be difficult to discern from ground level and are not considered to be visually obtrusive.

Photograph 38–1 – Aircraft at approximately 3,000 feet at a distance of 2.75 kilometres

The proposal may potentially be visible from Nepean lookout and Mount Portal Lookout both located at Glenbrook and between 13 and 14 kilometres from the airport site. A detailed assessment of visual impact is included in Chapter 36. This assessment concluded that a moderate impact to visual amenity was likely at Nepean Lookout and a negligible impact at Mount Portal.

Amenity can also be influenced by light spill from the proposed development. With continued increases in urban development within the region expected over the development period the specific contribution of the proposed airport would be expected to diminish.

38.3.3. Outstanding universal value

Operation of the airport in the long term would have no direct impact on the outstanding universal value of the GBMA. Indirect impacts on the outstanding universal value would be expected to be limited to potential noise and air quality impacts. These potential impacts are described and their significance assessed in Table 38–3.

The assessment of significance is based on the requirements of the EPBC Act Significant Impact Guidelines 1.1, which state that an action is likely to have a significant impact on the World Heritage values of a declared World Heritage property if there is a real chance or possibility that it would cause:

- one or more of the World Heritage values to be lost;
- one or more of the World Heritage values to be degraded or damaged; or
- one or more of the World Heritage values to be notably altered, modified, obscured or diminished.

Table 38–3 – Operational impacts on Outstanding Universal Value of the GBMWHA – long term (2063)

Criterion/element	Attributes	Operational impacts	Assessment of significance
Criterion (ix) Ongoing evolutionary processes	• Outstanding and representative examples of: ▪ evolution and adaptation of the genus Eucalyptus and eucalypt-dominated vegetation on the Australian continent; and ▪ products of evolutionary processes associated with the global climatic changes of the late Tertiary and the Quaternary. • Centre of diversification for the Australian scleromorphic flora, including significant aspects of eucalypt evolution and radiation; and • Primitive species of outstanding significance to the evolution of the earth's plant life: ▪ Wollemi pine (*Wollemia nobilis*); and ▪ Blue Mountains pine (*Pherosphaera fitzgeralii*).	Impacts on these attributes would only occur if there were direct loss through ground disturbance or significant pollution resulting in loss of habitat or alteration to evolutionary processes. Noise and air emissions represent indirect impacts and given the distance from the airport, the predicted emission levels are not considered to pose a threat to these listed values. The assessment of these impacts indicates that noise from overflights would not impact evolutionary processes. Air emissions from the long term airport operations are not considered to represent a material contribution to global climate change which may impact on these processes. Direct emissions from fuel jettisoning are rare and fuel evaporates before reaching the ground. As such, this would not have an impact on evolutionary processes. Outstanding and representative examples of evolutionary processes relate to pre-historical processes associated with climatic, geological, biological and ecological factors which have shaped the development of the GBMA. Similarly the significant aspects of scleromorphic flora and the existence of primitive species present in the GBMA are representative of evolutionary processes. No direct or indirect operational activities would have an impact on these processes in the GBMA and, as such, no discernible impact to attributes under this criterion would likely occur as a result of operation of the proposed airport.	The operation of a long term airport would not result in direct impacts on the attributes demonstrated within the GBMA relevant to evolutionary processes. The indirect impacts of a long term airport would not result in a World Heritage value being lost, degraded or damaged, or notably altered, modified, obscured or diminished. Accordingly, the proposed long term airport development would not have a significant impact on the attributes of this World Heritage criterion.

Criterion/element	Attributes	Operational impacts	Assessment of significance
Criterion (x) biological diversity	• Outstanding diversity of habitats and plant communities; • Significant proportion of the Australian continent's biodiversity (scleromorphic flora); • Primitive and relictual species with Gondwanan affinities; • Plants of conservation significance including 114 endemic species and 177 threatened species; and • Habitat that supports 52 mammal species, 63 reptile species, over 30 frog species and about one-third of Australia's bird species.	Impacts on these attributes would only occur if there were direct loss through on ground impacts or significant pollution resulting in loss of habitat or alteration to biological diversity. Noise and air emissions represent indirect impacts and given the distance from the airport site, predicted emission levels are not considered to pose a threat to these listed values. The assessment of these impacts indicates that noise from overflights would not impact biological diversity values. While peak noise levels associated with overflights may disturb species close to operations, flights to and from a long term airport over the GBMA, would generally be more than 5,000 feet above ground level, and would not exceed 55 dBA. These intermittent noise levels are unlikely to disturb fauna within the GBMA. Air emissions from the operation of a longer term airport are not considered to represent a material contribution to climate change which may impact biodiversity and direct emissions from fuel jettisoning would not impact biological diversity values. An assessment of the potential for the proposed development to impact upon biodiversity is provided in Chapter 39. Based on that assessment, no direct or indirect operational activities would impact on biological diversity of the GBMWHA and as such no discernible impact on the attributes under this criterion would likely occur as a result of operation of a long term airport.	The operation of a long term airport would not result in direct impacts on the examples of biological diversity present within the GBMA. The indirect impacts of a long term airport would not result in a World Heritage value being lost, degraded or damaged, or notably altered, modified, obscured or diminished. Accordingly a long term airport would not have a significant impact on the attributes of this World Heritage criterion.

Criterion/element	Attributes	Operational impacts	Assessment of significance
Integrity	• Sufficient size to protect the biota and ecosystem processes; • Largely protected by adjoining public lands of state forests and state conservation areas; • Statutory wilderness designation over 83.5 per cent of the property; • Closed and protected catchment for the Warragamba Dam; • Plant communities and habitats occur almost entirely as an extensive, largely undisturbed matrix almost entirely free of structures, earthworks and other human intervention; and • Custodial relationship of Aboriginal people from six language groups through ongoing practices that reflect both traditional and contemporary presence	The operation of the airport in the long term would not directly affect the physical size of the GBMA or the adjoining lands. Statutory provisions which provide protection to wilderness areas and the Warragamba Dam would not be impacted as the project will not directly encroach upon wilderness areas and indirect impacts are not expected to alter the wilderness values for which these areas have been designated under the National Wilderness Inventory. The operation of the airport in the long term would have no direct or indirect impact on the plant communities and habitats within the property. The operation of the airport in the long term would not directly or indirectly impact on the maintenance of Aboriginal cultural practices within the GBMA.	A long term airport development would not result in the loss of any elements necessary for the property to express its outstanding universal value. A long term airport would not reduce the size or change the boundary of the GBMA and would not impact on any features and processes that convey the property's outstanding universal value. An airport would not exacerbate existing threats to the integrity of the GBMA in the long term.

38.3.4. Other values

Table 38–4 provides an assessment of the potential long term impacts of an airport on the additional values of the GBMWHA identified in the Strategic Plan. These values complement and interact with the property's World Heritage values but are not part of the defined natural values for which the property is listed. The assessment of these values is relevant to the National Heritage listing of the GBMA.

Table 38–4 – Operational impacts on other important values of the GBMA – long term (2063)

Value	Attributes	Operational impacts	Assessment of significance
Geodiversity and biodiversity	• Extensive dissected sandstone plateaus; • Karst landscapes with several cave systems; • Prominent basalt-capped peaks; and • Quaternary alluvial deposits.	Potential impacts on this value would only occur if there were direct loss through ground impacts or pollution resulting in loss of geodiversity and biodiversity. No direct or indirect operational activities would have an impact on these processes and as such no impact on this value would occur as a result of operation of an airport in the long term.	A long term airport would not have a significant impact on the geodiversity and biodiversity of values associated with the GBMWHA.
Water catchment	• Wild rivers; • Pristine and relatively undisturbed catchment areas; and • Substantial contribution to maintaining high water quality.	Potential impacts on this value would only occur if there were direct loss through ground impacts or pollution resulting in harm to a water catchment. A portion of the GBMWHA fronts the Nepean River downstream of its confluence with Duncans Creek. The Duncans Creek catchment only covers approximately 11 percent of the airport site, the majority of which is outside of the footprint of the proposed works. In addition with the implementation of the proposed water quality control measures the impact to this creek and therefore changes to water quality and hydrology have very low potential to impact water quality in the Creek and the Nepean River. The remainder of the site discharges to the South Creek catchment with discharges to the Nepean River downstream of the GBMA. No direct or indirect operational activities would have an impact on these catchments and waterways and, as such, no impact on these values would occur as a result of operation of a proposed airport in the long term.	A long term airport would not have a significant impact on the water catchment values associated with the GBMA.
Indigenous heritage values	• Prominent landscape features with spiritual significance: ▪ Mount Yengo; and ▪ Coxs and Wollondilly River valleys. • Aboriginal rock art; and • Potential for uncovering further significant sites.	Operation of an airport in the long term would not directly impact on sites within the GBMWHA that have Indigenous heritage values. The only forms of indirect impact on cultural heritage values that can be reliably anticipated by this assessment are the temporary loss of contextual value from the periodic intrusion of low levels of aircraft noise. Mount Yengo is located in the north eastern extent of the GBMWHA and is not expected to be impacted by overflights or noise from aircraft. Similarly the Coxs River and Wollondilly River valley are located in areas of little to no noise impact.	An airport would not have a significant impact on the Indigenous heritage values associated with the GBMWHA in the long term.

Value	Attributes	Operational impacts	Assessment of significance
Historic heritage values	• Small graziers' huts; • Cedar logging roads and stock routes; • Ruins of oil shale mines and coal/shale mines; • Road and transport routes; and • Recreation and tourism.	Operation of an airport in the long term would not directly or indirectly impact on sites of historic cultural heritage within the GBMA. Indirect impacts on recreation and tourism are considered below.	A long term airport is not expected to have a significant impact on the historic heritage values associated with the GBMA.
Recreation and tourism	• Canyoning, bushwalking, rock climbing, nature observation, scenic driving, photography; • Picnic sites and basic camping facilities; • Catering, tours, accommodation; and • Direct and indirect contribution to the employment, income and output of the regional economy.	Key areas of recreation and tourism have been identified and assessed in regard to potential impacts from operation of a long term airport. While some areas are expected to experience intermittent noise levels above 50 dBA, such areas are limited in the context of the entire property. Similarly visual and lighting impacts are not considered to represent a significant change to existing conditions for recreation and tourism. The major tourism areas around Katoomba and Wentworth Falls would not be impacted by aircraft noise. Potential impacts may occur associated with increased traffic due to increased tourism in the region. However, these are expected to be limited to existing traffic routes and be limited to minor increases. Some increases in tourism development and infrastructure may occur, as a result of the increased tourism numbers, in the longer term result in an increase in regional traffic and economic development associated with tourism in the region. However, potential impacts from these facilitated developments can be effectively managed through the implementation of existing management plans for the region.	A long term airport would not have a significant impact on the recreation and tourism values associated with the GBMWHA.

