Australian Government

Department of Infrastructure
and Regional Development

WESTERN SYDNEY AIRPORT

ENVIRONMENTAL IMPACT STATEMENT

VOLUME 3
LONG TERM DEVELOPMENT

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Western Sydney Airport 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 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 approximately 10 million passengers each year and is fully described in the revised draft Airport Plan. The EIS assumes the airport could be operating at this level approximately 5 years after operations commence which for assessment purposes has been assumed to be 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 approximately 1,780 hectares at Badgerys Creek. The Stage 1 development impacts about 1,150 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.
EIS	This 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 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 EIS is divided into five 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*. Volume 5 outlines the feedback received from the community and stakeholders. It provides responses to the issues raised and describes how these were addressed in finalising the EIS and revised draft Airport Plan, where relevant.

Volume guide

Volume 1 Project Background

Part A	Project background
Part B	Airport Plan
Part C	Consultation

Volume 2a Stage 1 Development

Part D	Environmental Impact Assessment

Volume 2b Stage 1 Development

Part E	Environmental Management
Part F	Conclusions

Volume 3 Long Term Development

Part G	Long Term Environmental Impact Assessment
Part H	Conclusion and recommendations

Volume 4 EIS Technical Reports

Appendices A–D	A	Proponent details and environmental record
	B	EIS study team
	C	Western Sydney Airport EIS Guidelines
	D	Western Sydney Airport Useability Report
Appendix E	E1	Aircraft overflight noise
	E2	Airport ground-based noise and vibration
Appendix F	F1	Local air quality and greenhouse gas
	F2	Regional air quality
Appendices G–H	G	Community health
	H	Hazard and risk
Appendices I–J	I	Bird and bat strike
	J	Surface transport and access
Appendix K	K1	Biodiversity
	K2	Offset strategy
Appendix L	L1	Surface water hydrology and geomorphology
	L2	Surface water quality
	L3	Groundwater
Appendices M–O	M1	Aboriginal cultural heritage
	M2	European and other heritage
	N	Planning and land use
	O	Landscape character and visual
Appendix P	P1	Social impact
	P2	Property values
	P3	Economic analysis

Volume 5 Submissions Report

Part A	Summary of consultation activities undertaken during the exhibition of the draft EIS
Part B	Submissions summary
Part C	Detailed issues analysis

Table of Contents

List of tables

List of figures

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.
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 sulphides, which produce sulfuric acid when exposed to air.
AHD	Australian height datum
Airport Lessee Company	The company that is granted an airport lease over the Airport Site.
Revised draft 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 Sydney West Airport as defined in the Airports Act.
Airports Act	*Airports Act 1996* (Cth)
Airports Act amendment	*Airports Amendment Act 2015* (Cth)
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	Noise exposure contours produced for a hypothetical future airport usage pattern used, 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 usually 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.

Term	Definition
Bund	A constructed retaining wall designed to prevent inundation or breaches from a known source.
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 – indicatively shown in the revised draft Airport Plan.
Continuous descent approaches	A method by which aircraft approach an airport prior to landing that minimises segments of level flight. This type of approach can 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.
dBA	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.
DoE	Australian Government Department of the Environment (now Department of the Environment and Energy)
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, long term and cumulative effects or impacts a project will have on the environment.
Environment Minister	The minister who administers the EPBC Act.
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW)
EPA	NSW Environment Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
FTE	Full time equivalent

Term	Definition
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
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 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 Organization – 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.

Term	Definition
Indirect impact	As defined in the EPBC Act *Significant impact guidelines 1.2*, indirect impacts include downstream or downwind impacts, such as impacts on wetlands or ocean reefs from sediment, fertilisers or chemicals which are washed or dischardged into river system; upstream impacts, such as those associated with the extraction of raw materials and other inputs which are used to undertake the action; and facilitated impacts which result from futher actions (including actions by third parties) which are made possible or facilitated by the action, 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.
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 equivalent-continuous noise level between 9am and 3pm (it is used to describe 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
Main Construction Works	Main Construction Works means substantial physical works on the airport site (including large scale vegetation clearance, bulk earthworks and the carrying out of other physical works, and the erection of buildings and structures) described in Part 3 of the Airport Plan, other than Preparatory Activities.
Manual of Standards	Standard procedures for the operation of airports issued by the Civil Aviation Safety Authority.
MAP	Million annual passengers
Master plan	Master plan prepared and approved in accordance with the Airports Act.
Maximum noise level (L_{Amax})	L_{Amax} over a sample period is the maximum A-weighted noise level measured during the period. In the context of aircraft noise, L_{Amax} generally means the maximum A-weighted noise level recorded during a specific overflight, measured using “Slow” speed, and can therefore also be written L_{ASmax}. In this report, L_{Amax} denotes the maximum level attained during a single overflight.
MDP	Major development plan prepared and approved in accordance with the Airports Act.
mg/m^3	Milligrams per cubic metre

Term	Definition
MIKE21 modelling	MIKE21 is a two dimensional hydraulic modelling software program used to simulate surface flow and estimate flood levels and flow velocities.
Infrastructure Minister	The minister who administers the Airports Act.
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.
N60	N60 is a measure of noise exposure that shows the number of aircraft overflights per day exceeding 60 dBA. N60 is generally used to describe night time noise exposure. In this EIS, unless otherwise noted, N60 values represent the number of aircraft overflights per day exceeding 60 dBA during the period 10pm to 7am.
N70	N70 is a measure of noise exposure that shows the number of aircraft overflights per day (or other specified time period) exceeding 70 dBA. The numbers of overflights are graded in contour lines on a map. N70 contours can be calculated for different time periods; however in this EIS they are presented for 24-hour periods.
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 in visual flight conditions.
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

Term	Definition
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). For the airport site, proposed permissible uses that would apply once an airport lease has been granted are set out in the land use plan in Part 2 of the revised draft Airport Plan.
PM	Airborne particulate matter
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 Operations Act 1997* (NSW)
Point Merge system	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
Preparatory Activities	Preparatory Activities mean the following: a. day to day site and property management activities; b. site investigations, surveys (including dilapidation surveys), monitoring, and related works (e.g. geotechnical or other investigative drilling, excavation, or salvage); c. establishing construction work sites, site offices, plant and equipment, and related site mobilisation activities (including access points, access tracks and other minor access works, and safety and security measures such as fencing); and d. enabling preparatory activities such as: i. demolition or relocation of existing structures (including buildings, services, utilities and roads) provided they are demolished or relocated in accordance with applicable environmental impact mitigation measures specifically referable to demolition or relocation of the relevant structures; ii. the relocation of cemeteries in accordance with an approved cemeteries relocation management plan; and iii. application of environmental impact mitigation measures.
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.

Term	Definition
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
SES Officer	An SES employee under the *Public Service Act 1999*
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	Sulfur dioxide
SO_x	Sulfur oxides
Stage 1 development	The initial stage in the development of the proposed airport, including a single runway and facilities for approximately 10 million annual passengers. (the EIS assumes the airport could be operating at this level approximately 5 years after operations commence which for assessment purposes has been assumed to be 2030).
Stage 1 operations	The airport operating at the Stage 1 capacity as defined in the revised draft Airport Plan.
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
Sydney West Airport	The proposed airport. Note: this is the name used in the Act. The Airport is also commonly known as Western Sydney Airport.
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.

Term	Definition
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
$\mu g/m^3$	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.
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

PART G:
Assessment of Long Term Development

30 Introduction

30.1 Background

On 15 April 2014 the Australian Government announced that the Commonwealth-owned land at Badgerys Creek would be the site for a Western Sydney airport. The proposed airport would cater for ongoing growth in demand for air travel, particularly in the rapidly expanding Western Sydney region. The airport site was selected following extensive studies completed over a number of decades and culminating in the release of the *Joint Study on Aviation Capacity in the Sydney Region* (Department of Infrastructure and Transport 2012), referred to as the 'Joint Study', in March 2012 and *A Study of Wilton and RAAF Base Richmond for Civil Aviation Operations* (Department of Infrastructure and Transport 2013) in April 2013.

The proposed airport is planned to be operational by the mid-2020s. It would service both domestic and international markets and development would be staged in response to ongoing growth in aviation demand. A revised draft Airport Plan has been prepared in accordance with the requirements of the *Airports Act 1996* (the Airports Act), setting out the Australian Government's requirements for the initial airport development.

The revised draft Airport Plan sets out details of the initial development for which authorisation is being sought (referred to as Stage 1). The Stage 1 development would include a single 3,700 metre runway on a north-east/south-west orientation and aviation support facilities for an operational capacity of approximately 10 million passengers annually, as well as freight traffic. Stage 1 is designed to cater for the predicted demand for five years following services commencing.

The revised draft Airport Plan also refers to the potential long term development of the proposed airport. As demand increases beyond 10 million annual passengers, additional aviation infrastructure and aviation support precincts would add capacity to meet growing aviation demand. Incremental development of the proposed airport would continue as additional taxiways, aprons, terminals and support facilities are developed.

The proposed airport may ultimately expand to have a second parallel runway on a north-east/south-west orientation and supporting facilities, increasing aviation capacity to approximately 82 million passengers annually. The need for a second runway will be triggered when the operational capacity approaches 37 million annual passengers, which is forecast to occur around 2050. The long term passenger capacity of approximately 82 million annual passengers is forecast to occur around 2063.

This Environmental Impact Statement (EIS) has been prepared in accordance with the *Environment Protection and Biodiversity Conservation Act 1999* and will inform the determination of the Airport Plan.

Determination of the Airport Plan would authorise the Stage 1 development encompassing the construction and operation of the proposed airport to an annual operational capacity of approximately 10 million passengers. This EIS provides a detailed consideration of likely environmental impacts arising from the Stage 1 development based upon clearly defined design and operational parameters described in the revised draft Airport Plan.

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 (this volume) of the potential implications has been undertaken to support consideration of the Stage 1 development and long term planning and land use strategies.

This approach ensures that the extent of potential impacts for the long term development (including noise exposure), are considered as part of the initial approvals process. Future developments would be subject to separate approval processes in accordance with the requirements of the Airports Act.

30.2 The long term development

30.2.1 Progressive development and approvals

It is expected that the proposed airport would be progressively developed as demand increases beyond 10 million passengers annually. Additional aviation infrastructure and support services such as taxiways, aprons, terminals and support facilities would be required to service the growing demand. Future developments beyond the scope of Stage 1 would be subject to the requirements of the Airports Act.

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 around 1,900 metres. The need for a second runway would be triggered when the operational capacity approaches 37 million passengers per year, which is equivalent to approximately 185,000 air traffic movements including freight traffic.

The long term capacity of the airport is forecast to service approximately 82 million passengers per year, which is equivalent to approximately 370,000 air traffic movements including freight traffic. Indicative possible configurations of the progressive development of the proposed airport are presented in Figure 30–1. The layout of the long term airport development would form part of a subsequent master plan in accordance with the requirements of the Airports Act.

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 Infrastructure Minister, 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.

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.

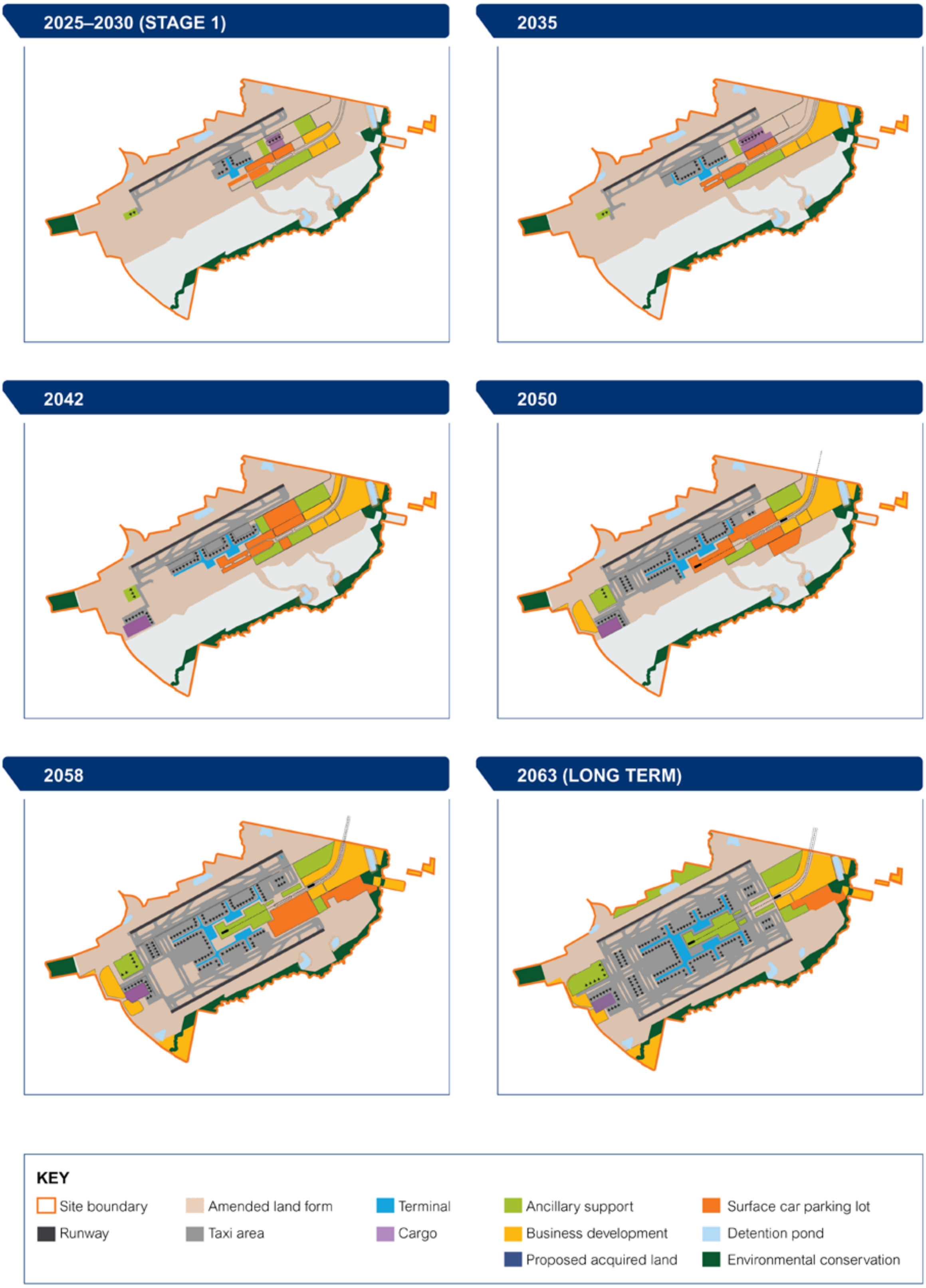


Figure 30–1 Potential indicative configurations and sequencing for the progressive development of the proposed airport