Value	Attributes	Operational impacts	Assessment of significance
Wilderness	• Extensive natural areas; • Absence of significant human interference; • Opportunity to maintain integrity, gradients and mosaics of ecological processes; • Opportunities for solitude and self-reliant recreation; and • Aesthetic, spiritual and intrinsic value.	The wilderness areas of the GBMA are generally associated with the Nattai National Park and the Wollemi National Park. With lower noise levels potentially also affecting Blue Mountains and Kanangra Boyd National Parks (e.g. effects on Grose and Kanangra Boyd Wilderness Areas. Access to these areas is generally limited to hikers and low impact tourism. These limitations restrict the number of people within the area and as such limits the number of people potentially affected. Some areas of Nattai National Park and Wollemi National Park would be affected by maximum noise levels associated with infrequent overflights of Boeing 747 aircraft, an aircraft type gradually being phased out by airlines. The majority of aircraft using the airport such as the A320 have minimal noise impacts on the GBMA and it is expected that future generations of aircraft would continue to develop quieter technologies which would reduce noise impact further. A small proportion of the wilderness areas may be impacted by visual and lighting changes; however these are considered to be insignificant for the vast majority of wilderness areas. A potential increase in tourism numbers in the longer term may impact the wilderness experience of some areas.	A long term airport is not expected to have a significant impact on the wilderness values associated with the GBMA.
Research and education	• High scientific value discovered and undiscovered; • Scientific research into the identification, conservation and rehabilitation of World Heritage values, best management practice and threat abatement; and • Education value for schools and universities.	Operation of the proposed airport is not expected to have an impact on the biological diversity of the GBMA in the long term and, as such, the availability of the area for scientific investigation and research would not be limited.	An airport would not have a significant impact on the research and education values associated with the GBMA in the long term.

Value	Attributes	Operational impacts	Assessment of significance
Scenic and aesthetic	• Vertical cliffs, waterfalls, ridges, escarpments; • Outstanding vistas, uninterrupted views of forested wilderness; • Extensive caves; and • Sandstone canyons and pagoda rock formations.	Aircraft overflying the key lookouts that take advantage of the unique scenic qualities of the GBMA would be more than 6,000 feet above the relevant ground level and at this altitude would have limited visual intrusion. Similarly visual and lighting impacts are not considered to represent a significant change to existing conditions for scenic and aesthetic amenity.	Based on the altitude of aircraft overflying scenic areas, it is not expected that a significant impact would occur as a result of the operation of an airport in the long term.

38.3.5. Influence on existing threats

Table 38–5 provides a description of a long term airport's influence on existing threats identified for the GBMWHA in the Strategic Plan (DECC 2009c).

Table 38–5 – Operational impacts on other important values of the GBMA – long term (2063)

Threat	Project influence
Uncontrolled and inappropriate use of fire	The only risk of fire associated with the operation of an airport in the long term would be as a result of an aircraft crash. This would be a very rare and unlikely event and is not considered to be a contributory factor in the overall threat of uncontrolled and inappropriate use of fire.
Inappropriate recreation and tourism activities, including development of tourism infrastructure	A long term airport would provide increased aviation capacity in the Sydney region, which could also parallel a growth in tourism and visitation for the GBMA. Such an increase in tourism may influence potential for inappropriate tourism development. However it is very unlikely that an airport would directly contribute to inappropriate development or uncontrolled visitor access particularly within the context of strong management plans which are in place for the GBMWHA. Other factors such as Sydney's expanding population are likely to drive the need for any new management responses to threats posed by increased visitations.
Invasion by pest species including weeds and feral animals	No direct impacts on biodiversity are expected as a result of airport operations in the long term. It is very unlikely that the proposal would contribute to threats associated with weed and pest species.
Loss of biodiversity and geodiversity	Loss of biodiversity and geodiversity would only occur as a direct loss through ground impacts or significant pollution resulting in loss of habitat or alteration to evolutionary processes. Noise and air emissions from overflying planes are not expected to adversely impact biodiversity or geodiversity. As such the indirect impacts associated with an airport are not considered to be a contributing factor to this threat in the long term.
Impacts of human enhanced climate change	An airport is expected to have a marginal contribution to overall transported related GHG emissions for 2030. A predicted overall contribution of 0.59 percent of GHG emissions is considered to be negligible. As such an airport is not considered to be a contributing factor to this threat in the long term.
Lack of understanding of heritage values	This threat would be relevant if no assessment of potential impacts was undertaken. An assessment of heritage values has been undertaken and as such a long term airport development is not considered to be a contributing factor to this threat.

38.4. Considerations for future development stages

Mitigation and management of potential noise impacts on the GBMA would be achieved through the planning and implementation of appropriate flight paths, airspace design and airport operating procedures to support long term airport operations. A future design process would include consideration of noise abatement opportunities and would require extensive consultation with airlines, the community and other stakeholders as part of a separate regulatory approvals process under the *Airspace Act 2007*.

The current assessment based on indicative long term airspace management arrangements shows that the level of impact on the Greater Blue Mountains, including the World Heritage and National Heritage values of the GBMA is likely to be low. The potential to further reduce the noise and visual impact from aircraft flying over wilderness and other areas of the GBMA would be important considerations in determining formal airspace and operational arrangements prior to the commencement of dual runway operations at the airport site.

38.5. Summary of findings

At its closest point, the GBMA is approximately eight kilometres from the airport site. As such, no direct impacts are expected on the World Heritage values from future construction activities or operation of an airport at Badgerys Creek. Potential indirect impacts on World Heritage and National Heritage values from the long term operation of an airport were assessed having regard to the attributes identified in the Statement of Outstanding Universal Value for the GBMWHA and the complementary values of the area as defined in the GBMA Strategic Plan. The assessment considered noise, air emissions and amenity impacts from overflight of aircraft.

The assessment's findings are that a long term airport would not have a significant impact on the GBMA. In particular, the indirect impacts of airport operation in the long term would not result in an attribute of the property being lost, degraded or damaged, or notably altered, modified, obscured or diminished.

39. Other environmental matters

39.1. Introduction

This chapter provides information on the remaining environmental matters not included in the preceding chapters. The strategic level assessment builds on the consideration of potential impacts associated with the Stage 1 development as appropriate to an indicative long term airport development.

The detailed design of the long term development would be prepared as part of the master planning process under the Airports Act and would therefore be subject to further assessment and approval requirements. This chapter therefore provides an overview of the likely scale of potential impacts associated with the long term development, and considerations for future development.

This chapter presents the following potential issues and impacts:

- biodiversity;
- topography, geology and soils;
- Aboriginal heritage;
- European heritage;
- resource and waste;
- hazard and risk; and
- human health.

39.2. Biodiversity

39.2.1. Existing environment

The airport site is part of an elevated ridge system dividing the Nepean River and South Creek catchments on the Cumberland Plain. The airport site features remnant patches of grassy woodland and narrow corridors of riparian forest within extensive areas of derived grassland, cropland and cleared, developed land. The main land uses are agriculture and low density rural-residential development.

A total of 280 terrestrial plant species, including 28 threatened species under the EPBC Act and the *Threatened Species Conservation Act 1995* (TSC Act), and 78 exotic species have been identified at the airport site. Field surveys confirmed the presence and distribution of five native and two non-native plant community types or vegetation zones at the airport site, including areas of endangered ecological communities listed under both the EPBC Act and the TSC Act. Stands of these plant community types include a variety of disturbance levels including near-intact vegetation in 'moderate/good – high' condition, partially cleared or regrowth vegetation in 'moderate/good – poor' condition and extensively modified areas in 'cleared' condition. Accordingly, nine native and two non-native vegetation zones (plant community types and broad condition classes) were identified and mapped within the airport site, as shown in Figure 39-1A-D.

A total of 172 terrestrial fauna species, including one threatened species under the EPBC Act and eight threatened species under the TSC Act, and a number of introduced species have been identified at the airport site. An additional 21 species of threatened fauna are considered likely to occur.

39.2.2. Assessment of impacts during construction

Construction of the long term development would result in both direct and indirect impacts on terrestrial and aquatic flora and fauna.

39.2.2.1. Direct impacts

Construction of the long term development would result in the removal of approximately 588 hectares of vegetation. The majority of this vegetation (approximately 461 hectares) consists of exotic grassland, cleared land and cropland dominated by exotic species and noxious and environmental weeds. Approximately 127 hectares of native vegetation would be removed. Vegetation removal by vegetation zone is summarised in Table 39–1.

The removal of vegetation (in addition to the loss of streams, artificial wetlands (farm dams) and associated aquatic habitats) at the airport site would result in the loss of foraging, breeding, roosting, sheltering and/or dispersal habitat for various fauna species.

The long term development area would not be cleared until required for future aviation development or other associated uses. This approach means that impacts on biodiversity values would be avoided for as long as is practicable.

Table 39–1 – Estimated vegetation removal by vegetation zone – long term development

Vegetation zone	Conservation status under applicable legislation		Direct impact (hectares)
	EPBC Act status	TSC Act status	
Native vegetation zones			
Good condition Grey Box – Forest Red Gum grassy woodland on flats (HN528)	CEEC	CEEC	43.0
Poor condition Grey Box – Forest Red Gum grassy woodland on flats (HN528)		CEEC	21.3
Good condition Grey Box – Forest Red Gum grassy woodland on hills (HN529)	CEEC	CEEC	11.1
Poor condition Grey Box – Forest Red Gum grassy woodland on hills (HN529)		CEEC	7.0
Good condition Forest Red Gum – Rough-barked Apple grassy woodland (HN526)		EEC	21.9
Poor condition Forest Red Gum – Rough-barked Apple grassy woodland (HN526)		EEC	10.4
Good condition Broad-leaved Ironbark – Grey Box – *Melaleuca decora* grassy open forest (HN512)	CEEC	EEC	2.5
Poor condition Broad-leaved Ironbark – Grey Box – *Melaleuca decora* grassy open forest (HN512)		EEC	0.6
Good condition artificial freshwater wetland on floodplain (HN630)			9.6
Total native vegetation			**127.4**
Non-native vegetation zones			
Exotic grassland			279.2
Cleared land or cropland			181.4
Total non-native vegetation			**460.6**
Total vegetation			**588.0**

CEEC = critically endangered ecological community; EEC = endangered ecological community.

39.2.2.2. Indirect impacts

The long term development at the airport site is expected to result in a similar set of indirect impacts as for the Stage 1 development (refer to Chapter 16 in Volume 2). Potential indirect impacts would include:

- increased fragmentation of native vegetation and habitat in the locality and region;
- weed invasion of adjacent vegetation or aquatic areas, which may reduce habitat quality for native flora and fauna;
- edge effects, which may reduce habitat quality for native flora and fauna in adjacent areas;
- erosion and mobilisation and transportation of sediment, which could reduce habitat quality for flora and fauna species by reducing plant and animal health in adjacent areas of vegetation and aquatic areas downstream;
- generation of dust, which could reduce plant and animal health in adjacent areas of vegetation;
- the risk of habitat degradation from accidental spills of fuel or the mobilisation of contaminants due to earthworks;
- further alterations to the hydrology of catchments (noting that the airport would be designed to avoid adverse changes to hydrology and may result in an overall improvement in water quality);
- generation of noise, light and vibration, resulting in the disturbance of fauna that reside or use habitats near the construction area; and
- potential spread or introduction of pathogens such as Phytophthora, Myrtle Rust and Chytrid fungus into adjacent native vegetation and downstream habitats through vegetation disturbance and increased human traffic.