30.2.2 Preliminary airspace design

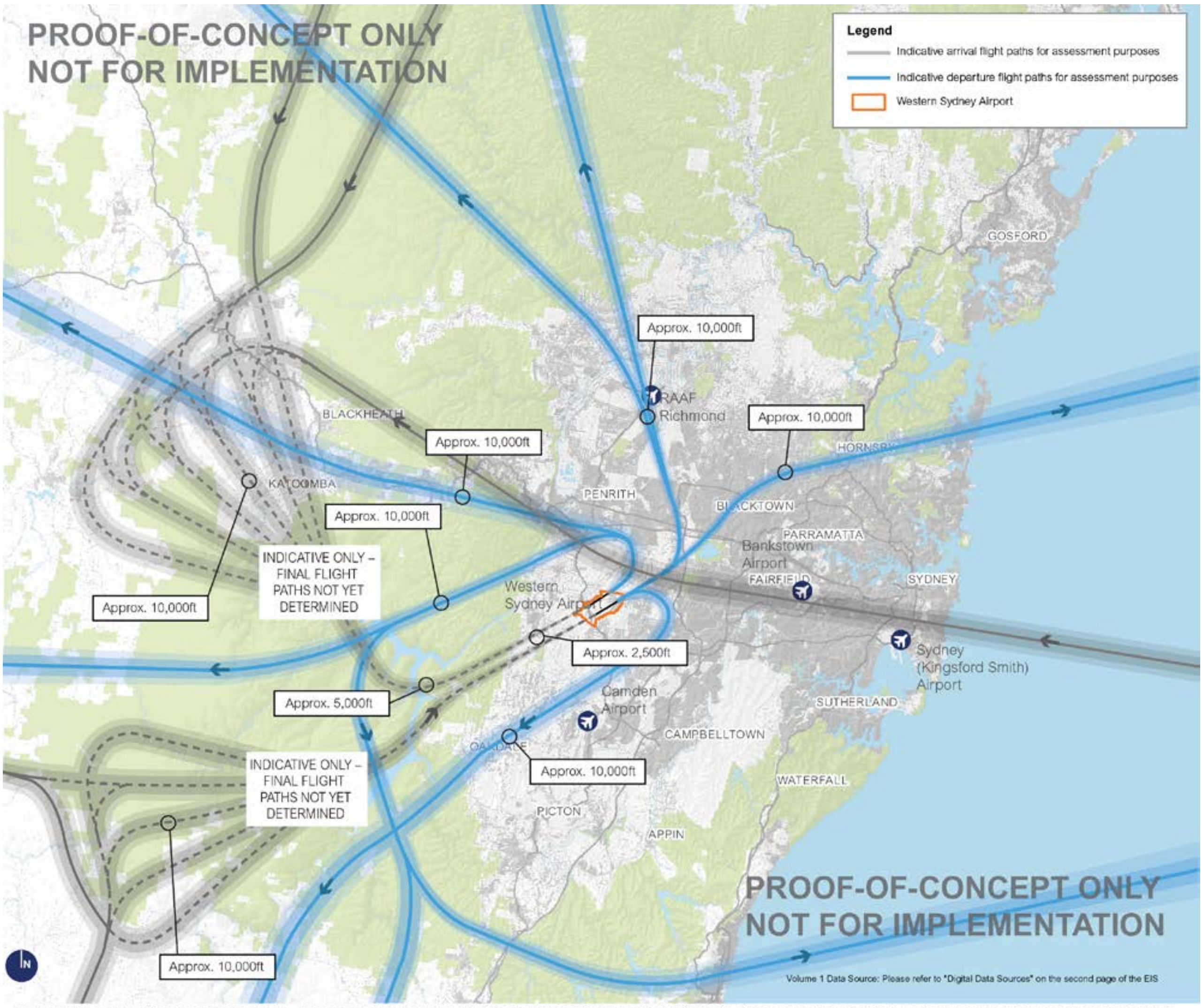
Airservices Australia provided a preliminary assessment of one potential air traffic management arrangement for airspace in the Sydney region associated with the introduction of flights to and from the proposed airport (Airservices Australia 2015). The preliminary airspace assessment was limited to a conceptual proof-of-concept design to establish whether safe and efficient operations could be introduced at the proposed airport. Both single and parallel runway operations were considered in this analysis.

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 (Kingsford Smith) 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 proposed airport's 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.

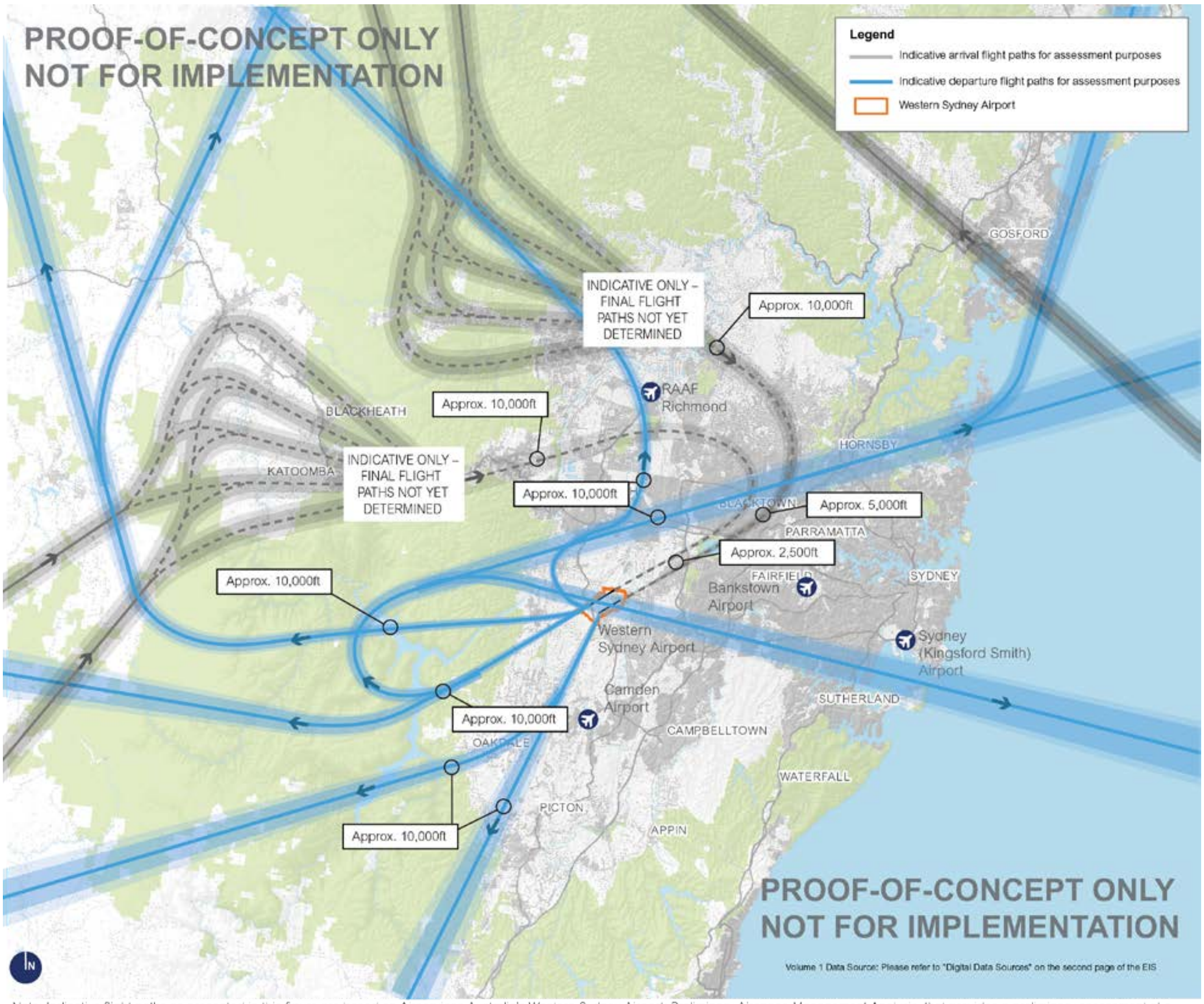
Any proposal to introduce a new airspace regime for parallel runway operations at the proposed airport would comply with relevant legislation governing airspace and air traffic management and national environmental law.

Indicative flight paths for proof-of-concept long term operations at the proposed airport with parallel runways are presented in Figure 30–2 and Figure 30–3.



Note: Indicative flight paths as presented in this figure are based on Airservices Australia's Western Sydney Airport: Preliminary Airspace Management Analysis, that provides a preliminary assessment at a conceptual level of airspace management design. The Australian Government has announced that aircraft arrivals for the proposed Western Sydney Airport will not converge through a single merge point over Blaxland or any other single residential area. The formal flight path design process will start from determination of the Airport Plan and optimise flight paths on the basis of safety, efficiency, capacity, and noise and environmental considerations.

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



Note: Indicative flight paths as presented in this figure are based on Airservices Australia's Western Sydney Airport: Preliminary Airspace Management Analysis, that provides a preliminary assessment at a conceptual level of airspace management design. The Australian Government has announced that aircraft arrivals for the proposed Western Sydney Airport will not converge through a single merge point over Blaxland or any other single residential area. The formal flight path design process will start from determination of the Airport Plan and optimise flight paths on the basis of safety, efficiency, capacity, and noise and environmental considerations.

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 EIS. The assessment is based upon clearly defined construction and operation parameters described in detail in Volume 1 of this EIS and in Part 3 of the revised 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 any potential longer term developments, 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 environmental matters are also considered in a concise and consolidated chapter.

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 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 or near its expected capacity of around 37 million annual passengers or approximately 185,000 aircraft movements per year – has been conducted. 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. These 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, Volume 3 does not provide any specific mitigation measures. Instead, issues for future consideration have been provided where relevant.

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 2a.

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 agencies 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 overflight and ground-based operations noise associated with the potential long term development of the proposed airport. The chapter draws on comprehensive assessments of these factors which are included in Appendices E1 and E2 (Volume 4).

The assessment addresses two operational scenarios:

- 37 million annual passengers – this represents a stage of development, which could be reached about 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 about 2063, when the airport comprises two operating runways and both runways are operating close to capacity.

These key stages, along with any incremental expansion of airport infrastructure between them would be subject to separate approvals under the Airports Act 1996.

Consideration of the findings of the assessment in relation to social amenity, world heritage and National 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 (Volume 2a). 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 possible stage length (a measure of distance to destination for departing aircraft), specialist software was used to calculate noise levels at each point on a 185 x 185 metre 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 this noise assessment are indicative, which introduces uncertainty in regards to predicting the extent of aircraft overflight noise impacts. A future airspace design process would be undertaken closer to the commencement of operations and would be expected to evolve in time throughout the life of the proposed airport.

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 (described in greater detail in Chapter 7 (Volume 1)) 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 the airport site, it is likely that either the 05 operating mode or 23 operating mode could be used over 80 per cent of the time based solely on these factors. However, the selection of a preferred or priority operating mode, or a preferred combination of operating modes (i.e. preferred operating strategy), for noise management or other operational purposes has a notable effect on the overall noise impact from the airport. In this context, the preferred operating strategies that were considered as part of the noise impact assessment are as follows:

- 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). This strategy gives priority to operations in the 05 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). This strategy gives priority to operations in the 23 direction;
- Prefer 05 with head-to-head – as per Prefer 05, except that during the night time period between 10.00 pm and 7.00 am, the head-to-head operating mode to the south-west would be used when:
  - there are no more than a total of 20 aircraft movements expected 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 the 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 development, a number of alternative airport operating modes are also possible. However, it is difficult to determine accurately the likely availability, capacity and usage of such alternative modes at this point in time and therefore only the Prefer 05 and Prefer 23 strategies have been considered.

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'. The synthetic schedule identifies the aircraft family, operation type (arrival or departure), time of operation and port of origin or destination for each aircraft movement.

Predicted total aircraft movements for the indicative assessment scenarios are summarised in Table 31–1.

Table 31–1 Predicted daily aircraft movements in 2050 and 2063 by aircraft family

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
Total	554	1,110

31.2.2 Understanding noise

31.2.2.1 Sources of aircraft noise

Operation of the proposed airport would result in changes to the pattern of aircraft movements in the airspace above Western Sydney due to the introduction of new aircraft flight paths.

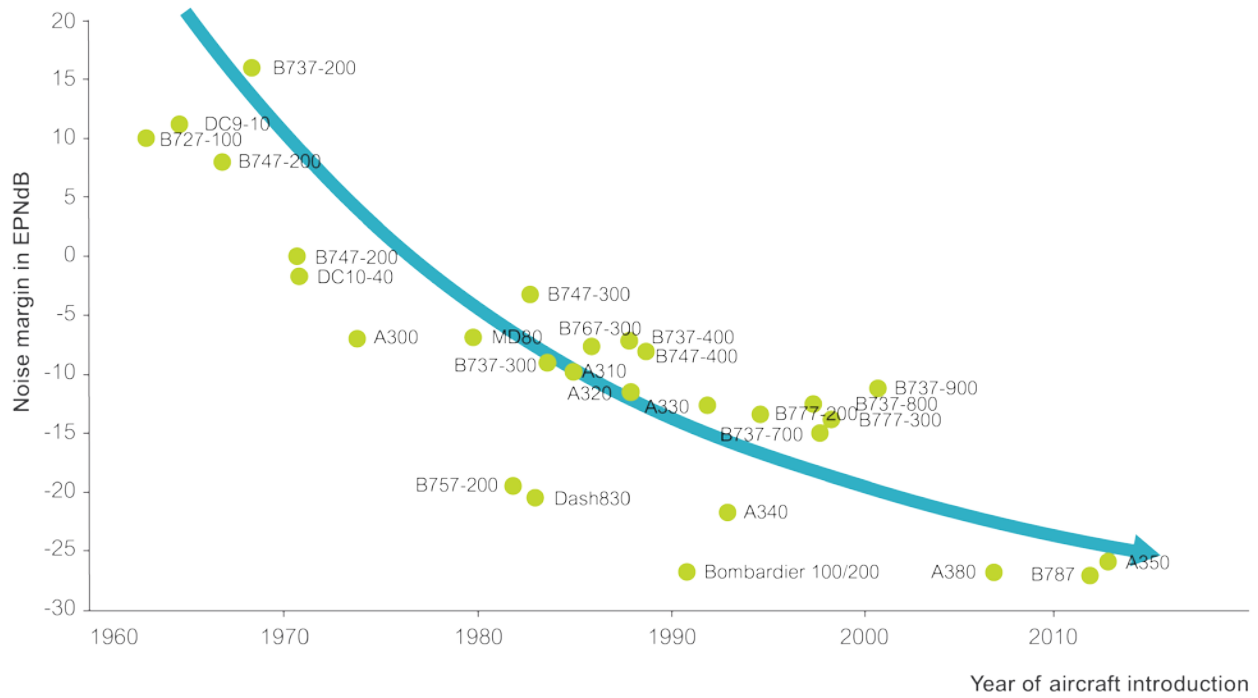
The characteristics of sound from aircraft can vary depending on a range of factors, including the type of engine, the stage of flight, the height of the aircraft and the prevailing meteorological conditions. While there are many sources of noise from an aircraft, including noise generated by the airframe, engines are the dominant source of noise for the majority of the flight cycle.

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 noise levels are typically higher than take-off noise levels as a result of the diversion of the engine exhaust to assist with deceleration, which results in a characteristic noise contour bulge surrounding a runway.

The pattern of noise exposure that would result from operation of the proposed Western Sydney Airport is complex, and depends on final flight paths and airport operating procedures, time of day, season, weather conditions and other factors. Generally speaking, aircraft noise levels would decrease with distance from the proposed airport primarily as a result of the higher altitude of aircraft operations.

Advances in aviation technology are resulting in a reduction in noise generated by aircraft. Figure 31–1 shows how aircraft have become progressively quieter over the past several decades through the incorporation of new airframe technologies and engine innovations. In 2013, ICAO agreed that more stringent noise standards would apply to all new aircraft types over 55 tonnes in weight submitted for certification on or after 31 December 2017. The amendments include a new noise standard for jet and turboprop aircraft, which represents a reduction of 7 EPNdB[1] relative to the current ICAO 'Chapter 4' cumulative noise standard.

[1] EPNdB, or Effective Perceived Noise level in decibels, is used for the certification of aircraft according to ICAO procedures. It is a measure of human annoyance to aircraft noise that takes into account the special spectral characteristics, intensity, tonal content and duration of noise from an aircraft pass-by event. EPNdB values cannot be directly measured. They are calculated using noise monitoring data recorded at certification points that account for different phases of an aircraft movement (e.g. approach and flyover on departure) and the lateral spread of noise.



Source: Brisbane New Parallel Runway EIS, 2007, CANSO and ACI 2015. Composited by GHD 2016.
Note: Noise levels are relative to ICAO 'Chapter 3' noise standards which took effect in 1978.

Figure 31–1 Reduction in aircraft noise over time

Despite the likely introduction of these next-generation aircraft in the future, the assessment of aircraft noise in this EIS has been based on aircraft types that are commonplace today, including the louder Boeing 747 and the Airbus A320. The Boeing 747 is the loudest aircraft anticipated to operate at the proposed airport and airlines are already beginning to retire it from regular passenger services.

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 average day'. As a cumulative or averaged measure of noise exposure, the system does not illustrate the day to day variation in noise exposure that is associated with airport operations. The ANEF system was developed on the basis of social survey data which aimed to correlate aircraft noise exposure with community reaction in residential areas. While the ANEF system is useful for informing land use planning, including controlling new noise sensitive developments near airports, it has not proven effective for assessing the potential impact of aircraft noise on individuals and communities.

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. They are generally used in environmental assessments to depict and compare noise exposure levels for different flight path options.

*Australian Standard 2021:2015 Acoustics—Aircraft noise intrusion—Building siting and construction (*AS 2021) 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.

A series of ANECs[2] was 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.

Planning controls that are implemented based on an ANEF typically 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 20 ANEF contour in the local government areas of Fairfield, Liverpool, Penrith and Wollondilly and requires that planning proposals not contain provisions enabling development that 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,* with the inclusion of provisions aimed at preserving noise related buffers around the airport site (see Chapter 21 (Volume 2a)). This has resulted in limited noise sensitive development around the airport site.

31.2.2.3 Measuring noise

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

- ANEC – a measure of aircraft noise exposure levels for an 'annual average day' that uses indicative data on aircraft types, aircraft operations and flight paths using the same methods as the ANEF;
- N70 – the average number of aircraft noise events per day (i.e. over a 24-hour period) 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 partially open. An internal 60 dBA noise level is sufficient to disturb conversation, in that a speaker would generally need to raise their voice to be understood, or some words may be missed from a television or radio. If windows are closed, an external noise of 70 dBA would result in an internal noise level of approximately 50 dBA;
- N60 – the average number of aircraft noise events per day with maximum noise levels exceeding 60 dBA during the night-time period of 10.00 pm to 7.00 am. An external noise level of 60 dBA approximates an internal level of 50 dBA if windows are partly 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 is also 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;

[2] The 1985 EIS included a scenario-based noise exposure chart in the form of an "ANEF", which we would today term an "ANEC".

- 90th percentile – a statistical category representing noise values that would be exceeded on only 10 per cent of days. The 90th percentile N70 and N60 values represent days where there would be a particularly high number of aircraft movements and may therefore be likened to a near worst case scenario compared to the standard 'average' N60 or N70; 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 of a particular aircraft occurring at any time.

31.3 Aircraft noise in 2050

This section considers aircraft noise impacts for a 2050 scenario where the single runway 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 have been developed based on indicative flight paths and operating strategies to provide an indication of the likely acceptability of building types at locations around the airport site based on AS 2021. Operating procedures for the proposed airport are yet to be determined and Figure 31–2 presents combined ANEC contours for the Prefer 05 and Prefer 23 operating strategies. Because these ANEC contours combine noise exposure levels for the two assumed operating strategies, they are a conservative or 'worst case' representation of noise exposure levels. ANEC contours for the individual Prefer 05 and Prefer 23 operating strategies are shown in Appendix E1 (Volume 4).

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. 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

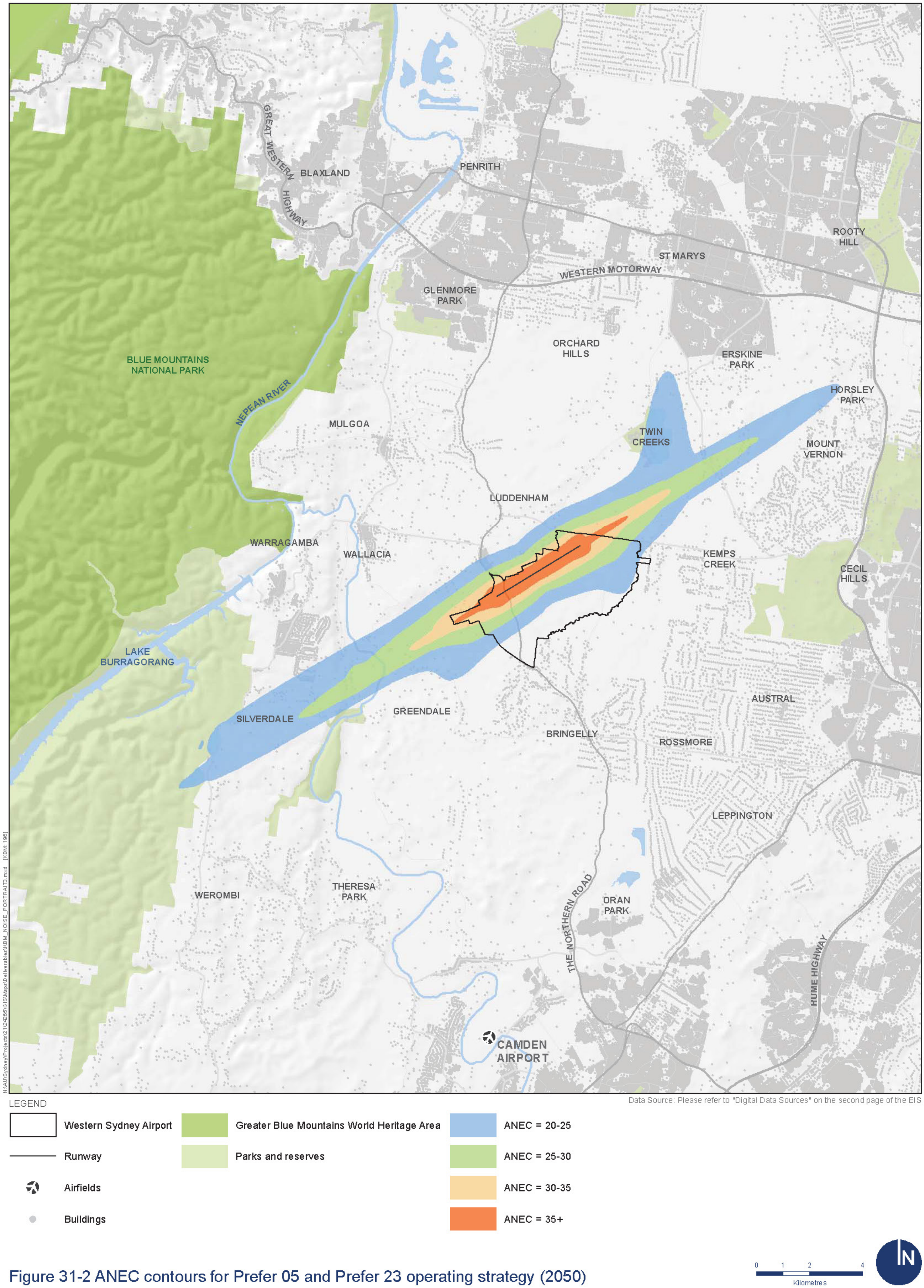


Figure 31-2 ANEC contours for Prefer 05 and Prefer 23 operating strategy (2050)

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 Stage 1 operations.

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 (see Section 4.5 of Appendix E1 (Volume 4)). This is because even with the additional 6 dBA weighting for night-time noise events included in the ANEF formula, overall noise exposure is still dominated by daytime events.

Figure 31–3 shows the combined year 2050 ANEC 20 contour compared to the ANEC 20 contour 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, the inclusion of new quieter aircraft types, 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.

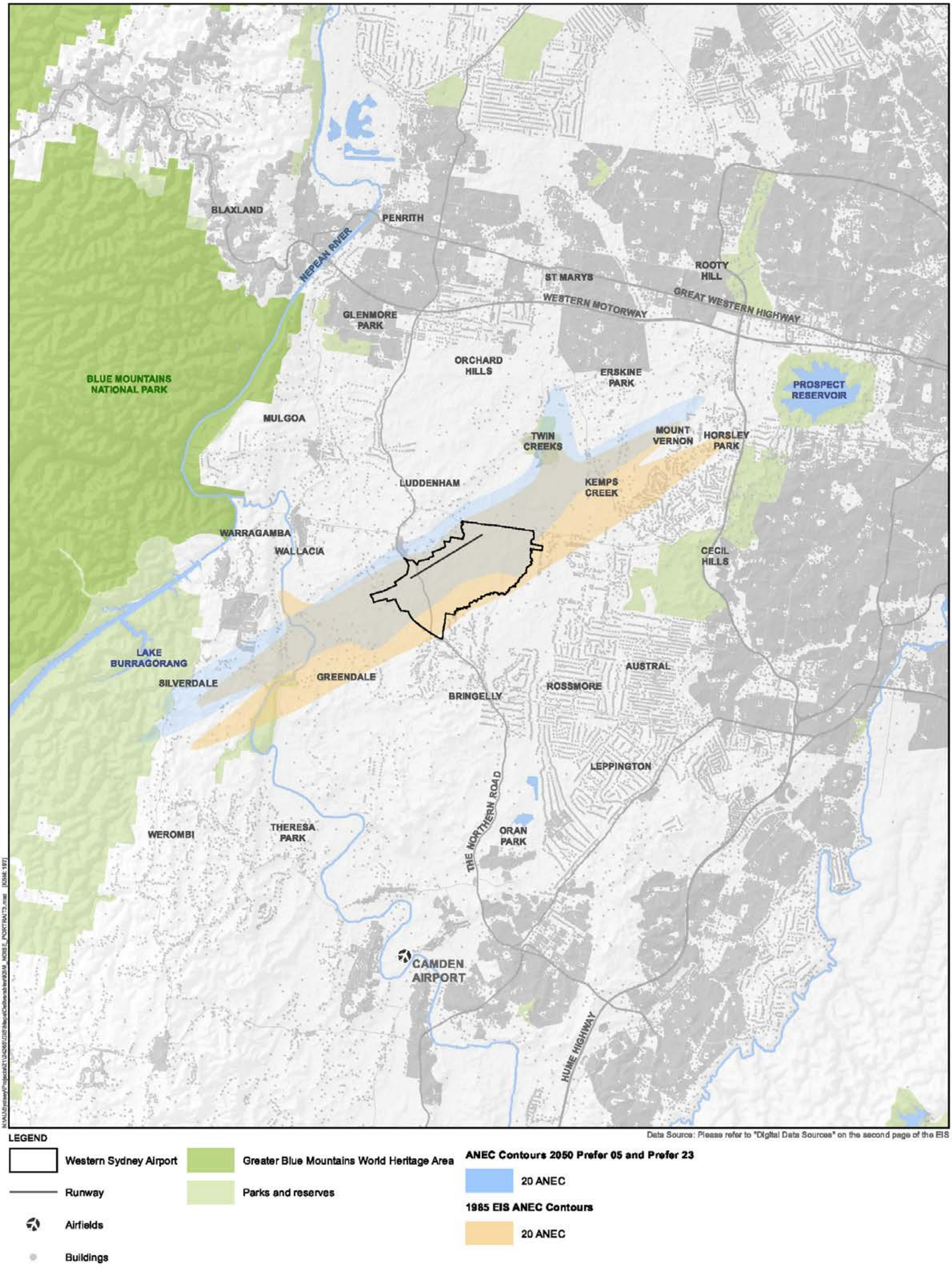


Figure 31-3 1985 Draft EIS combined ANEC contours compared to 2050 Prefer 05 and Prefer 23

31.3.2 Single event maximum noise levels

Single-event noise contours depict the maximum (L_{Amax}) noise levels 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 Stage 1 operations and therefore the single event contours would typically remain unchanged.

One exception is that the predicted schedule for the Stage 1 operations included assessment of the Boeing 747 (or equivalent) as the noisiest aircraft with a maximum stage length (or destination distance category) 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 (Volume 2a), 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.

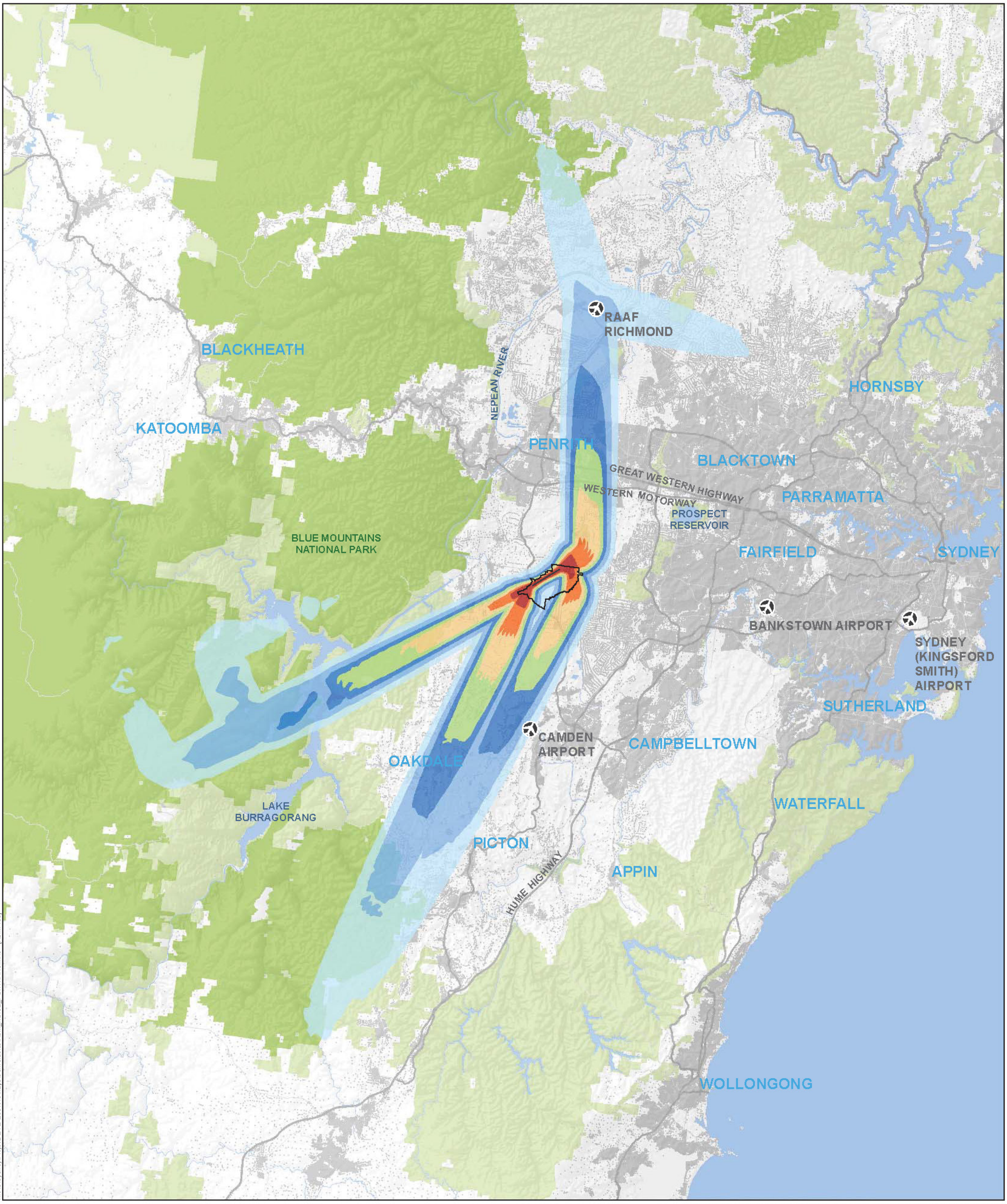
According to the predicted schedule, stage 9 departures by Boeing 747 aircraft could occur on average once every two days by 2050 and may occur on any of a number of flight paths. Although contours are shown for these events on paths heading south from the airport, it is very unlikely that a stage 9 departure would occur on these paths 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 departure event type are shown in Figure 31–4 and Figure 31–5. 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 departures, located to the south-west of the airport site.