39.2.3. Assessment of impacts during operation

The long term development would result in a similar set of operational impacts as for the Stage 1 development (refer to Chapter 16 in Volume 2). Potential operational impacts would include:

- increased risk of bird and bat strike with the increased volume of aircraft traffic and associated need to control bird habitat both on and surrounding the airport site;
- the risk of terrestrial fauna mortality through vehicle strike, although the initial operation of the airport and increased development of industrial and commercial areas around the airport site is likely to result in a reduced risk over time, as less habitat is available for these fauna species;
- the risk of habitat degradation from accidental spills of fuel, pesticides, herbicides or transported goods;
- increased noise, light and vibration which may result in the further displacement of less-tolerant species from habitats adjoining the airport site;
- the risk of fires which may spread to adjacent vegetation; and

- introduction of exotic species.

39.2.4. Assessments of significance

This section summarises impacts on matters of national environmental significance (MNES) and on state-listed threatened species, populations and ecological communities from the construction and operation of the long term development.

39.2.4.1. Impacts on matters of national environmental significance

Assessments of significance for MNES have been prepared in accordance with the Significant Impact Guidelines 1.1 – Matters of National Environmental Significance (DoE 2013a) and the Significant Impact Guidelines 1.2 – Actions on, or Impacting upon, Commonwealth Land and Actions by Commonwealth Agencies (DoE 2013b). The assessments of significance are included as Appendix D of Appendix K1 in Volume 4. Assessments of significance were prepared based on the assumption that the entire airport site would be developed.

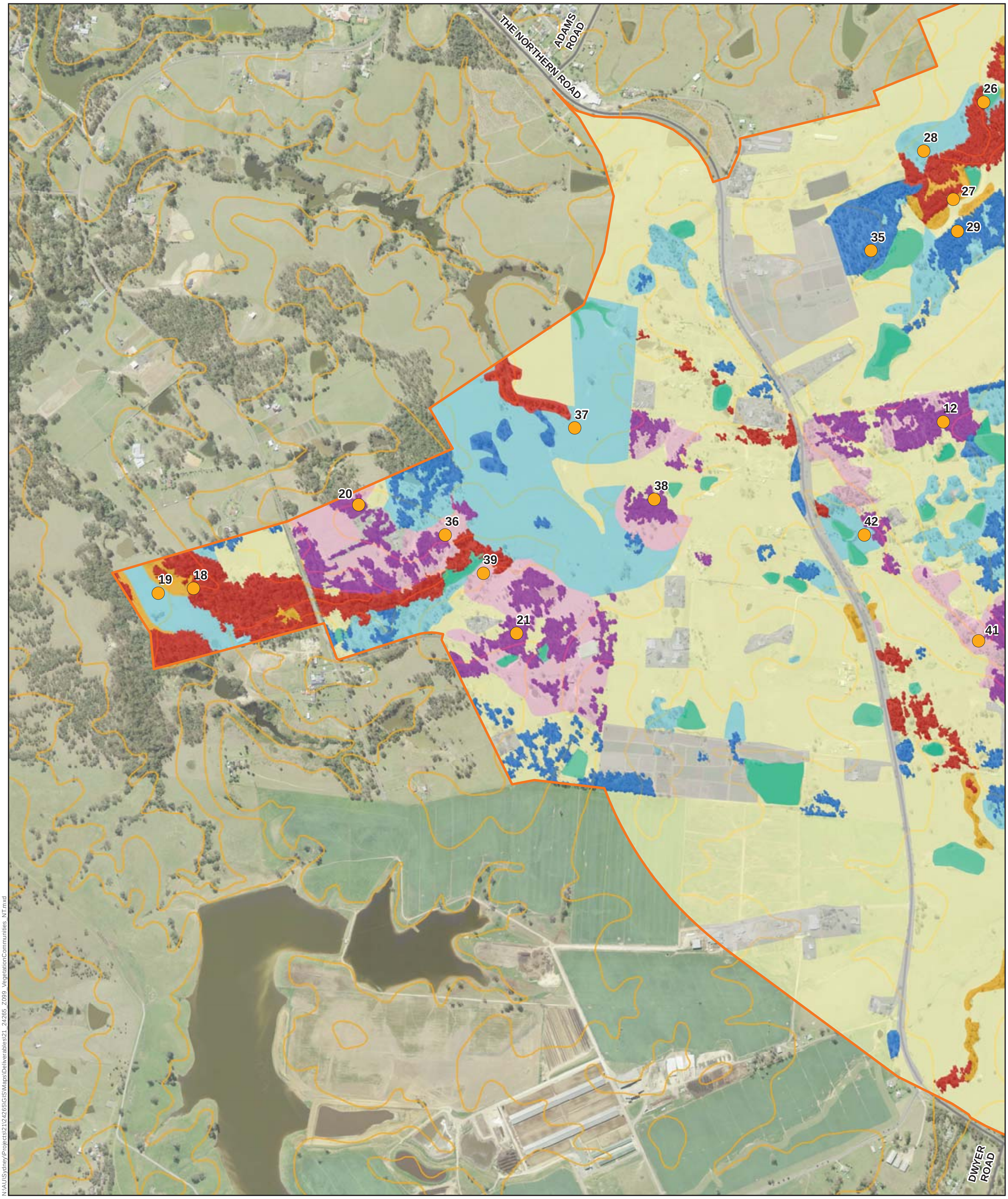
A significant impact was determined for Cumberland Plain Woodland and the Grey-headed Flying-fox. Construction and operation of the long term development would also have a significant impact on plants and animals on Commonwealth land. The key findings of the assessments are summarised in Chapter 16 in Volume 2.

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

An assessment of impacts was undertaken for threatened species, populations and ecological communities listed under the TSC Act. A significant impact was determined for one threatened flora population (*Marsdenia viridiflora* subsp. *viridiflora*) and for three threatened ecological communities (Cumberland Plain Woodland, River Flat Eucalypt Forest and Shale-Gravel Transition Forest). In addition, a significant impact was determined for one threatened invertebrate (the Cumberland Plain Land Snail) and four threatened bat species (the Eastern False Pipistrelle, Eastern Freetail-bat, Greater Broad-nosed Bat and Yellow-bellied Sheathtail-bat). The key findings of the assessment are summarised in Chapter 16 in Volume 2.

39.2.5. Considerations for future development

Chapter 16 in Volume 2 sets out the mitigation and management measures that are proposed to address impacts on terrestrial and aquatic flora and fauna for the Stage 1 development, including an offset for the residual impacts to biodiversity values. These measures would also generally apply to the construction and operation of the long term development. Appropriate offsetting would also be required as part of any future approvals for the long term development.



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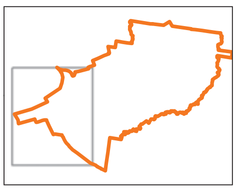
Data Source: Please refer to "Digital Data Sources" on the second page of the EIS

LEGEND

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



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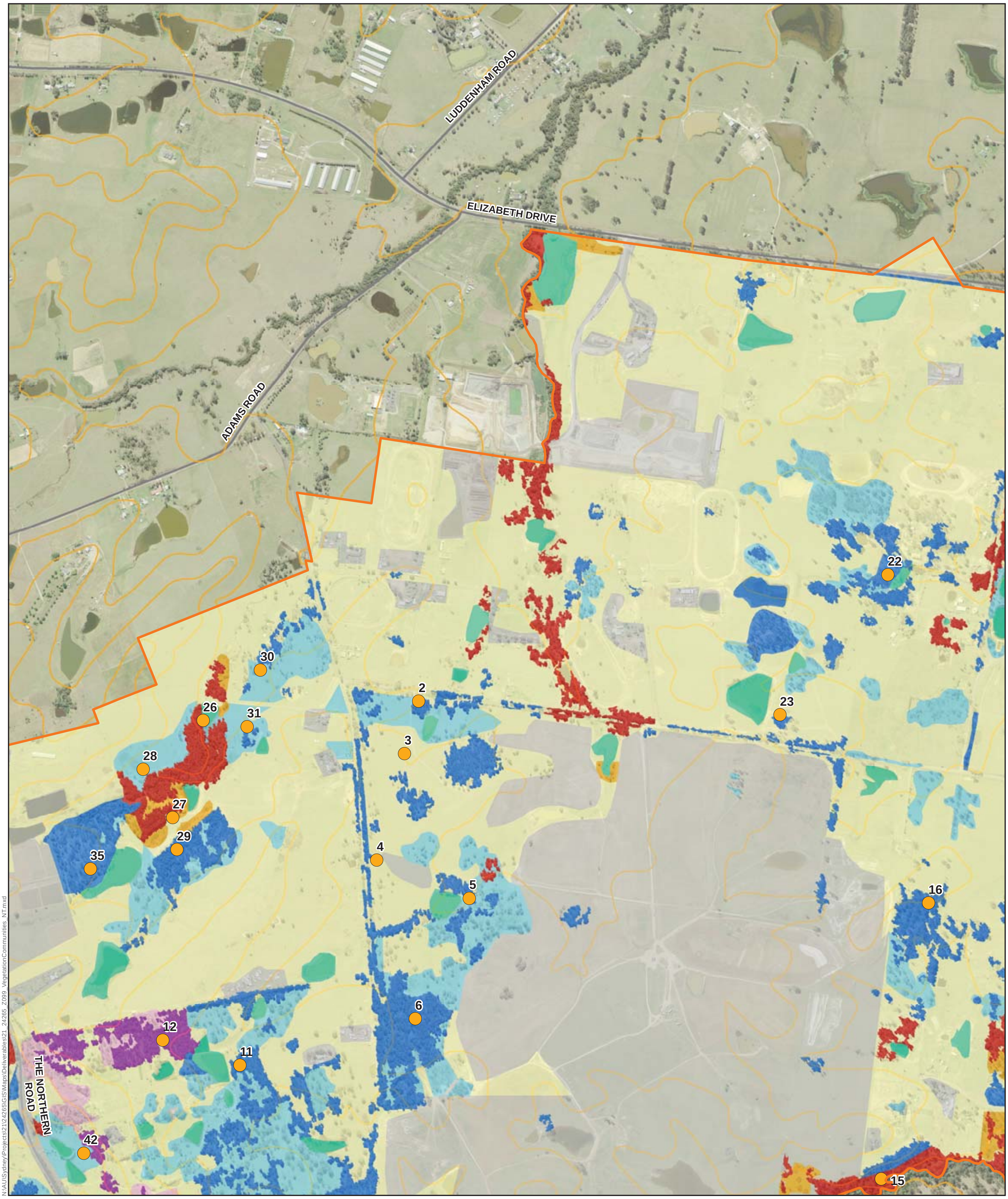
Kilometres