When these events occur on the flight path leading north in the 05 direction (i.e. departures to the north-east), L_{Amax} noise levels exceeding 75 dBA are predicted over more densely-populated areas around St Marys, with levels above 80 dBA predicted in some parts of Erskine Park.

Figure 31–6 and Figure 31–7 show L_{Amax} noise levels from a B747 arrival on any flight path. In this case, noise levels are identical to those experienced from the proposed Stage 1 operations. Noise levels of 60 to 70 dBA are predicted over sections of Erskine Park and St Marys, extending to parts of Blacktown. Based on the indicative flight paths, noise levels from this event would reach 60 dBA in parts of the lower Blue Mountains.

Maximum noise levels from other more common aircraft operations would be as described for the Stage 1 operations (see Chapter 10 (Volume 2a)) as the aircraft type and stage length would remain the same for the 2050 scenario.



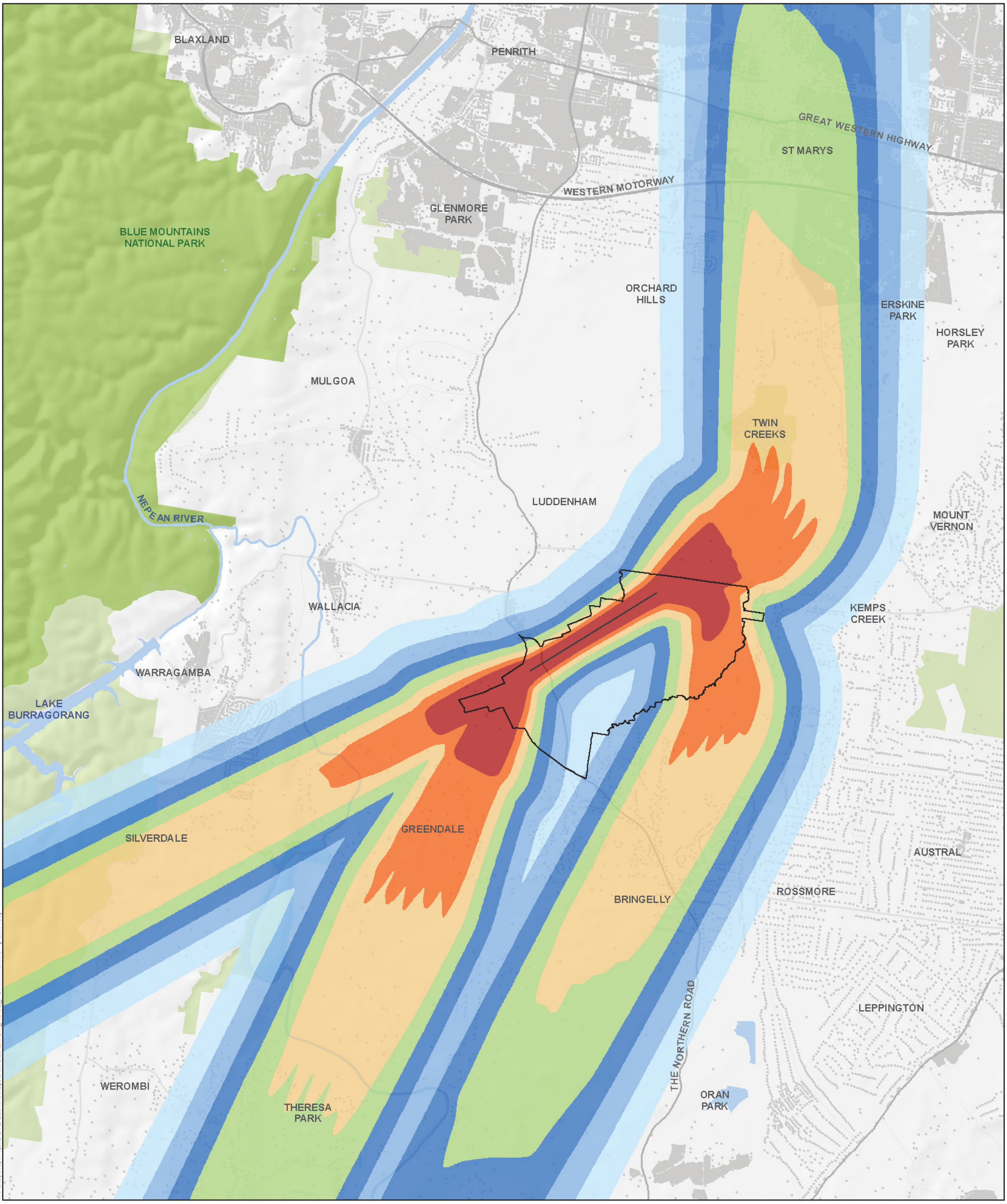
LEGEND

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

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

0 3.5 7 14
Kilometres

Figure 31-4 Combined single event Boeing 747 departure Stage Length 9 2050 Scenario



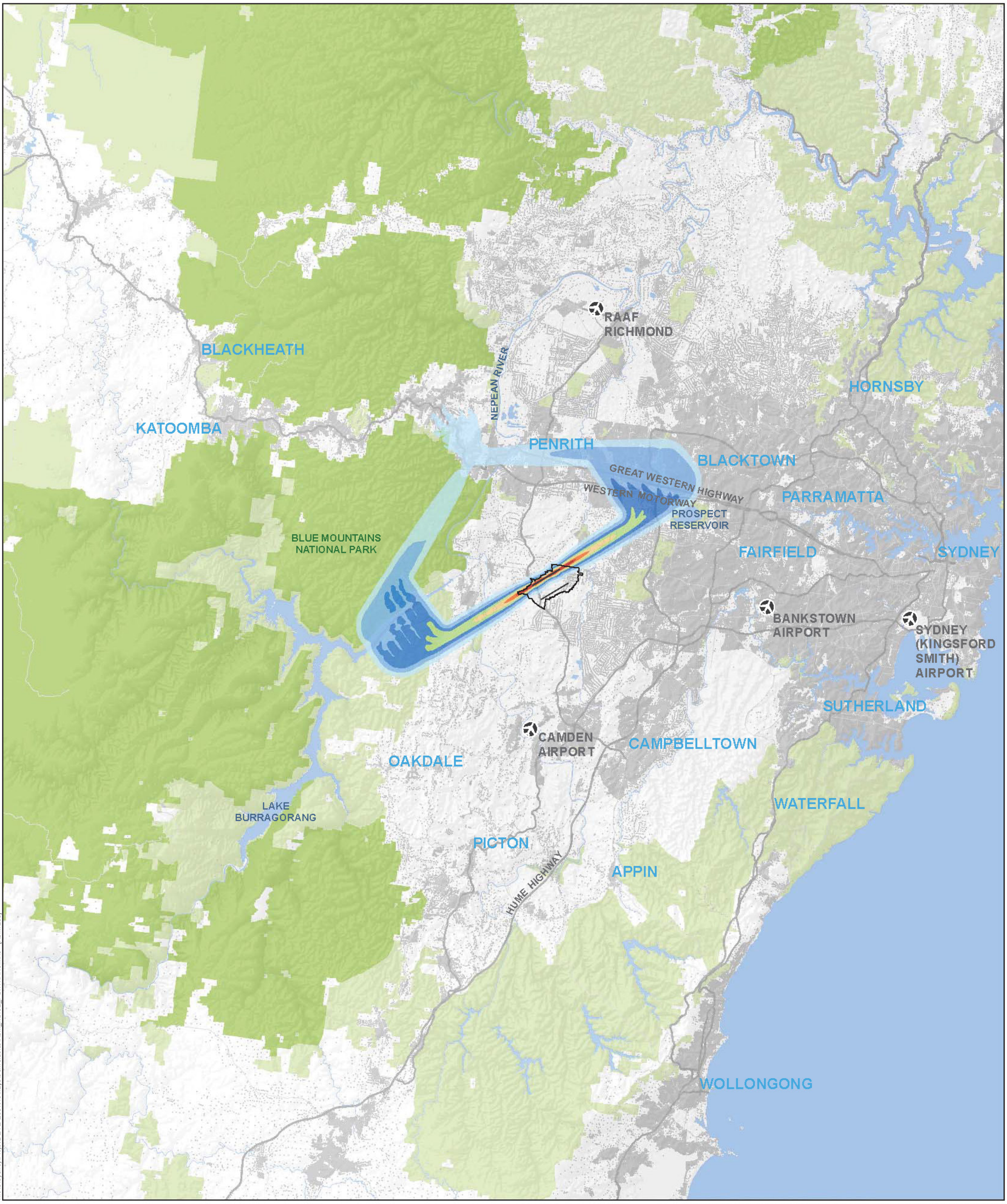
Data Source: Please refer to "Digital Data Sources" on the second page of the EIS

LEGEND

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

0 0.75 1.5 3
Kilometres

Figure 31-5 Combined single event Boeing 747 departure Stage Length 9 2050 Scenario (meso scale)



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

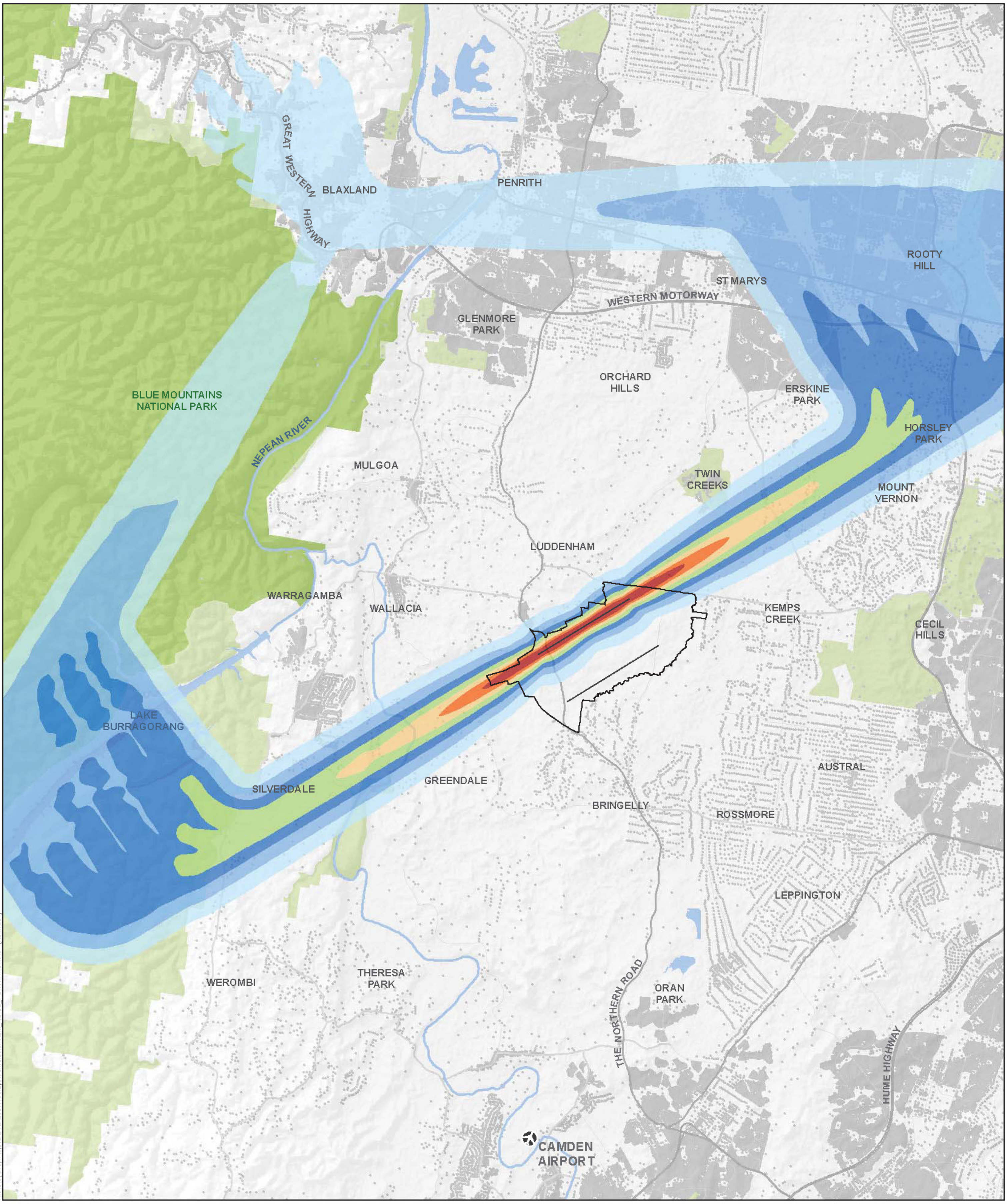
85-90 dBA

>90 dBA

0 3.5 7 14

Kilometres

Figure 31-6 Single event B747 arrival on all flight paths



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 1 2 4

Kilometres

Figure 31-7 Single event B747 arrival on all flight paths (meso scale)

31.3.3 Noise over 24 hours

31.3.3.1 N70 contours – 2050 scenario

As the volume of air traffic increases beyond 10 million annual passengers, 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. Calculated N70 noise contours for each of the four airport operating strategies are shown on Figure 31–8 to Figure 31–11. 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 more densely-populated areas around St Marys.

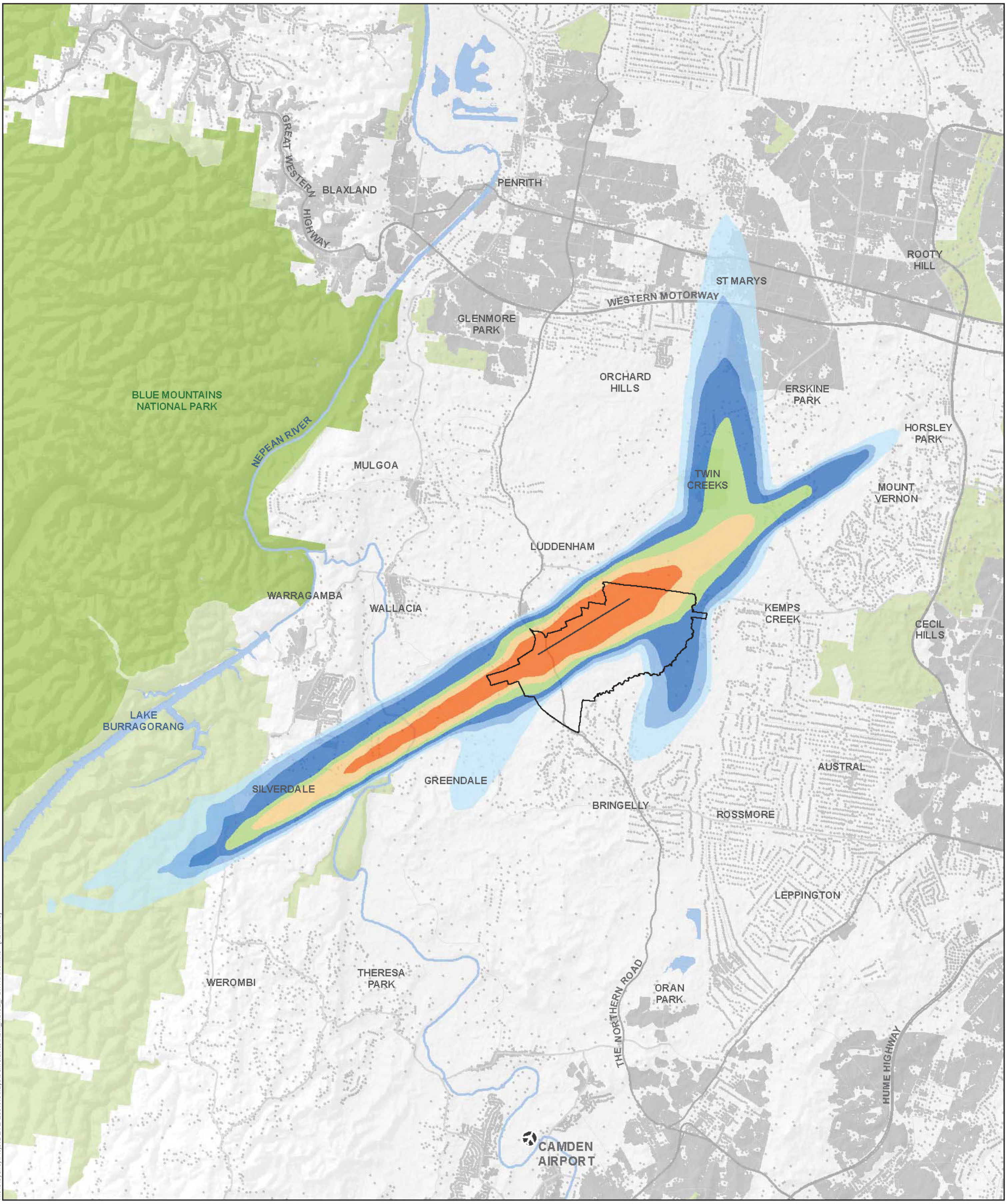
In comparison, the Prefer 23 operating strategy is predicted to result in an impact of less than five events per day in these areas. The predicted impact would be greater in less densely-populated areas to the north of Horsley Park, and also in rural-residential areas around Greendale. Compared to the Prefer 05 operating strategy, the Prefer 23 operating strategy also results in higher predicted impacts in the Burragorang State Conservation Area to the south-west of the airport site.

Table 31–3 shows the population estimated to be affected by aircraft noise above 70 dBA in 2050. Larger areas of existing built-up residential development would be exposed to aircraft noise compared to the proposed Stage 1 operations. A Prefer 05 operating strategy would result in an estimated 30,000 people experiencing more than five events per day above 70 dBA. Under the Prefer 23 operating strategy, this number is substantially lower at approximately 5,000 people. However, it is notable that a Prefer 23 strategy still results in rural residential areas to the south-west of the airport site experiencing a higher number of noise events above 70 dBA.

Head-to-head operations at night would reduce the population exposed to between five and 20 noise events per day above 70 dBA under a Prefer 05 operating strategy. The use of a head-to-head mode under a Prefer 23 operating strategy would result in little change to overall N70 values.

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
Runway	Parks and reserves	N70 = 10-20
Airfields		N70 = 20-50
Buildings		N70 = 50-100
		N70 = 100-200
		N70 = 200+

0 1 2 4
Kilometres

Figure 31-8 - N70 contours for Prefer 05 operating strategy (2050)

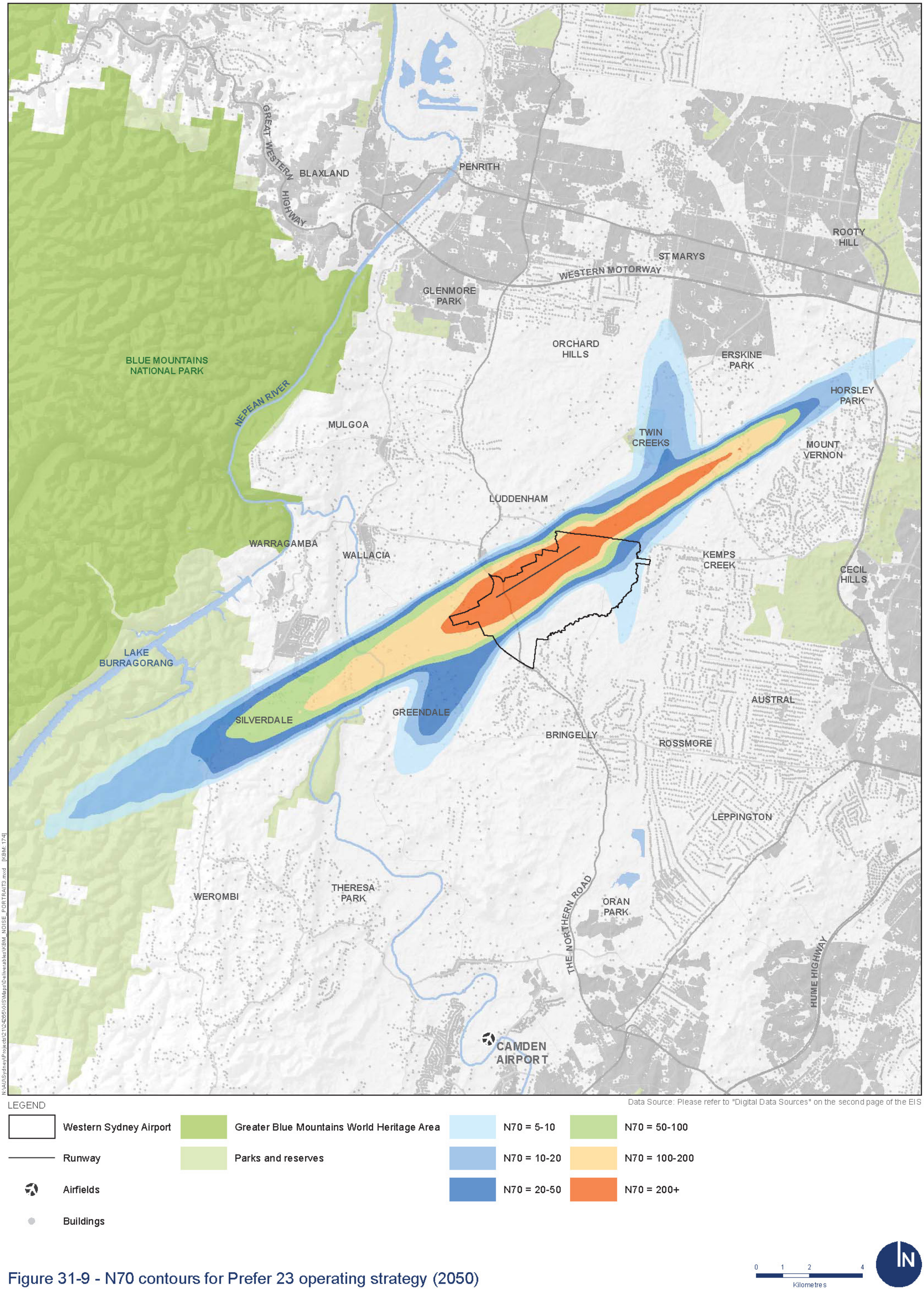


Figure 31-9 - N70 contours for Prefer 23 operating strategy (2050)

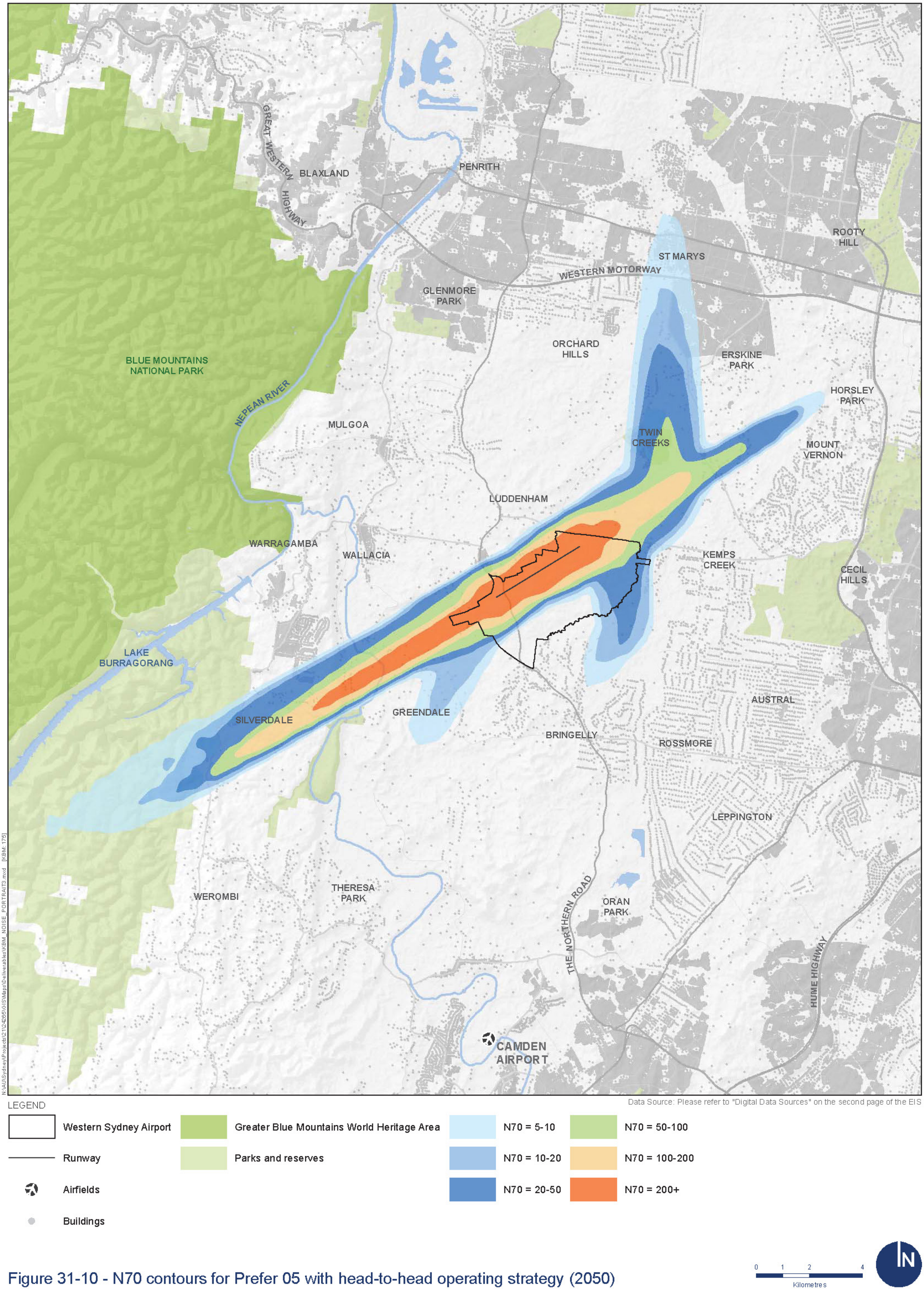


Figure 31-10 - N70 contours for Prefer 05 with head-to-head operating strategy (2050)

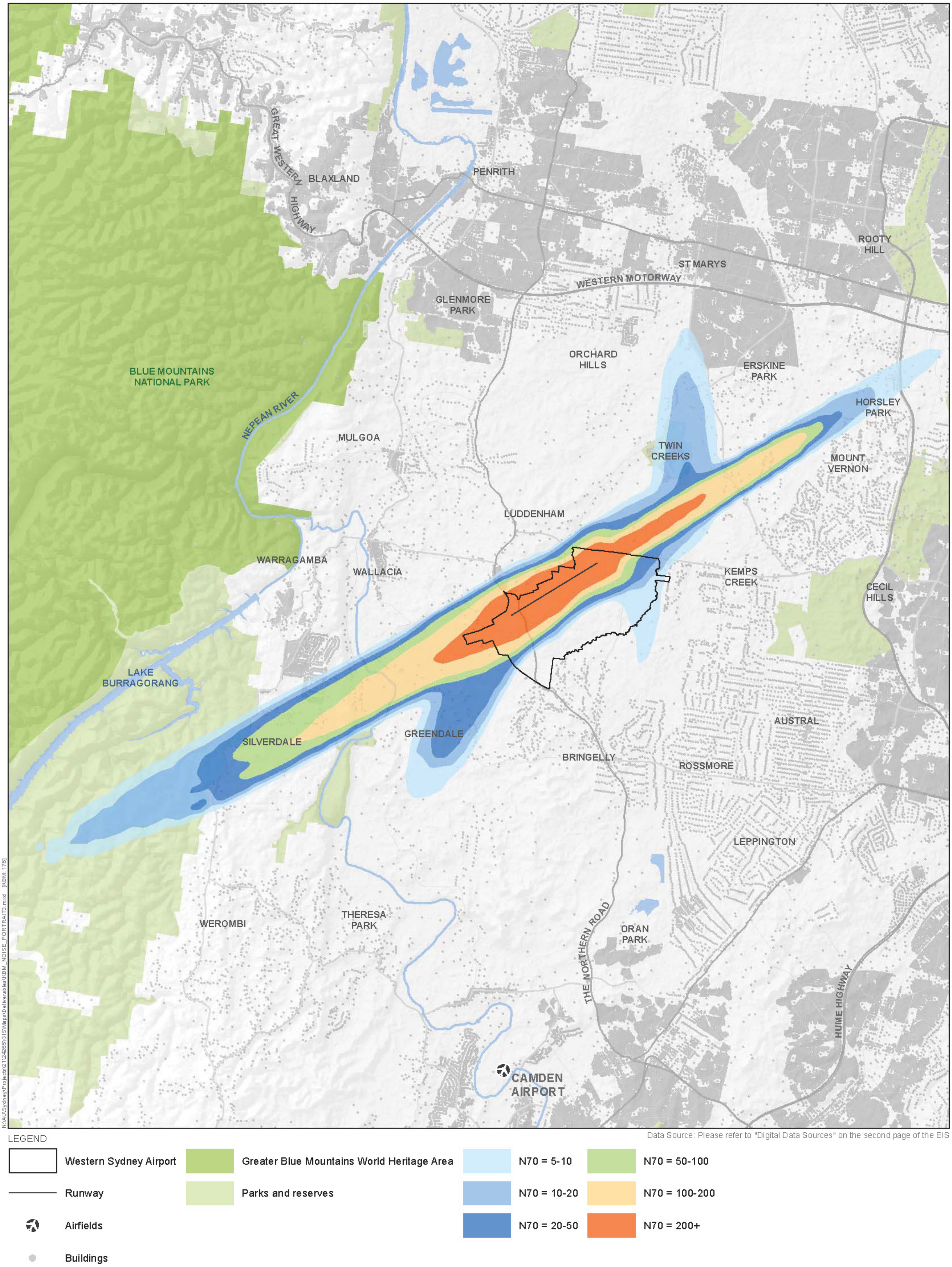


Figure 31-11 - N70 contours for Prefer 23 with head-to-head operating strategy (2050)