Figure 39-1A - Vegetation zones within the airport site



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

LEGEND

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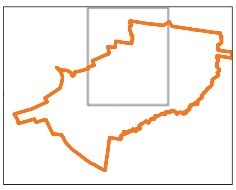
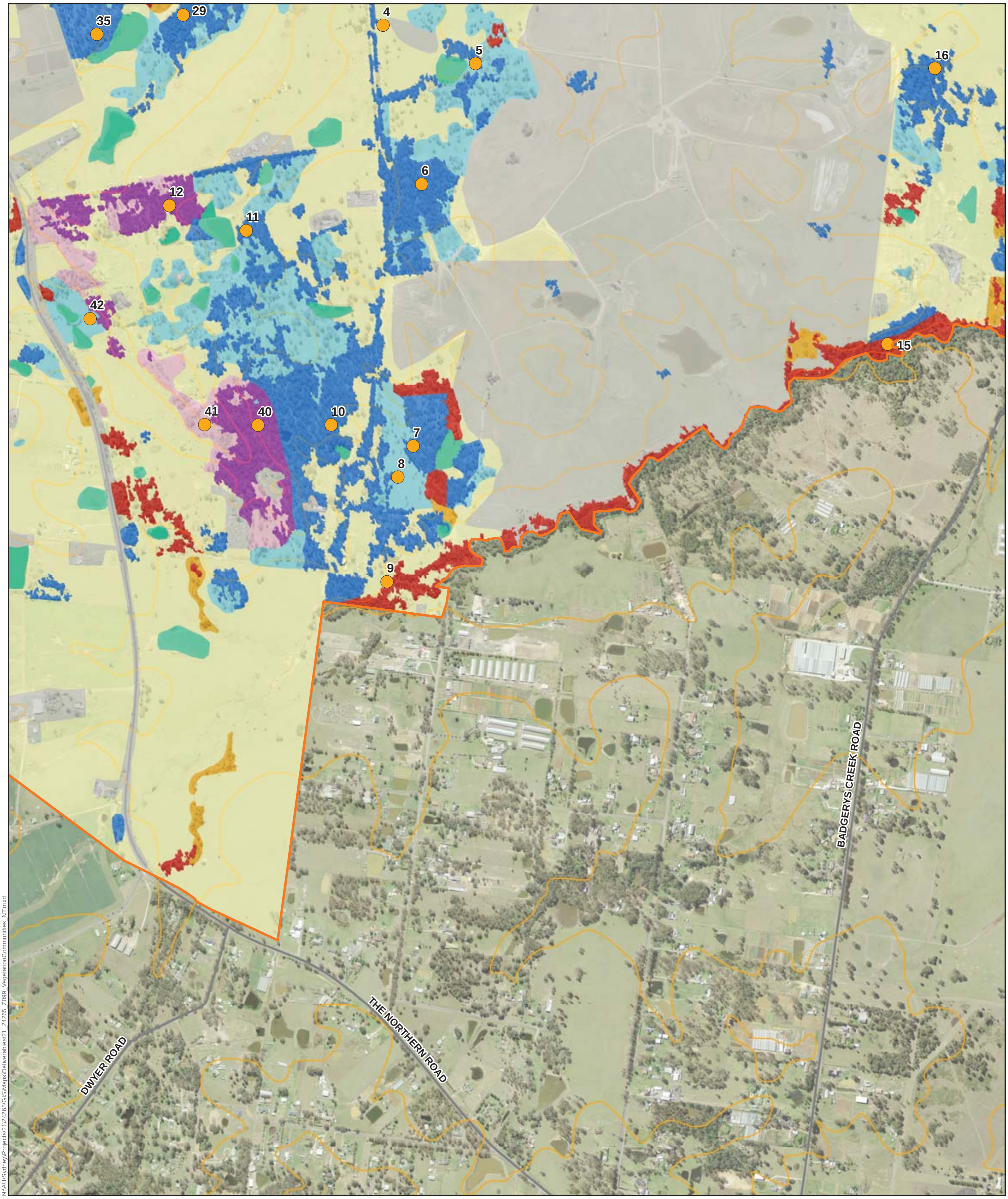
- Exotic grassland
- Cleared land or cropland



0 2 4 8
Kilometres

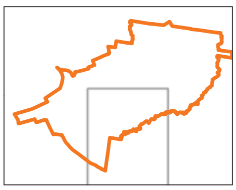
Figure 39-1B - Vegetation zones within the airport site



LEGEND

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

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



0 2 4 8

Kilometres

N

Figure 39-1C - Vegetation zones within the airport site

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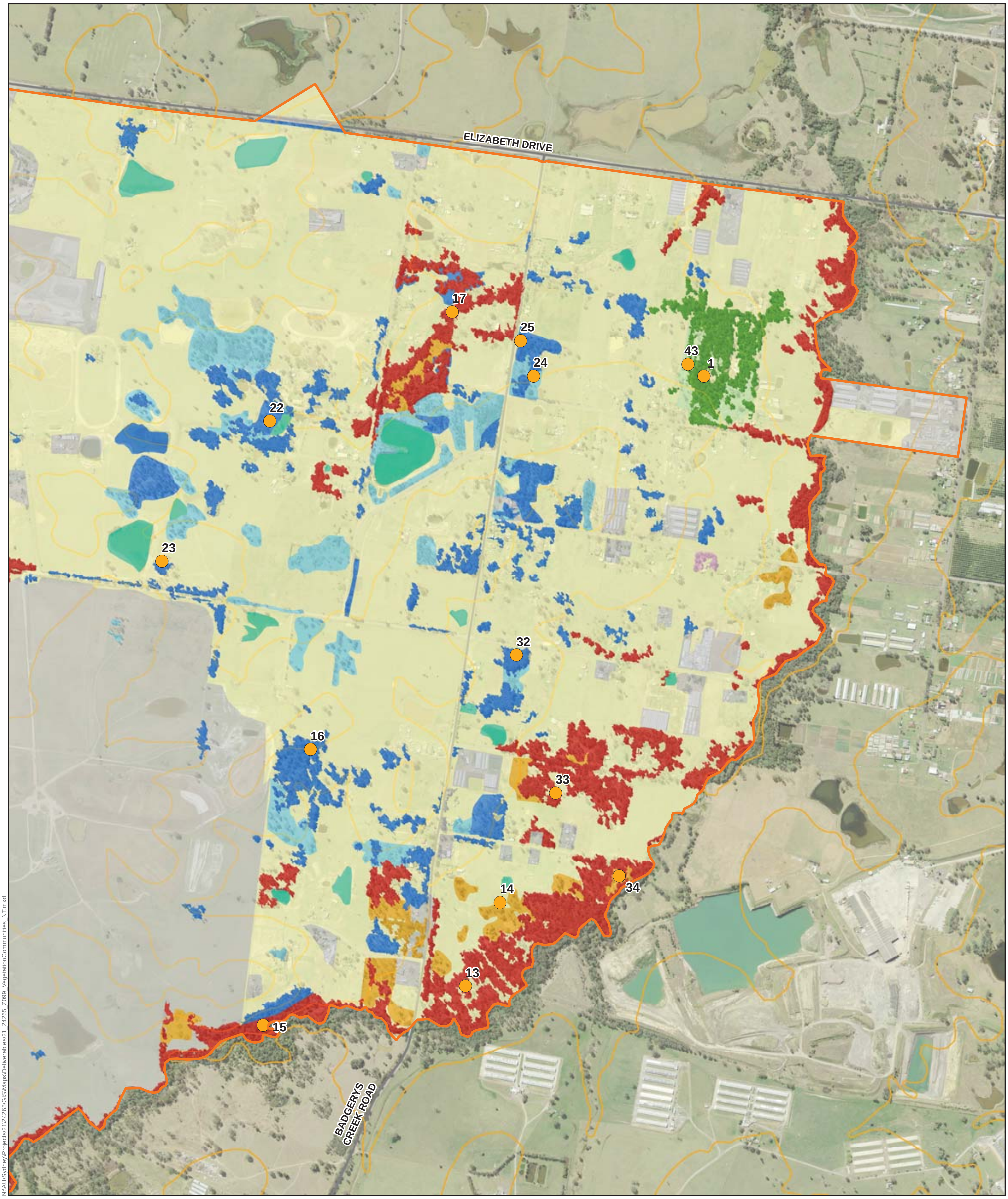

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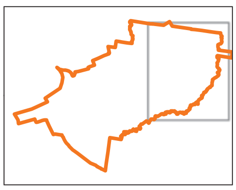
Data Source: Please refer to "Digital Data Sources" on the second page of the EIS

LEGEND

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



0 2 4 8
Kilometres

Figure 39-1D - Vegetation zones within the airport site

39.3. Topography, geology and soils

39.3.1. Existing environment

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

The dominant geological formations beneath the airport site are Bringelly Shale, the Luddenham Dyke and alluvium. Bringelly Shale is a Triassic geological unit mainly comprising claystone and siltstone, with some areas of sandstone. Luddenham Dyke is a Jurassic groundmass of olivine basalt, analcite, augite, feldspar and magnetite that outcrops toward the peak of the ridge in the western portion of the airport site (Bannerman and Hazelton 1990). Alluvium at the airport site consists of Quaternary sedimentary deposits along Cosgrove Creek and Badgerys Creek.

Geotechnical investigations at the airport site generally indicated surficial silt and/or clay topsoils overlying firm residual clays from the weathering of Bringelly Shale, with areas of alluvial gravels, sands, silts and clays associated with Badgerys Creek.

The soils at the airport site are categorised as the Blacktown, Luddenham and South Creek soil landscapes, based on consistent soil type, material, depth and erosion characteristics. Soils are anticipated to be moderately saline, with higher potential for salinity along Badgerys Creek and drainage lines in the south and west of the airport site.

Prior activities at the airport site – including agriculture, light commercial and building demolition – mean there is potential for contaminated land to be present at the airport site.

39.3.2. Assessment of impacts

It is expected that a bulk earthworks programme would be undertaken over the southern portion of the airport site. This would provide a level platform for construction of the long term development including the second runway. The bulk earthworks would change the topography of the southern portion of the airport site from a rolling landscape to an approximately level, built environment.

Clearing and bulk earthworks would increase the surface area and, in some instances, the slope of exposed soil at the airport site. These changes to the landscape would present a risk of increasing erosion. Erosion may occur in the form of runoff during rainfall or windblown dust. Stockpiled topsoil would also present an erosion hazard and would be subject to potential degradation of chemical and physical fertility over time.

The design of the long term development would incorporate landscaped areas and stormwater drainage including grassed swales and detention basins to control the quantity and quality of stormwater runoff. This drainage system would be functional throughout construction and operation to capture surface runoff prior to discharge to receiving waters. Implementation of standard erosion and sediment control measures during earthworks would minimise impacts in relation to soil erosion and degradation.