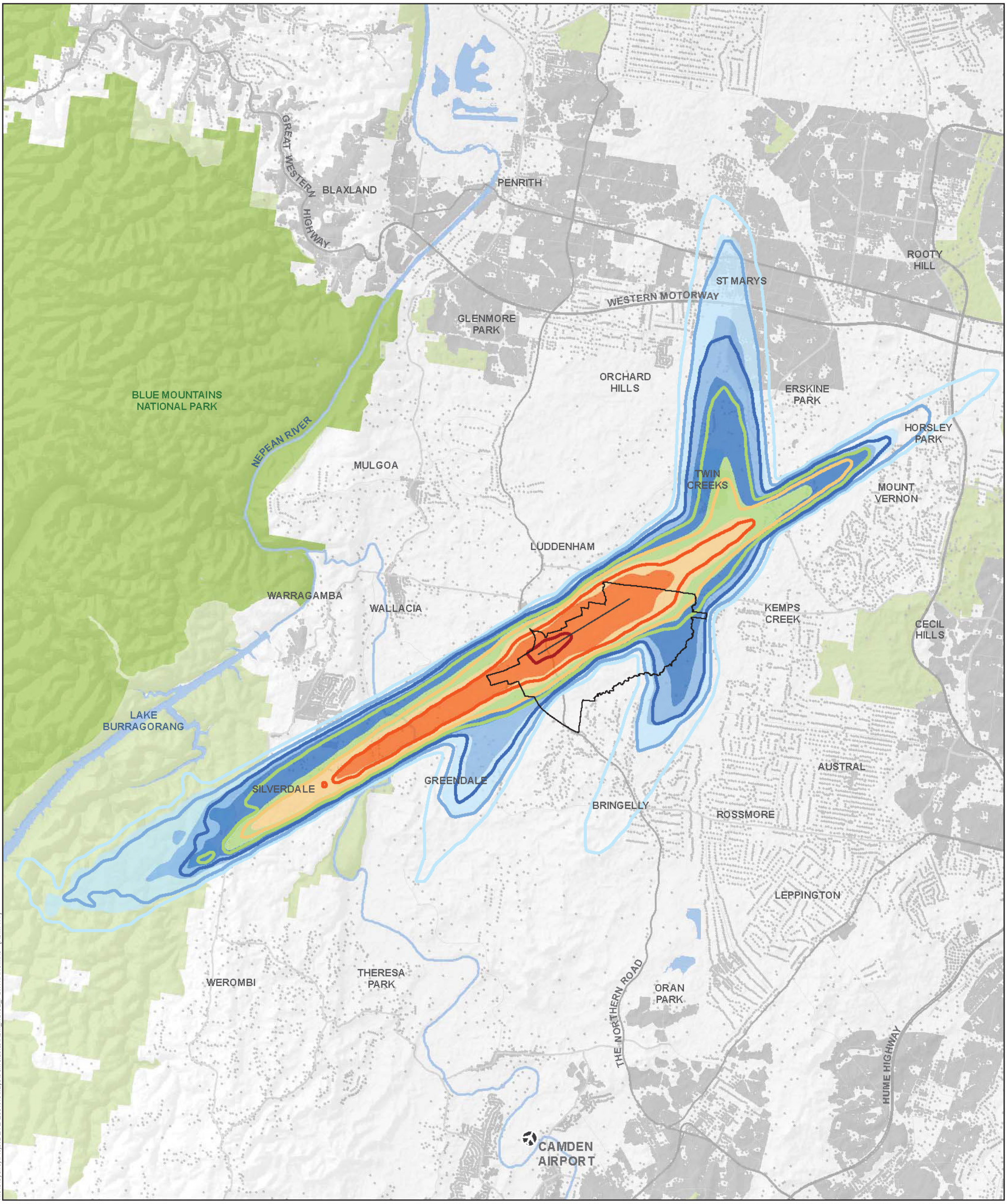
31.3.3.2 90th percentile N70 contours – 2050 scenario

The 90th percentile values of N70 calculated over all days for the 2050 scenario are shown on Figure 31–12 and Figure 31–13. The 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 for the 90th percentile N70 values.

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

Although for the Prefer 23 operating strategy established built-up areas are not predicted to experience more than five events per day over 70 dBA on an average day, there are areas of St Marys and St Clair 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.

The number of noise events exceeding 60 dBA (N60) has been used to describe the impact of noise at night.



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

LEGEND

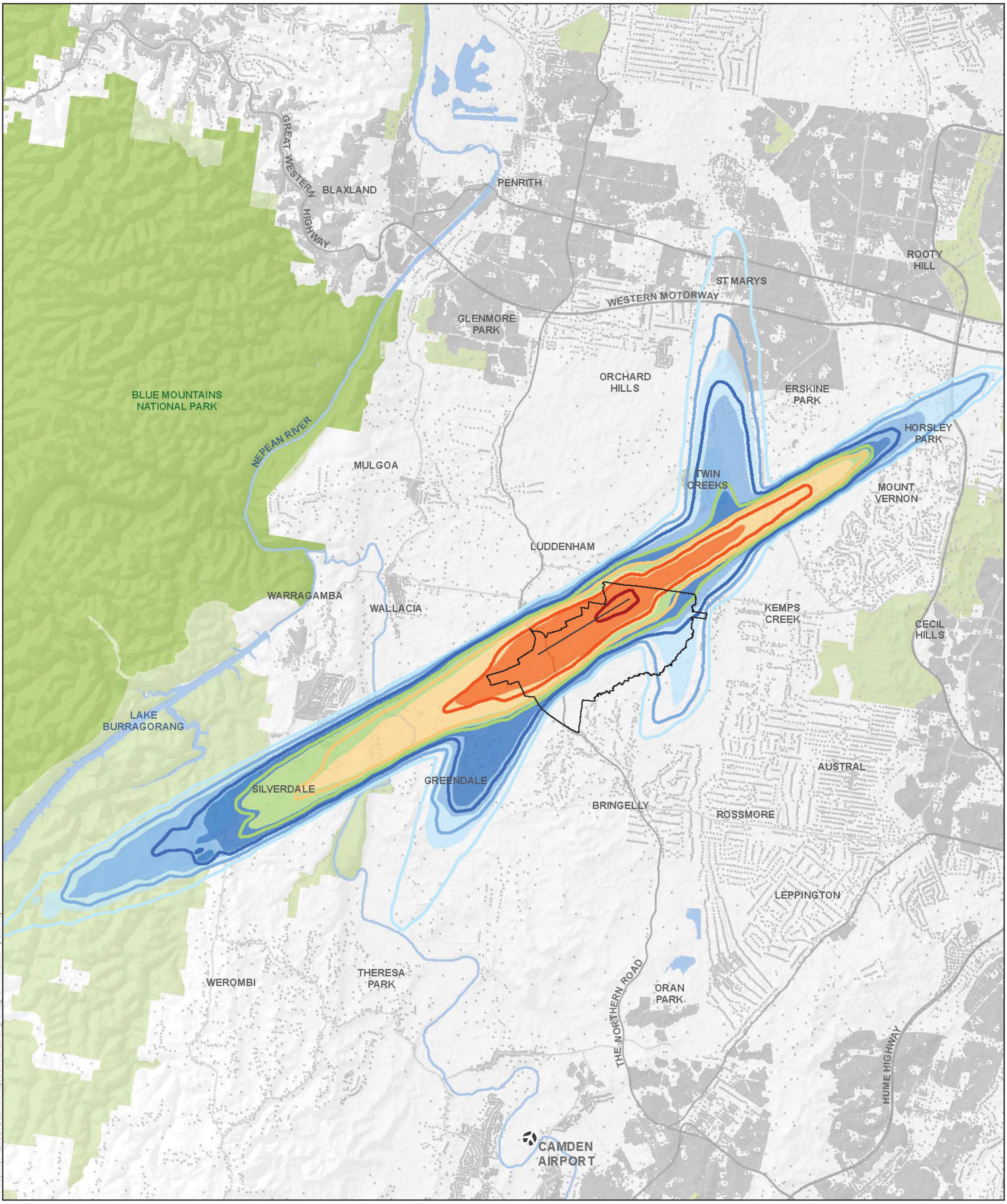
- Western Sydney Airport
- Runway
- Airfields
- Buildings
- Greater Blue Mountains World Heritage Area
- Parks and reserves
- N70 = 5-10
- N70 = 10-20
- N70 = 20-50
- N70 = 50-100
- N70 = 100-200
- N70 = 200+

N70 90th Percentile

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

0 1 2 4
Kilometres

Figure 31-12 - 90th percentile 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+

N70 90th Percentile

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

0 1 2 4
Kilometres

Figure 31-13 - 90th percentile N70 contours for Prefer 23 operating strategy (2050)

31.3.4 Night time noise

31.3.4.1 N60 contours – 2050

The number of noise events exceeding 60 dBA (N60) has been used to describe the impact of noise at night.

N60 values have been calculated for the standard night-time period 10.00 pm – 7.00 am. Figure 31–14 to Figure 31–17 show 2050 N60 contours for the four operating strategies considered.

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, St Clair 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 five to 10 events per night.

Areas near 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.

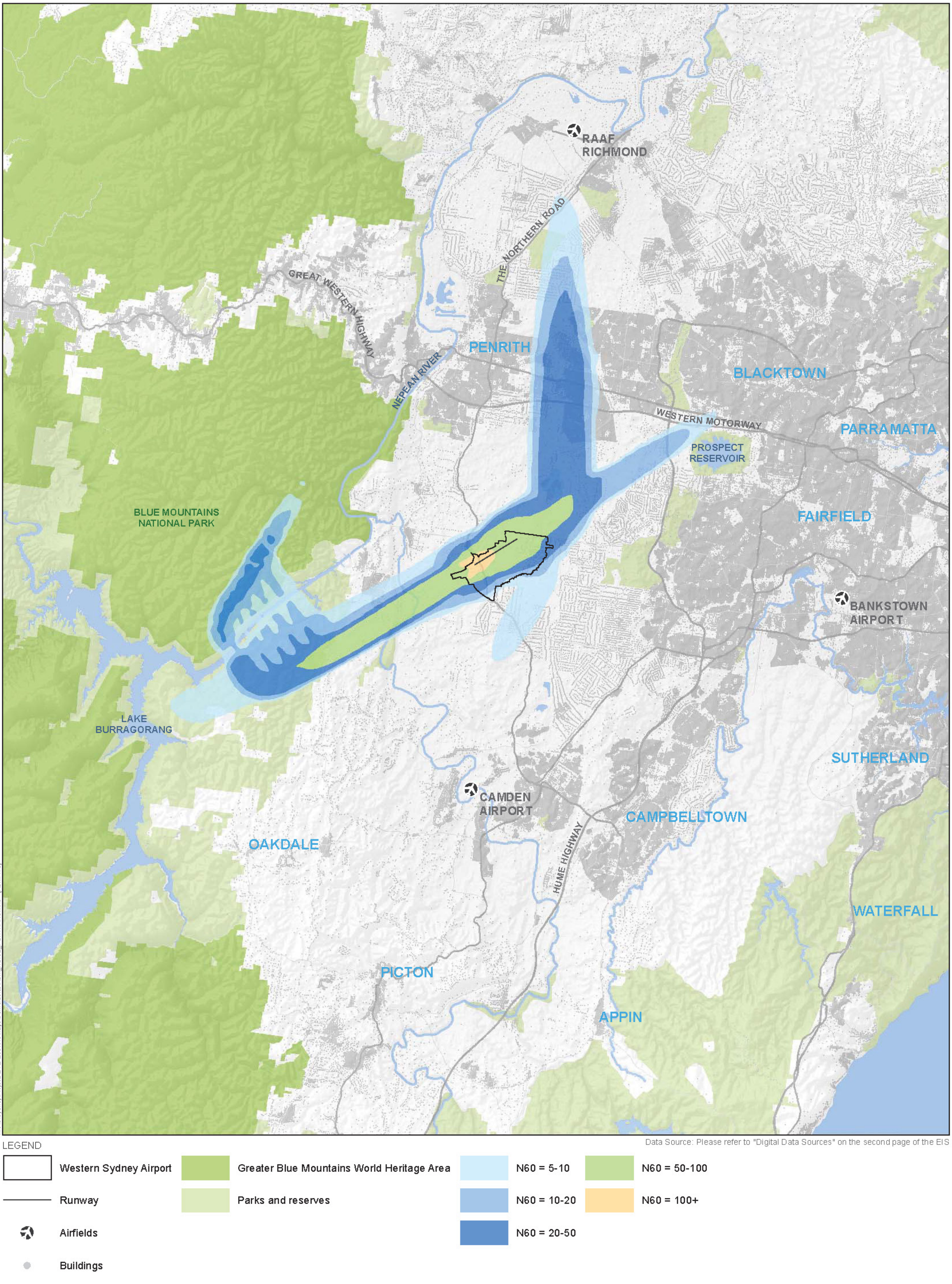
Night-time noise impact towards the north-east could be reduced by the use of head-to-head operations where available. As demonstrated in Figure 31–18 and Figure 31–19, this would result in almost no built-up residential areas being exposed on average to more than five events per night above 60 dBA. The use of a head-to-head operating mode would have minimal effect on the level of disturbance to residents close to the airport site.

Table 31–4 shows the population estimated to be affected by night-time noise above 60 dBA in 2050. By this time, the population experiencing night-time noise impacts events at some level is predicted to increase substantially compared to the Stage 1 operations. At 2050 levels of aircraft traffic, the use of a Prefer 23 operating strategy with head-to-head operations offers clear benefits in terms of the number of residents experiencing 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

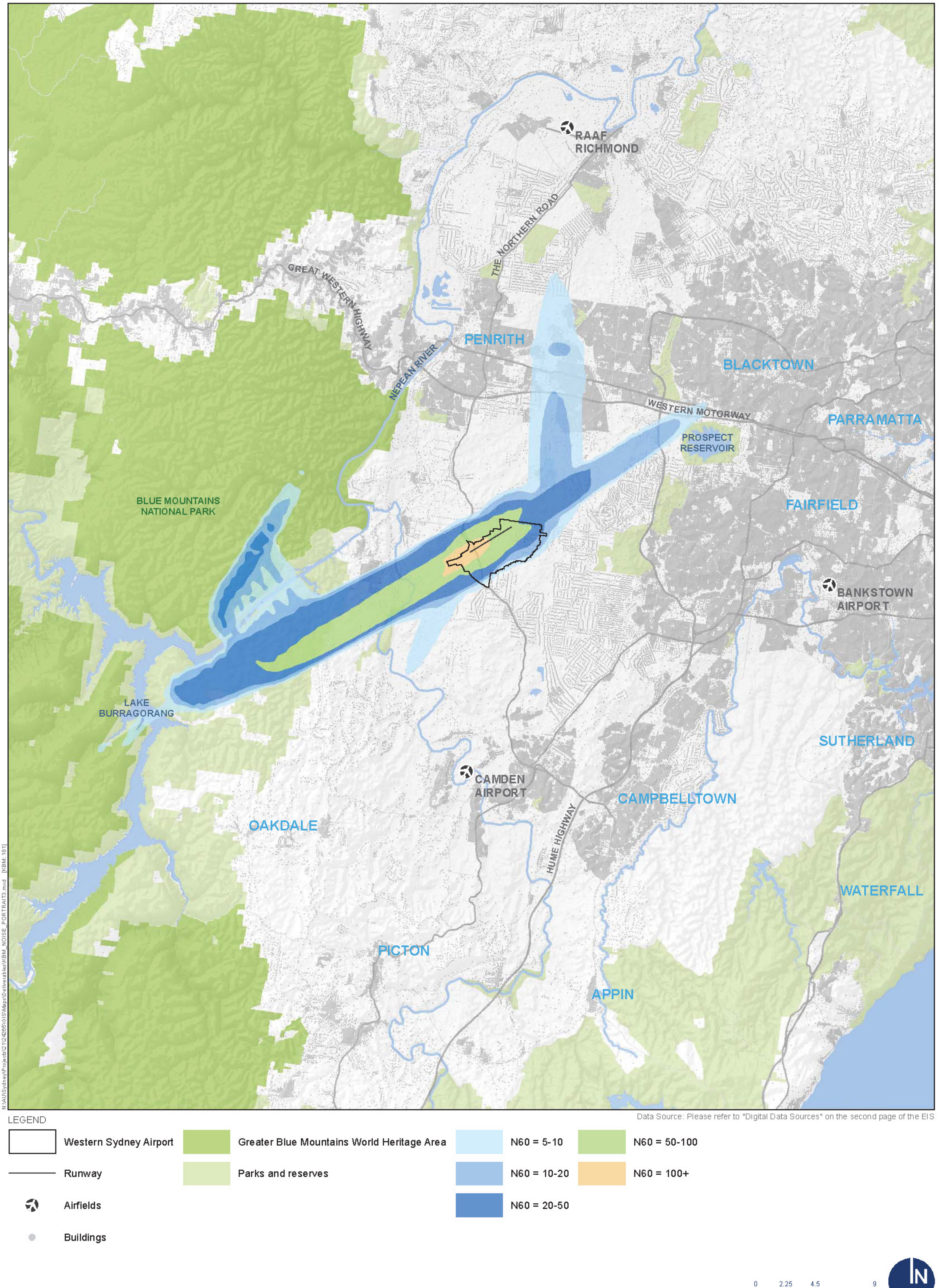
The 90th percentile night-time N60 values, representing the predicted number of events per night exceeding 60 dBA on a ‘worst case’ night, are presented in Appendix E1 (Volume 4). Differences between average and worst case days are generally not large; however, more extensive residential areas would be exposed to more than five events per night on a worst case night than on an average night, particularly with head-to-head operations.



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

Figure 31-14 - N60 contours for Prefer 05 operating strategy (2050)

Figure 31-15 - N60 contours for Prefer 23 operating strategy (2050)



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

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

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

LEGEND

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

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

0 2.25 4.5 9
Kilometres

31.3.5 Recreational areas

A number of recreational areas near to the airport site have been identified within the area predicted to be affected by the threshold levels of aircraft overflight noise exposure used in this assessment. 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 calculating the number of events per day exceeding maximum noise levels of 60 and 70 dBA. Where an outside 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, noise events of this level 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 7.00 am – 6.00 pm, representing the times when these areas would most likely be used.

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

Recreational area	2050 N60 noise events	
	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 number of daily noise events with L_{Amax} exceeding 60 dBA (N60) at recreational areas (2050)

Recreational area	2050 N70 noise events	
	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 noise levels at Twin Creeks Golf and Country Club would be noticeable and at times a raised voice effort would be required for effective communication outdoors. At this location, predicted noise exposure would be significantly reduced under a Prefer 23 operating strategy.

Bents Basin State Conservation Area and Gulguer Nature Reserve, Rossmore Grange and Whalan Reserve would be subject to a number of flyovers with noise levels exceeding 60 dBA, which would be noticeable to passive users of these areas. Bents Basin State Conservation Area and Gulguer Nature Reserve, and Whalan Reserve noise levels would be lower under a Prefer 05 operating strategy. 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 2063 scenario where the airport is servicing around 82 million annual passengers and around 370,000 annual aircraft movements. 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.

As for the single runway assessment scenarios, the flight paths and operating procedures for parallel runway operations 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 operating in 2063, 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 for the assessment of parallel runway operations.

31.4.1 ANEC contours

ANEC contours have been developed based on indicative flight paths and operating modes to provide an indication of the likely acceptability of building types based upon ANEF zones specified in AS 2021. Figure 31–18 presents combined ANEC contours for the Prefer 05 and Prefer 23 operating strategies. Because these ANEC contours combine noise exposure levels for the two assumed operating strategies, they are a conservative or ‘worst case’ representation of noise exposure levels. ANEC contours for the individual Prefer 05 and Prefer 23 operating strategies are shown in Appendix E1 (Volume 4).

The area between the 20 and 25 ANEC contours represents the area within which new residential development is described as conditionally acceptable. New residential development is considered unacceptable within the area defined by the 25 ANEC contour under AS 2021.

The contours cover a larger area 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 in 2063 is shown in Table 31–7.

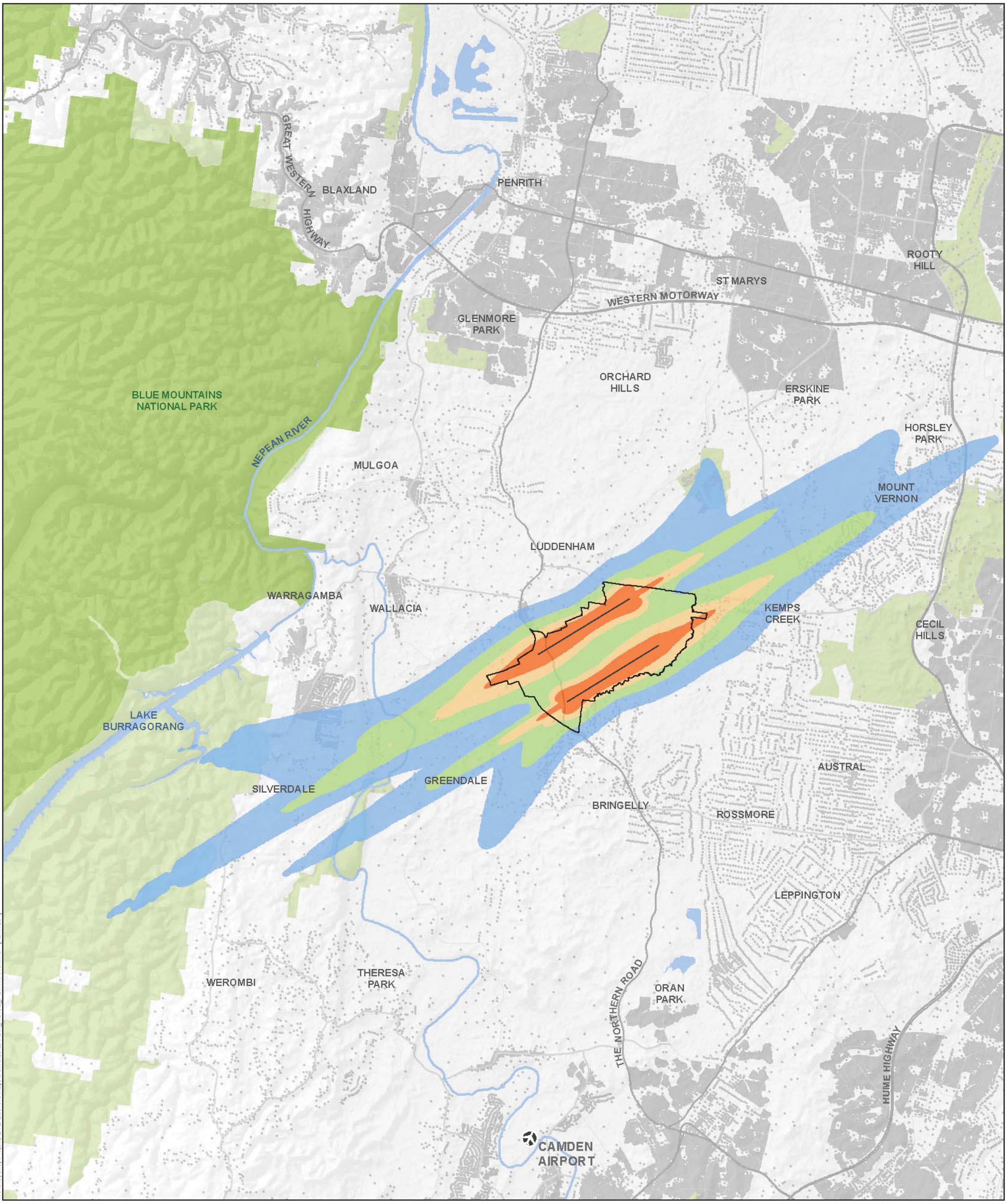
Table 31–7 Estimated population within ANEC contours (2063)

ANEC	Operating strategy	
	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 31–19 shows the year 2063 ANEC 20 contour for the combined operating strategies compared to the ANEC 20 contour 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 combined 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, including into the Burragorang Conservation Area. 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 existing planning controls arising from the 1985 ANEC contours have restricted development within the majority of the land area covered by the modelled 2063 ANEC contours.



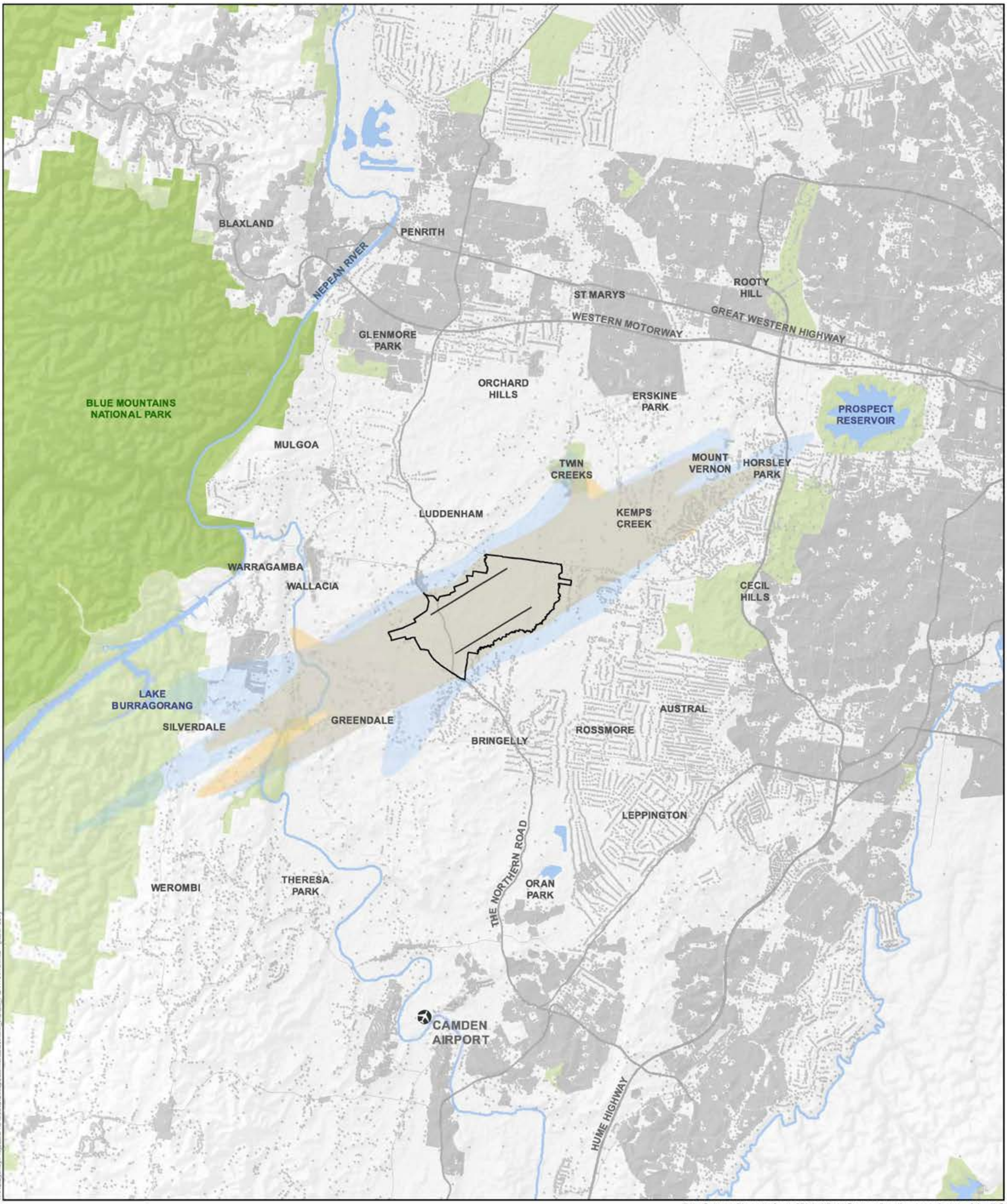
Data Source: Please refer to "Digital Data Sources" on the second page of the EIS

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+

0 1 2 4
Kilometres

Figure 31-18 ANEC contours for combined Prefer 05 and Prefer 23 operating strategies (2063)



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

ANEC Contours 2063 Prefer 05 and Prefer 23

20 ANEC

1985 EIS ANEC Contours

20 ANEC

Figure 31-19 1985 Draft EIS ANEC contours compared to combined 2063 Prefer 05 and Prefer 23 ANEC contours