Construction of the long term development has the potential to interact with existing sources of potential land contamination. Demolition works across the airport site prior to the site preparation and construction of the long term development would include measures to mitigate contamination risks of asbestos and lead based paints. However, historic demolition sites and land use also present a risk of existing contamination. Any contamination discovered during construction would be managed and mitigated to make the land suitable for its intended use and to prevent impacts on human health and the environment.

Accidental release or mobilisation of contaminants has the potential to affect human health and the environment through contact with pathogens (in the case of sewage), inhalation (in the case of asbestos or chemical vapours), or mobilisation to surface waters or bioaccumulation. These events would be avoided in the first instance through the implementation of applicable Australian Standards for the storage and handling of hazardous materials. In the unlikely event of a significant leak of spill or contaminants, remediation would be implemented as soon as practicable.

39.3.3. Considerations for future development

The potential impacts of the construction of the long term development would be typical of a large scale construction project and are expected to be manageable with the implementation of standard stormwater, erosion and dust controls and adherence to industry standards for the storage and handling of chemicals. Other considerations for the mitigation and management of potential impacts arising from future development include designing earthworks and final landforms to integrate with the surrounding landscape with particular emphasis on avoiding steep slopes and the protection of the conservation zone along Badgerys Creek.

39.4. Aboriginal heritage

39.4.1. Existing environment

The airport site has been the subject of a number of previous archaeological assessments. Fifty-one Aboriginal heritage sites have been recorded during these surveys, consisting of surface artefact occurrences and a modified tree. Twenty-three additional sites were recorded at the airport site during the course of the current assessment, which focused on test excavation and characterising the subsurface archaeological resource. The new recordings comprised nine sites with surface artefacts (including a grinding groove site) and 14 sites where subsurface artefacts were confirmed through test pit excavations. The locations of all site recordings to date at the airport site are shown in Figure 39-2.

The test excavation programme included a representative sample of landform types and zones within the airport site. It was determined that a relatively high average artefact incidence occurred across valley floors, basal slopes, first order spurlines and within 100 metres of second, third and fourth order streams.

These findings indicate that Aboriginal heritage sites occur widely across the landscape, but particularly on elevated level ground and slopes within relative proximity of a water source, and that larger sites with higher artefact densities are more likely to be near permanent water.

A more detailed review of the Aboriginal cultural heritage values of the site and surrounding area is provided in Chapter 19 of Volume 2 and in Appendix M1.

39.4.2. Assessment of impacts during construction

Construction of the long term development would affect 23 recorded Aboriginal sites. All of these sites contain artefact occurrences and are listed in Table 39–2.

Eight sites, including the scarred tree (B40) and the grinding groove site (B120), are located within the proposed environmental conservation zone adjacent to Badgerys Creek and would therefore be unaffected by the construction of the long term development.

Table 39–2 – Aboriginal heritage sites directly affected by construction of the long term development

Development area or land use zone	Affected surface sites	Total
North and west of the proposed boundary fence	B3, B15, B31, B42, B46, B59, B66, B67, B68, B74, B75, B76, B90, B95, B104, B117, B118, B123, B124, B125, B126, B133, B132	23
Potentially situated in environmental conservation zone bordering Badgerys Creek	B4, B40, B41, B54, B55, B120, B121, B130,	8
Total		**31**

With regard to the predicted subsurface archaeological resource, construction of the long term development would directly affect approximately 387 hectares of archaeologically sensitive landform. This constitutes about 21 per cent of the airport site. These landform categories, and their affected proportions, are presented in Table 39–3.

The long term development of the airport site would directly affect a large proportion of the remaining Badgerys Creek catchment across the eastern half of the airport site. Consistent with the Stage 1 development, all of the higher relief and prominent topography of the airport site would be transformed into a level and graded platform. This would alter and remove the natural topography, which acts as a means for Aboriginal people to ‘read’ and experience the Aboriginal cultural values of the land.

Table 39–3 – Area and proportion of archaeologically sensitive landforms directly affected by the construction of the long term development

Landform category or feature[1]	Area within long term development area (hectares)	Proportion of airport site	Total of this landform category within whole of airport site (hectares)	Proportion of total landform area within airport site (1,845 hectares[2])
Riparian corridor (100 m either side of drainage line)	112.1	6.1%	369.6	20%
Ridge and spur crests	51.6	2.7%	120.3	6.5%
Broad scale landforms				
Valley floor	136.2	7.4%	184.0	10.0%
Basal slopes	86.7	4.7%	214.2	11.6%
Total	**386.6**	**20.9%**	**888.1**	**48.1%**

Note. 1. These are mutually exclusive categories. The area of fluvial corridors and crests which overlap valley floor or basal slope topography have not been separately tabulated.

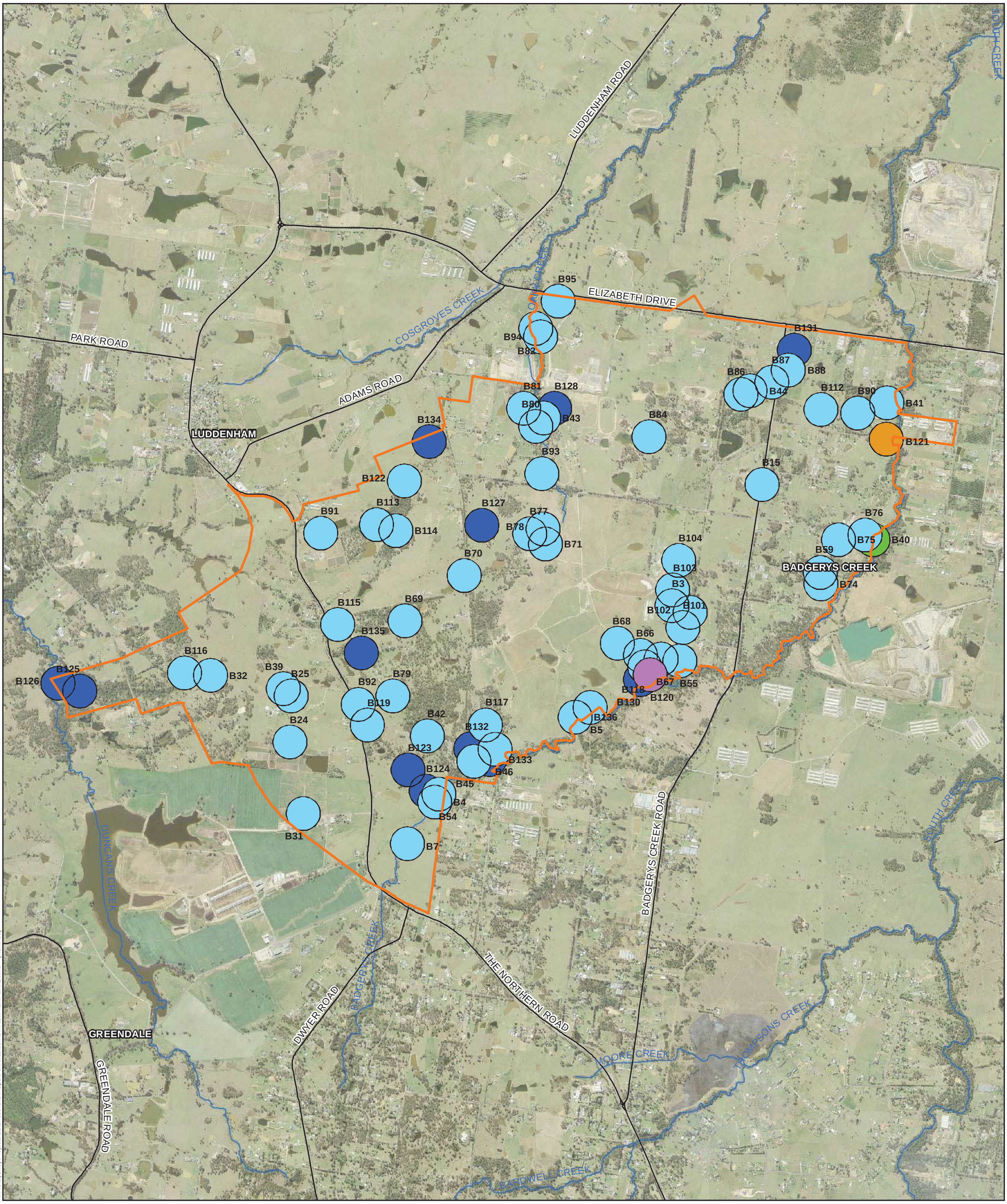
2. This area total includes Commonwealth land that is non-contiguous with the airport site.

39.4.3. Assessment of impacts during operation

Impacts during operation of the long term development would be limited to indirect impacts on adjacent and nearby sites. These may be located within that portion of the Badgerys Creek riparian zone within conservation reserves, or on lands adjoining the airport site. The majority of known Aboriginal heritage sites within approximately 500 metres of the construction impact zone of the long term development consist of artefact occurrences. The heritage values of artefact occurrences are unlikely to be vulnerable to indirect impacts such as loss of context, unless they are subject to public interpretation or visitation based on Aboriginal cultural reasons. The two exceptions are the scarred tree (B40) and the grinding groove site (B120). These sites are situated close to the airport site boundary fence and retain cultural heritage value and potential for public interpretation.

39.4.4. Considerations for future development stages

Chapter 19 in Volume 2 sets out the mitigation and management measures that are proposed to address impacts on Aboriginal heritage for the Stage 1 development. These measures would also generally apply to the construction and operation of the long term development, subject to the assessment of that development as appropriate. These measures may include the conservation of heritage sites, recording and salvage of heritage sites, the commemoration of cultural heritage values at the airport site, curation and repatriation of heritage items, and protocols for the discovery of artefacts and human remains. Consideration would also be given to the requirements of the EPBC Act for the management of places on the airport site with Commonwealth Heritage values.



LEGEND

Airport site

gg - grinding groove

sao + ssao - surface and subsurface artefact occurrence

st - scarred tree

sao - surface artefact occurrence

ssao - subsurface artefact occurrence

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

0 0.25 0.5 1
Kilometres

Figure 39-2 - Aboriginal heritage at the airport site

39.5. European heritage

39.5.1. Existing environment

The assessment of European heritage identified 19 European heritage items at the airport site and an additional 22 heritage items in the surrounding area, as shown on Figure 39-3. The identified items are all considered to be generally of local heritage significance.

The identified European heritage items reflect the historical context of the airport site and European settlement more generally, including early attempts to develop local agricultural and pastoral economies and the emergence of settled village communities. These farmlands have continued in rural use and provide insight into early agricultural production.

European settlement around Badgerys Creek began with land grants to settlers in the early nineteenth century for the purpose of establishing large rural estates for agricultural production to feed the colony's growing population. The site was associated with cropping and later vineyards and orchards, and retains an historic association with markets for the supply of meat and livestock to metropolitan Sydney.

The emergence of a settled village and farm community at Badgerys Creek in the last half of the nineteenth century is historically associated with the breakup of the large estates for closer settlement. This is demonstrated in street alignments, subdivision patterns, dwellings, churches and cemeteries, community gathering places, recreation grounds, park reserves and places of education.

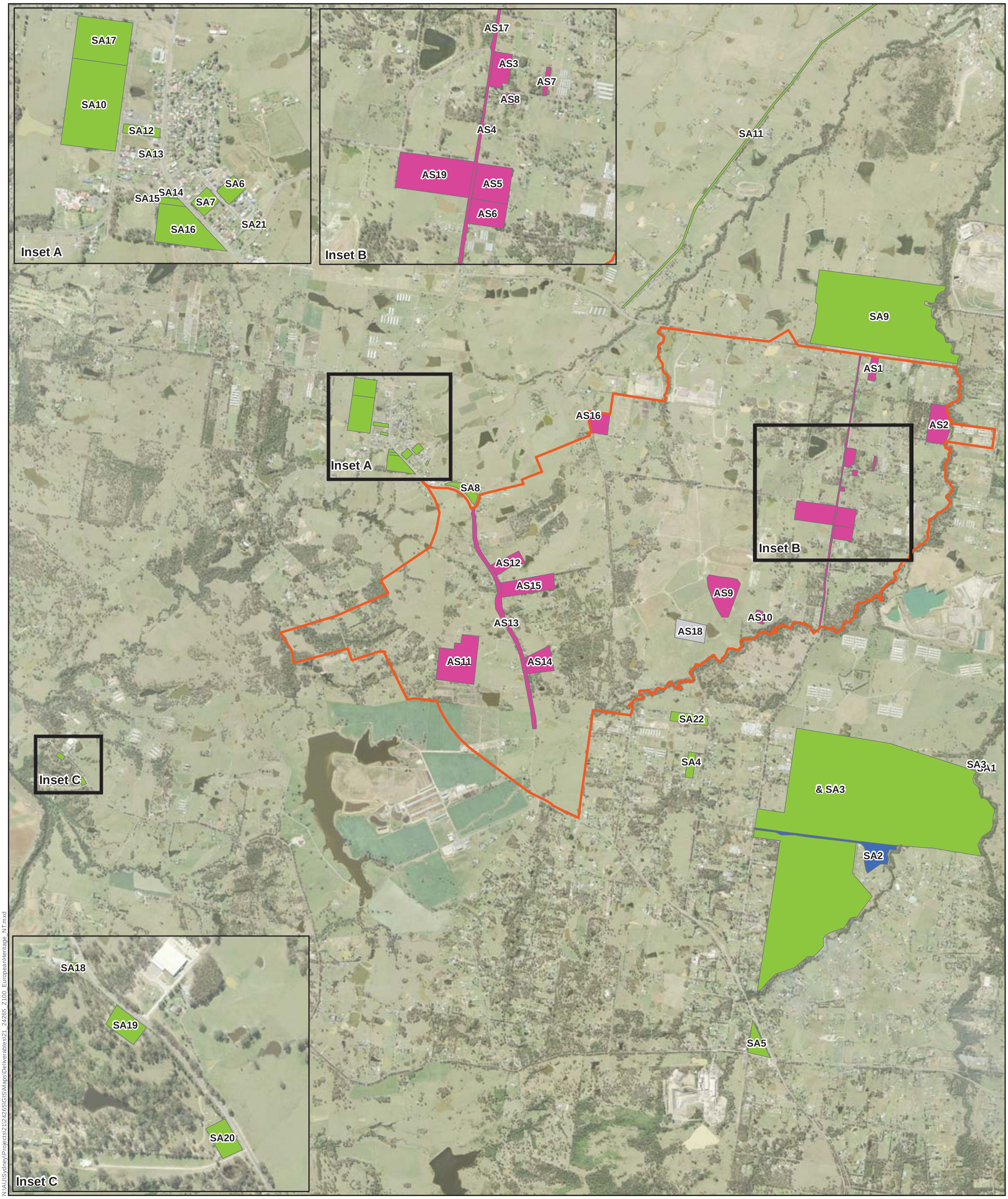
The site includes a public school, which demonstrates the development of public education from the late 1800s. The scale, material and design of the school buildings reflect the evolving fortunes of Badgerys Creek, education reform, the local community and architectural styles.

A more detailed review of the European heritage values of the site and surrounding area is provided in Chapter 20 of Volume 2 and in Appendix M2.

39.5.2. Assessment of impacts

Site preparation activities would take place before construction of the long term development and would involve the removal of any remaining structures from the airport site. The European heritage items identified at the airport site would therefore not be present during the long term development of the airport site.

The European heritage items surrounding the airport site would potentially be present during the construction and operation of the long term development. The long term development would not be expected to have a significant impact on the heritage value or conservation significance of these items. While the landscape and views experienced at these places would change, the changes would not materially affect the European heritage values. Similarly, noise from the construction and operation of the long term development would affect the ambience and amenity of these places, but would not be expected to cause material harm to European heritage structures or items.



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

LEGEND

- Airport site

European heritage items

- Commonwealth significance
- Local significance
- State significance
- Undetermined significance

0 0.5 1 2
Kilometres

N

Figure 39-3 - European heritage at the airport site

39.5.3. Considerations for future development stages

A range of measures are proposed to mitigate and manage potential impacts on particular European heritage items at the airport site before site preparation and construction of the Stage 1 development. These measures include archival recording, cultural plantings and exploration of options to relocate structures. The measures to be implemented during Stage 1 are described in more detail in Chapter 20.

The potential impacts of the long term development on the European heritage values at the airport site would be negligible, as all potential impacts would be mitigated and managed prior to the construction of the long term development. Alterations to the landscape, views and ambience would not materially affect European heritage items surrounding the airport site.

39.6. Resources and waste

39.6.1. Waste streams

Establishment of the long term development would involve clearing and a major bulk earthworks programme to achieve a level surface suitable for construction of airport facilities, along with the use of a range of construction materials.

As with any large infrastructure project, the construction and operation of the long term development would involve the consumption of natural resources and has the potential to generate significant quantities of waste.

Key waste streams would include waste vegetation from clearing, waste construction materials such as concrete and timber, food waste and other general waste from terminal facilities, and waste oils, paints and cleaners from maintenance activities. The waste streams that would be generated would be similar to those described for the Stage 1 development included in Chapter 25 of Volume 2.

The volume of resources consumed and waste generated during the construction of the long term development would be similar to the volumes consumed and generated for the construction of the Stage 1 development.

The volume of waste generated during operation, particularly during peak operations, would be substantially greater than during Stage 1 operation. The operational waste volume would increase from about 5,200 tonnes each year during Stage 1, to about 44,000 tonnes each year during the peak operations in the long term.

39.6.2. Considerations for future development stages

As with the management of waste generated by the Stage 1 development, a combination of on-site and off-site management measures would provide a range of options to reuse, recycle, recover and treat waste generated by the long term development. The waste management strategy for the airport would be incrementally augmented in the lead up to the long term development and would incorporate best practice measures including the development of new technologies such as vacuum collection systems if practicable. The implementation of measures to manage waste and thus avoid and mitigate impacts on human health and the environment would be the primary purpose of the waste management strategy.

Despite the increase in waste volume, the overall volume of operational waste would not be significant in the context of the already mature waste management industry in the Sydney region, which has developed to accommodate the needs of many thousands of other commercial waste generators. While the operational long term development would be a major waste generator, the needs of the long term development are expected to be met by the market.

39.7. Hazards and risk

An assessment of hazard and risk was undertaken for the Stage 1 development (refer Appendix H in Volume 4). The assessment identified key hazards and risks associated with the construction and operation of the proposed airport using a precautionary-based approach, consistent with the provisions of the *Work Health and Safety Act 2011* (Cth) and the *Work Health and Safety Act 2011* (NSW). Owing to the preliminary nature of the design, it was not considered appropriate to conduct the full due diligence assessment required by the above legislation. Such an assessment would be conducted subsequently by others.

Despite the assessment being focused on the Stage 1 development, the range of hazards and risks assessed are also relevant to the long term development.

The potential hazards associated with the operation of the proposed airport were divided into airspace hazards (such as bird and bat strike or adverse meteorology) and ground-based hazards (such as fire or flood). The assessment found that the majority of the identified hazards, and their associated risk, would be satisfactorily resolved through:

- further design and approval processes;
- implementation of industry standards; and
- responsibilities of statutory authorities.

Aspects of the above would be undertaken prior to the long term development – including further bird and bat surveys, obstacle limitation surface surveys and protection, design of flight paths and declaration of protected airspace, CASA aerodrome certification, and various separate approval processes for any additional infrastructure. Some of these matters would be revisited or built upon iteratively up to the long term development, such that risks are adequately controlled at all times.

The operation of a second runway, as part of the long term development, would add substantial complexity to the configuration of Sydney basin airspace as well as the expected growth in overall air traffic movements. The development of flight paths associated with the long term development would be subject to a flight path and airspace design and approval process that would include safety as a principal consideration.

A pipeline for the supply of jet fuel would likely be required prior to the realisation of the long term development in 2063. The pipeline would eliminate the transport safety risks associated with the delivery of fuel by road. The corridor for the pipeline would be subject to a separate planning and approval process, which would include consideration of risks to people and property. The timing of the pipeline would be based on negotiation between the airport-lessee company and the fuel supply industry.

The risk of aircraft accidents was assessed by applying contemporary aircraft manufacturer accident data (2013) to expected air traffic movements for the long term development. Based on the expected air traffic movements in 2063, this equated to an accident rate of one in 30 years. It is noted that this rate reflects 2013 accident data and therefore current aircraft technologies and airspace practices. Actual safety performance of the long term airport development would benefit from improvements to technologies and practices over the coming years and decades.

Overall, it is envisaged that the potential hazards and risks of the future development of the airport could be satisfactorily managed in accordance with design and approval processes, industry standards and statutory responsibilities. Progressive improvements to aircraft technologies and airspace practices are expected to occur up to the long term development and would likely be accompanied by improvements in the safety of people and property.

39.8. Human health

An assessment of the predicted risks to human health associated with noise, air emissions, and surface water and groundwater impactsof the long term development was undertaken as part of the preparation of the EIS (refer Appendix G in Volume 4). This health risk assessment builds upon the analysis presented for the Stage 1 development in Chapter 13 of Volume 2.

The health risk assessment was undertaken in accordance with the Australian Government *Guidelines for Health Risk Assessment* (2012) and the *National Health and Medical Research Council Approach to Hazard Assessment for Air Quality* (2006). The health risk assessment uses information about pollutants to estimate a theoretical level of risk for people who might be exposed to defined levels. Health statistics for Sydney have been used as a baseline in the assessment, with information on the health risks of pollutants being drawn from epidemiological studies. Data on existing pollutant levels come from ambient monitoring stations in Western Sydney operated by the NSW Office of Environment and Heritage and the NSW Environment Protection Authority.

The risk assessment process comprises five stages: issue identification, hazard (or toxicity) assessment, exposure assessment, risk characterisation and uncertainty assessment. Through the issues identification stage, it was determined that the primary pathways by which the proposed airport could pose a risk human health were exposure to air pollutants, noise, and surface and groundwater pollutants. While there may be other exposure pathways by which human harm may result, these are considered the primary pathways for which potential health effects of the proposed airport may affect people.

The health risk assessment is based upon the findings of the local and regional air quality, noise and water technical studies undertaken as part of the preparation of the draft EIS. The potential health effects of local air quality, including emissions from aircraft overflights, ground based activity and traffic associated with the proposed airport are key considerations in the assessment.

39.8.1. Assessment of impacts during operation

39.8.1.1. Air quality

The predicted future air quality data used in the health risk assessment has been generated by the local air quality technical report (refer Appendix F1). Given the uncertainties associated with predicting baseline emissions in 2063, as well as emissions from a future aircraft fleet, the long term assessment only considers health impacts associated with exposure to 10 micron (or less) particulate matter (PM_{10}), 2.5 micron (or less) particulate matter ($PM_{2.5}$), and nitrogen dioxide (NO_2). Further details of these limitations are provided in the local air quality technical report at Appendix F1. This chapter also includes an assessment of the predicted risk associated with exposure to ozone, based on data sourced from the regional air quality technical report (refer Appendix F2).

The analysis presented in this section should be viewed in the context of overall health in the Sydney basin. In particular, evidence provided by NSW Health to a Parliamentary Inquiry into health effects of pollution showed that in 2006 it was estimated that between 600 and 1400 deaths per year were attributed to air pollution in the Sydney basin (NSW Parliament 2006).

Particulates

Annual average and 24-hour particulate matter (PM_{10} and $PM_{2.5}$) have been modelled as part of the air quality assessment for the long term development. The average 24 hour National Environmental Protection Measure (NEPM) ambient air quality residential standards for PM_{10} is 50µg/m^3 and for $PM_{2.5}$ is 25µg/m^3.

The highest 24 hour average PM_{10} impact for the long term airport operations is predicted for Rossmore and Mulgoa, with a maximum predicted impact of less than 25µg/m^3. The highest 24 hour average $PM_{2.5}$ impact for airport operations in the long term is predicted for Rossmore and Badgerys Creek, with a maximum predicted impact of less than 16µg/m^3. As such, emissions of particulate matter associated with the long term development would be within NEPM standards.

Having regard to the number of attributable cases from PM_{10} due to long term airport operations, the highest risk is for all-cause mortality from long term exposures, with between two additional deaths per 1000 years and four additional deaths per ten years. All other risks are lower than that predicted for long-term mortality.

Similarly, the highest predicted risk for $PM_{2.5}$ associated with the long term development is for all-cause mortality and cardiopulmonary mortality from long-term exposures with between five additional deaths per 1000 years and three additional deaths per ten years. All other risks are lower than that predicted for these outcomes. The highest predicted impacts are at Rossmore and Kemps Creek.

Nitrogen dioxide

The daily 24-hour nitrogen dioxide concentrations at residential receivers for the long term development are predicted to be low. The air quality assessment identified that for all relevant averaging periods, the nitrogen dioxide levels due to the long term development are below the current NEPM air quality standards. The levels predicted at all residential locations in the vicinity of the airport are similar.

Based on the modelling data, the highest predicted risk is for long-term mortality in people over 30 years of age with between six additional deaths every 100 years and six additional deaths in 10 years predicted for 2063.

Although the predicted nitrogen dioxide levels meet the NEPM standards, it is accepted that there is no threshold for nitrogen dioxide below which adverse health effects are not observed. This means that even meeting the air quality standards means that there is a level of risk associated with exposure to nitrogen dioxide.

Ozone

Peak daily ozone concentrations have been predicted for a number of days of for the long term development and the largest changes in ozone concentration have been calculated. Increases in ozone occur downwind of the airport site which, on most days, is to the south and southwest. Decreases in daily maximum ozone occur only in the vicinity of the airport site and are attributable to ozone suppression by fresh NO_x emissions.

There is general agreement by international agencies including the World Health Organisation and the US EPA that acceptable risk levels fall between one in a million and one in 100,000. The increases in predicted risk for the long term development, falls well within these limits.

For the base year of 2009, the resulting risk for the outcomes assessed is between two in a million (respiratory mortality) and 1.8 in 100,000. For the long term operations, the increase in risk ranges from one in a million for respiratory mortality to nine in a million for emergency department attendances for asthma in children. The largest predicted ozone concentration changes from the airport occur in a different location to the predicted daily peak ozone concentrations.

39.8.1.2. Noise

Aircraft noise

Based on the calculated $L_{night\ outside}$ noise levels, the number of annual additional EEG awakenings in 2063 due to aircraft overflight noise is between zero and ten per person (i.e. up to 0.00114 per cent increase in annual awakenings). The most affected areas would be Luddenham, Greendale and Horsley Park.

To put these results into context, the European Environment Agency (2010) noted that there are usually 24 awakenings per person even during 8-hours of undisturbed sleep at night. For most scenarios the aircraft noise associated with the proposed airport would not increase this number. The exception to this would be in Luddenham where consideration should be given to noise mitigation measures.

In terms of learning and cognitive development in children, hazard quotients less than one are considered to be an acceptable level of risk (enHealth 2012). Most hazard quotients due to the long term development are less than one, indicating that the risk of aircraft overflight noise from each of the proposed modes of operation generally do not pose an unacceptable risk.

In some cases there are marginal exceedances of one. This does not mean that there will be an impact on children's learning and cognitive development but that there is an increased risk, albeit very low. Noise mitigation measures recommended Chapter 31 of the draft EIS would lead to a reduction in this potential risk.

Ground based operations

Noise from ground based operations at the proposed airport site would have a greater impact in the localities closest to the proposed airport, in particular Luddenham. The combined effects of aircraft overflight and ground based operations noise is predicted to lead to an additional 25 EEG awakenings per year (i.e. an 0.3 per cent increase). Other affected areas include Greendale, Kemps Creek, Rossmore and Bringelly.

For ground based sources, the $L_{night\ outside}$ levels predicted for Luddenham exceeded the 55dB threshold. Based on the World Health Organisation exposure response curve, the levels predicted for Luddenham may result in an increase in myocardial infarction of approximately ten per cent. In terms of children's learning and cognitive development, the hazard quotients experienced at Luddenham exceed one suggesting that noise mitigation measures should be implemented.

Noise mitigation measures recommended in Chapter 31 of the EIS would lead to a reduction in this potential risk.

39.8.1.3. Groundwater

Based on available information relating to the types of activities which will be conducted during the long term operation of the proposed airport, there is considered to be minor potential for risks to the environmental values of groundwater in the alluvial and Bringelly Shale aquifers. It is noted however that the potential for exposure to groundwater contaminants by off-site users of extracted groundwater is minimal as bores draw from the Hawkesbury Sandstone aquifer.

39.8.1.4. Surface water

The indicative flight paths for the long term development are located above the catchment areas for Warragamba Dam and Prospect Reservoir. In addition, through consultations there have been concerns raised by parts of the community about the potential for aircraft emissions to impact on the quality of tank water in the area close to the airport site.

Chapter 13 provided a qualitative evaluation of the operation activities and whether there would be an impact to surface water bodies in and around the airport site. This included an assessment of accidental spills of stored chemicals or fuels, release of stored groundwater, aircraft emissions and fuel jettisoning. As with the Stage 1 development, activities associated with the operation of the long term development are considered to have a low risk of impacting on the environmental values of nearby surface water.

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PART H:
Conclusion and Recommendations

40. Conclusion and recommendations

40.1. Introduction

The proposed airport would be developed progressively as demand increases beyond the scope of Stage 1. Additional aviation infrastructure and support services such as taxiways, aprons, terminals and support facilities would be required to service the growing demand. A second runway is forecast to be required by around 2050 and would be located parallel to the first runway with a centre line separation distance of approximately 1,900 metres. The long term capacity of the proposed airport is forecast to service approximately 82 million annual passengers which is equivalent to approximately 370,000 air traffic movements.

It is recognised that implementation of the Stage 1 development would facilitate future growth in the capacity at the proposed airport, so a strategic assessment of the anticipated long term development is considered appropriate.

The high-level strategic assessment recognises the uncertainty in predicting impacts which may occur nearly 50 years into the future and the additional approval and consultation requirements for all future development. The assessment approach provides flexibility in the master planning process for the site to allow land use changes, technological improvements and changes in operational practices to be reflected in future development scenarios.

40.2. Key environmental impacts

The focus of the assessment for the long term development centres on potential impacts of the expanded operations on the amenity of the surrounding community. Key issues considered as part of the assessment of the long term operation of the proposed airport include noise, air quality, human health, traffic and transport, landscape and visual amenity, and socio-economic impacts. Direct physical impacts are also discussed, including those associated with biodiversity, water resources, heritage and planning and land use. A summary of the key findings of the assessment of the long term development are outlined below.

40.3.0 Noise

It is recognised that aircraft noise is one of the most sensitive issues associated with the development of the proposed airport and an increase in air traffic movements has the potential to increase the level of noise disturbance to the surrounding community. Taking this into account, the long term assessment considers aircraft noise impacts for a 2050 scenario which is representative of the single runway operating close to capacity, as well as anticipated impacts for an airport operating with two runways at around 2063.

The flight paths and procedures to be used by aircraft using the proposed airport (either for the single runway or the two runway scenario) are indicative and are required to undergo further detailed consideration prior to being finalised. Other sources of uncertainty such as noise emission levels from future aircraft types, and the role and pattern of movements at a dual runway airport also reduce the certainty in predicting impacts into the future.

For the loudest aircraft operations (long-range departures by a Boeing 747 aircraft or equivalent), maximum noise levels over 85 dBA would be experienced at residential locations near the airport site. Maximum noise levels of 75–80 dBA are predicted within built-up areas in St Marys and Erskine Park. Maximum noise levels from more common aircraft types such as Airbus A320 or equivalent are predicted to be 60–70 dBA in built-up areas around St Marys and Erskine Park, and over 70 dBA in some areas to the south-west of the airport such as around Greendale.

The extent to which particular areas would be potentially exposed to aircraft noise would be strongly influenced by the airport operating strategies especially when operating a single runway at maximum capacity. In terms of total population, the 'Prefer 05' operating strategy (which gives preference to approaches and departures in a south-west to north-east direction) is predicted to have substantially more impact on existing residential areas than the 'Prefer 23' operating strategy, in which the opposite direction is preferred. Most residents that would be affected under the 'Prefer 05' strategy are in suburbs to the north of the airport site, including St Marys and Erskine Park. Predominantly rural-residential areas to the south-west, including Greendale and parts of Silverdale would be affected under the 'Prefer 23' strategy. Adoption of 'Head to Head' operations would also slightly reduce the number of residents affected.

For night-time operations in 2050, the operating strategy with least impact is 'Prefer 23 with Head-to-Head'. Other operating strategies are predicted to result in substantially greater numbers of residents being affected by night-time noise, and in particular, a 'Prefer 05' strategy would result in large parts of St Marys experiencing more than 20 aircraft noise events per night above 60 dBA.

The operating strategies would have less influence following the implementation of operations on the second runway. Despite the forecast number of movements at the airport approximately doubling between 2050 and 2063, there are fewer densely populated areas currently located within the noise affected areas, particularly for the Prefer 05 operating strategy. The reason is that movements can be spread between two runways and the locations of flight paths are less constrained in the two runway scenario. The total number of residents affected may increase in the future as a result of population growth and ongoing housing development over the next 50 years. The continuation of existing planning controls will limit the potential for new residential development to be impacted by a progressive increase in usage of the airport.

Australian Noise Exposure Concept (ANEC) contours for the indicative long term development are similar to those for the single runway airport in 2050, although they extend over a somewhat larger area to the south as a result of operation of the second runway. For the 2063 scenario, the 20 ANEC contour does not enclose any existing built-up residential areas including the townships of Warragamba and Silverdale.

The identification of potential noise abatement operating modes would be an important consideration in the future formal airspace design process to be undertaken closer to the proposed commencement of operations. Other approaches to mitigating aircraft overflight noise generally focus on reducing noise emissions from the aircraft themselves, planning flight paths in a way that minimises potential noise and environmental impacts and provides respite periods, together with implementing land use planning controls and other relevant operating practices.

Noise impacts associated with aircraft operations at the proposed airport are expected to be monitored using the noise and flight path monitoring system operated by Airservices Australia.

40.3.1. Air quality

Dust emissions similar to those assessed for the construction of the Stage 1 development would be generated during construction activities undertaken progressively as part of the long term development. It is anticipated that dust emissions would be closely controlled as there are significant safety issues associated with dust generation in the vicinity of an operational airport that would require much more stringent management than a typical construction programme.

The progressive increase in aircraft movements and site based activities would increase the level of emissions during the operation of the long term development. With the exception of roadways external to the airport site, aircraft movements were again predicted to be by far the largest source of PM_{10}, $PM_{2.5}$, NO_X and SO_2. Aircraft and stationary sources, in particular evaporative loss from the jet fuel tanks, were shown to be a significant contributor to VOCs emissions and corresponding predicted ground level concentrations. There is an increased potential for the formation of secondary pollutants such as ozone through the photochemical reaction between emissions of precursor gases associated with the proposed development including NO_x, VOCs and CO.

A key assumption integral to the assessment of the long term development was that no improvement in aircraft emissions, either due to improvements in fuel or engine emissions was able to be incorporated into the modelling. This is based on the inability to predict the effect of future policies or technological developments which are expected to occur and which are likely to result in improvements in levels of combustion emissions and pollutants. The assessment is therefore considered to be conservative. Given the uncertainty about emissions from a future aircraft fleet, combined with an expected improvement in aircraft emissions over time, the long term development was evaluated only for the air quality metrics, namely: PM_{10}, $PM_{2.5}$ and NO_X.

The results of the dispersion modelling indicate that exceedances of the short term nitrogen dioxide ambient objective may be experienced at seven residential receptors for very limited periods of between one and two hours per year. Exceedance of short term cumulative PM_{10} concentrations would be limited to one on-site receptor representing impacts upon airport staff and passengers. Predicted cumulative short and long term $PM_{2.5}$ concentrations are predicted above the NEPM advisory reporting goals at a number of surrounding receptors, largely as result of the existing background level concentrations.

The maximum predicted 1-hour and 4-hour ozone concentrations increased by a maximum of 0.2 parts per billion during the operation of the long term development. Both predicted base case and the long term development were generally above the NEPM criteria. Larger ozone incremental increases in the surrounding localities were recorded for the long term development, driven primarily by the increase in NO_X and VOC emission sources.

Actual air emissions from the long term development may be lower than predicted given use of mains powered auxiliary power units at airport gates, increased use of public transport (instead of motor vehicles) to travel to and from the airport, as well as progressive improvements in aircraft technology.

40.3.2. Surface water and groundwater

The long term development would represent a continuation of the impacts identified for the Stage 1 development with regards to water resources. By transforming the southern portion of the airport site to an essentially built environment, the airport development would alter the catchment areas within the airport site over the long term. This would alter the permeability of the ground surface, which in turn would alter the duration, volume and velocity of surface water flow.

Hydrologic and hydraulic modelling of the airport site indicates the drainage system is generally effective at mitigating watercourse and flooding impacts and further refinement would be required to occur during the detailed design stage.

Minor alterations to local groundwater recharge and drawdown are anticipated to occur at the airport site, along with the need for minor dewatering as a result of the establishment of building basements or station cavities. Changes to groundwater conditions at the site are anticipated to be minimal and are not expected to impact any sensitive ecological receptors or beneficial uses of the groundwater system.

Baseline and ongoing monitoring of surface water and groundwater would be undertaken to characterise any residual impacts and prompt corrective action where necessary.

40.3.3. Traffic

Long term operation of the airport is expected to result in around 85,000 vehicle trips to and from the airport each day by 2063. These additional trips would be generated in the context of substantial urban growth forecasts for Western Sydney. Airport generated travel and the forecast development growth in Western Sydney would significantly increase demand on roads and public transport. With or without the proposed airport, the road network is forecast to be considerably congested by 2063. The assessment indicates:

- the M4, M5 and M7 motorways have high volume/capacity ratios;
- Bringelly Road is congested eastbound in the AM peak and westbound in the PM peak; and
- Narellan Road is considerably more congested than in 2031.

In anticipation of this, a significant amount of road improvement works, including a new M12 Motorway, are being delivered ahead of the proposed airport as part of the Western Sydney Infrastructure Plan. To cater for the expected passenger and employee traffic demand associated with the proposed airport, these works are being designed with growth capacity.

Long term operation of the proposed airport would be reliant on the introduction of the South West Rail Link extension. Even with the extension in operation, the increase in demand by 2063 shows that detailed planning and transport upgrades would be required to cater for the growth associated with the proposed airport and other development in the region.

40.3.4. Socio economic

The long term development of the proposed airport would result in significant opportunities for regional and wider economic benefits through direct, indirect and induced spending. Benefits will be accrued beyond the aviation industry, and extend to such industries as construction, utilities, trade, transport, accommodation, retail professional services and administration.

The proposed airport would also create better business development opportunities in Western Sydney as businesses will have access to a large labour pool and proximity to markets and supporting businesses. There would be relatively higher employment densities in Western Sydney, particularly in areas like Penrith and Blacktown, but also in Liverpool, Fairfield and Camden and across the rest of Sydney's West.

Social impacts during the long term development would include changes to amenity of communities and recreational areas in proximity to the airport and those within the flight paths due to overflight noise, ground based noise from the airport operations and visual impacts from overflights.

40.3.5. Planning and land use

Construction and operation of the proposed airport would change the rural character of the airport site and surrounding land uses. This land use outcome has been anticipated in Australian, NSW and local government strategic planning for the area over several decades.

The proposed airport would be a key anchor for employment generating development in Western Sydney, creating jobs for the new residents of the South West Priority Growth Area.

40.3.6. Visual

Future development of the areas surrounding the airport site, under provisions of the Western Sydney Employment Area and the South West Priority Growth Area, would lead to a significant transition from an environment that is predominantly rural in character to one that has a more urban form. In general terms, this is expected to reduce the visual impact of the proposed airport development, including night-time lighting effects, as the proposed airport is integrated into the changing urban visual character of the area.

40.3.7. Greater Blue Mountains World Heritage Area

Potential indirect impacts on World Heritage values from the operation of the airport were assessed having regard to the attributes identified in the Statement of Outstanding Universal Value for the GBMWHA and the complementary values of the area as defined in the GBMWHA Strategic Plan. The assessment considered noise, air emissions and amenity impacts from the overflight of aircraft.

The assessment's findings are that the proposed airport would not have a significant impact on the GBMWHA. In particular, the indirect impacts of long term airport operation would not result in an attribute of the property being lost, degraded or damaged, or notably altered, modified, obscured or diminished.

40.3.8. Other Environmental Matters

There is potential for a range of direct physical impacts to arise from the expansion of the development footprint within the airport site. Impacts upon biodiversity, topography, Aboriginal heritage and European heritage would typically form a continuation of the disturbance footprint associated with the Stage 1 development. These would be considered as part of the future approval requirements for the site.

The health risk assessment considers the likely health impacts of the long term development of the proposed airport. While there are limitations in undertaking an assessment of predicted health risk so far into the future, overall the assessment found that the predicted health risk associated with the long term development would increase from the Stage 1 development, but would remain in line with national and international standards of acceptability.

40.4. Future environmental assessment and approval processes

Part 5 of the Airports Act requires an ALC to prepare an airport master plan to provide the strategic direction for the airport site for a period of 20 years. For the Western Sydney Airport, the ALC would be required to submit for approval a full master plan within five years of an airport lease being granted or such long period as the Minister for Infrastructure and Regional Development allows. Following approval, the master plan would be required to be updated every 5 years.

The ALC would also be required to prepare major development plans for future major airport developments that are not authorised by the Airport Plan. Major developments are defined in section 89 of the Airports Act to include items such as constructing or modifying runways, certain buildings, taxiways, transport links or any development that is likely to have significant environmental or community impacts. The Minister for Infrastructure and Regional Development is required to seek the advice of the Minister for the Environment before deciding to approve a draft major development plan.

Most future building activities on the airport site, including those authorised by Part 3 of the Airport Plan, require building approval and certification under the *Airports (Building Control) Regulations 1996* once an airport lease is granted. Approval and certification is given by the airport building controller and must be consistent with the relevant planning instrument (for example, the Airport Plan, master plan or major development plan).

The Airports Act and the *Airports (Environment Protection) Regulations 1997* set out the framework for the regulation and management of activities at airports that have potential to cause environmental harm. The ALC for the proposed airport will be responsible for operational environmental management.

40.5. Summary

This EIS has been prepared in accordance with Part 3 of the EPBC Act and the Department of the Environment guidelines for the assessment of the airport proposal.

The proposed Western Sydney Airport is required to meet the long term aviation requirements of the Sydney basin. The proposed airport has been demonstrated by a number of studies over several decades to be the preferred option for meeting capacity constraints over the long term. The proposed airport would increase access to aviation services for the people of Western Sydney and provide significant economic benefits over the long term for the region.

The design of the proposed long term airport would be developed as part of the master planning process and would be subject to further assessment and approval requirements in accordance with the Airports Act. This assessment has identified a number of environmental and social issues that would need to be addressed as part of the future approval processes.

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