Kilometres

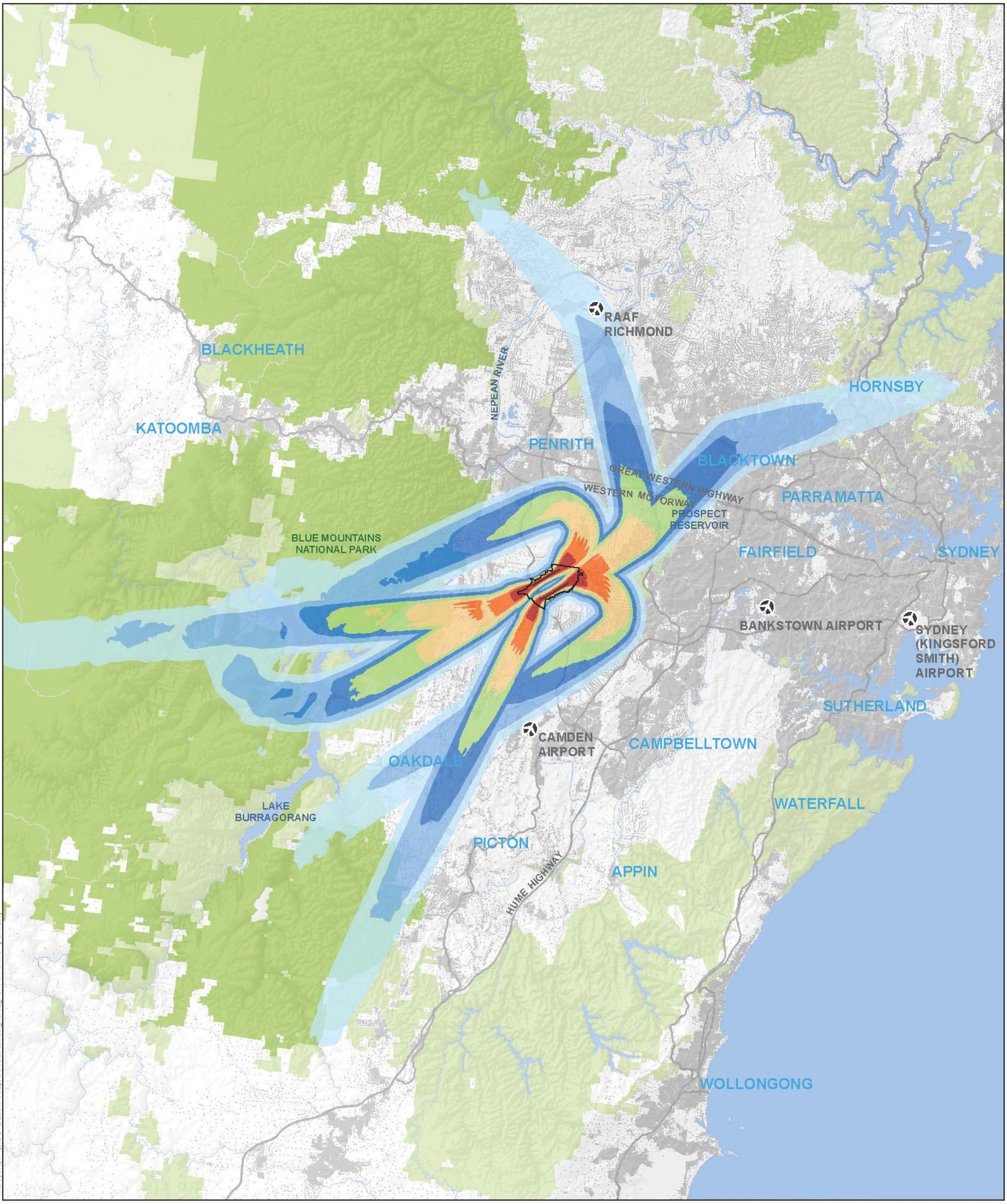
31.4.2 Single event or maximum noise levels

Single-event noise contours depict the maximum (L_{Amax}) noise levels resulting from a single operation of a specific aircraft type on all applicable arrival or departure flight paths.

Figure 31–20 to Figure 31–25 show combined, single event L_{Amax} noise level contours for departures and approaches by a 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 long term development. These figures show that noise events above 60 dBA would be experienced over a wider area, compared to operations on 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 emissions) operating on certain departure paths would result in noise levels exceeding 60 dBA over more areas of the Greater Blue Mountains World Heritage Area, 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 by airlines 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 operations, but the pattern of exposure is predicted be extended with additional residential areas, such as Mount Vernon and Horsley Park exposed to noise levels exceeding 60 dBA. Some residential areas, notably in Silverdale, are predicted to experience noise events over 70 dBA from A320 departures.



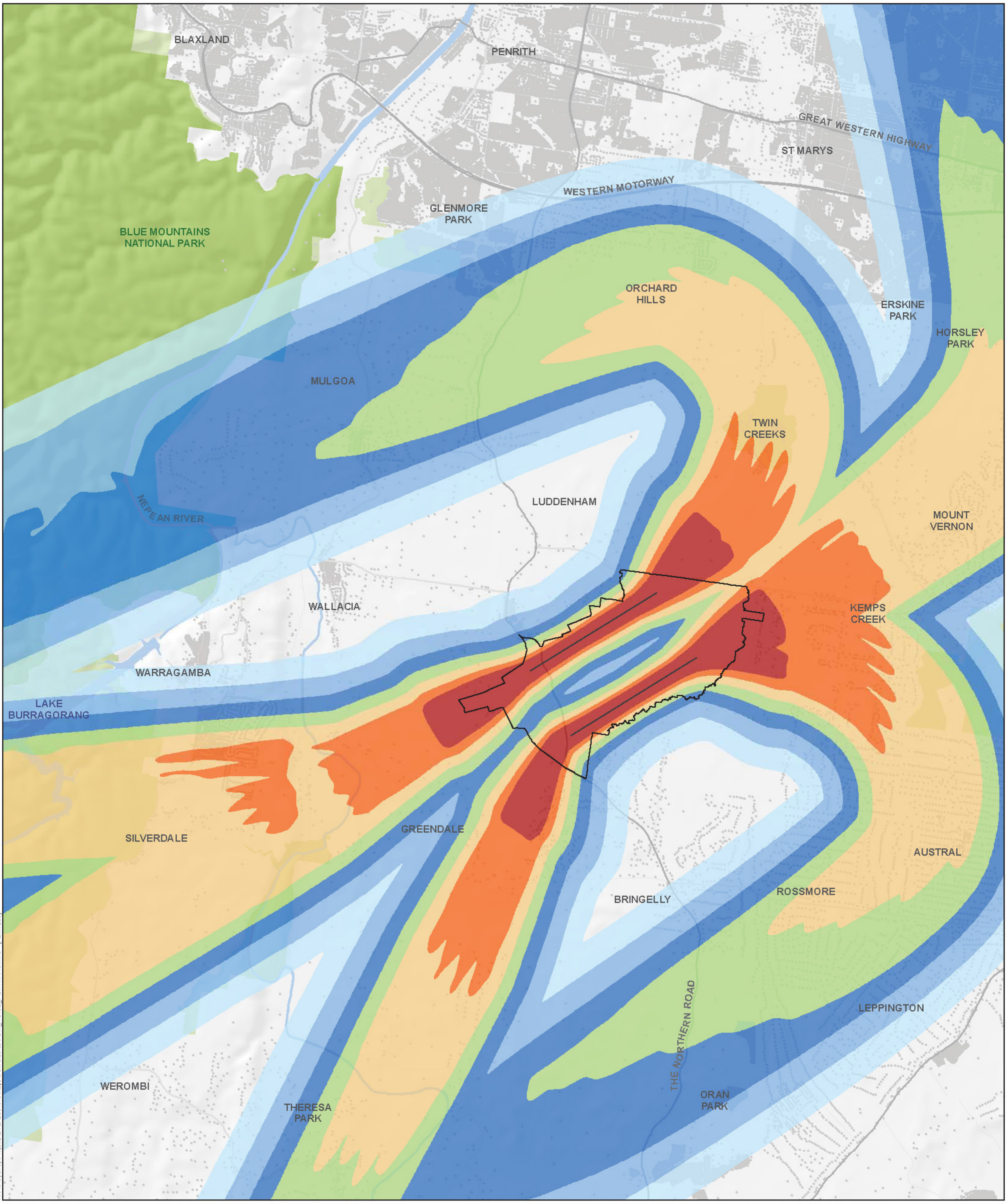
Data Source: Please refer to "Digital Data Sources" on the second page of the EIS

LEGEND

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

0 3.5 7 14
Kilometres

Figure 31-20 Combined single event Boeing 747 departure (stage length 9) 2063



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

LEGEND

- 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 31-21 Combined single event Boeing 747 departure (stage length 9) 2063 (meso scale)

0 0.75 1.5 3
Kilometres

Figure 31-22 Combined single event 747 arrival 2063

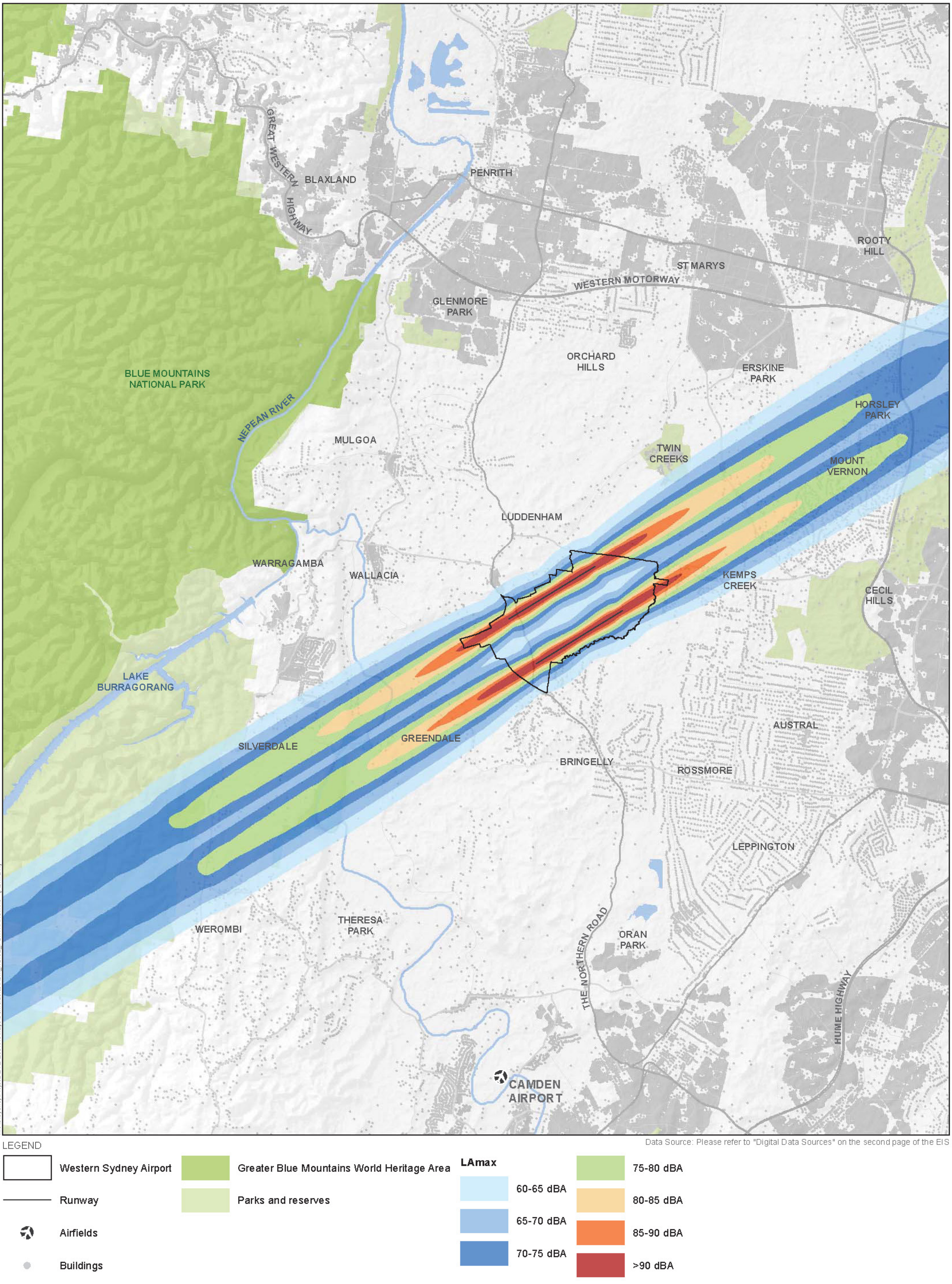
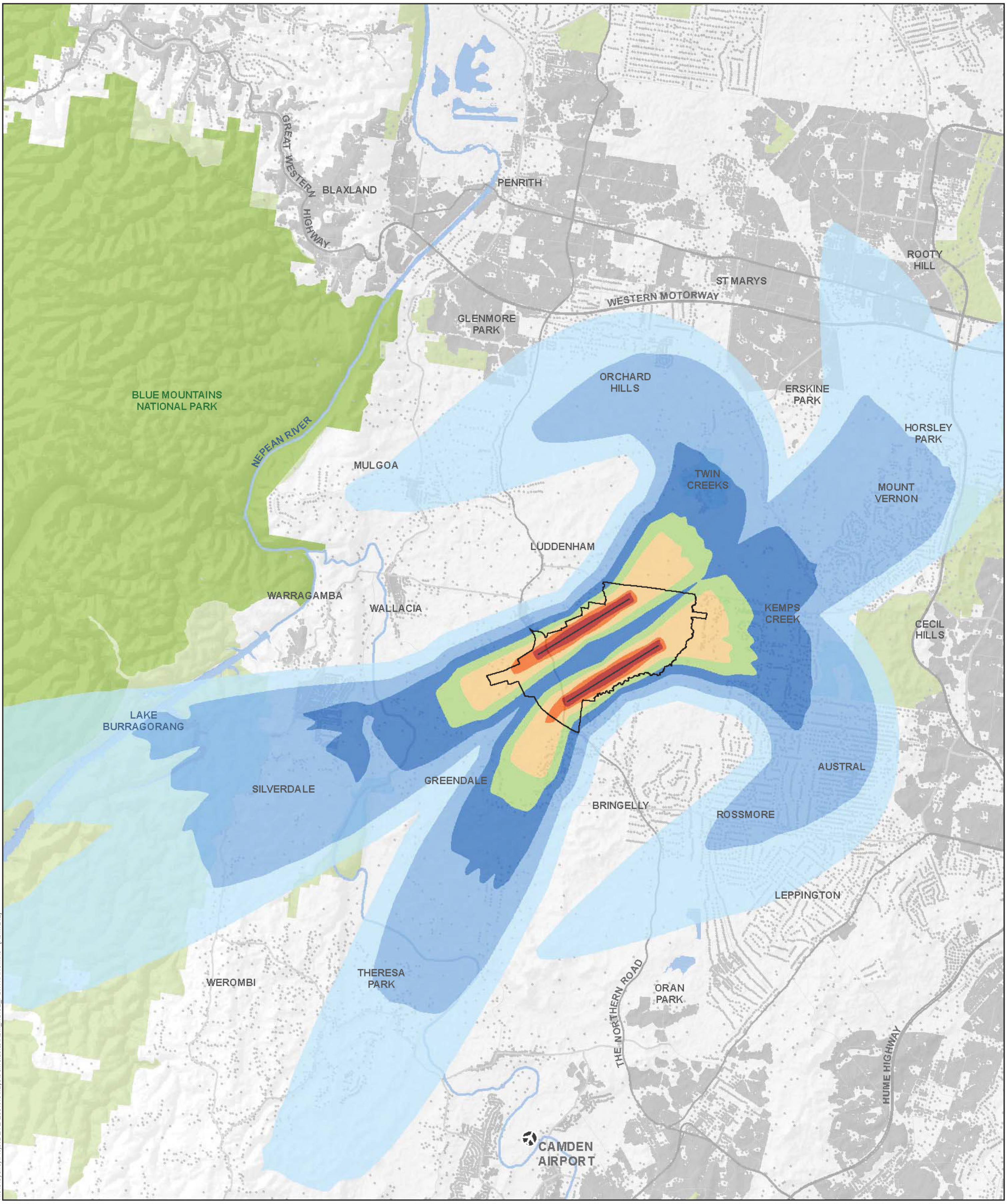


Figure 31-23 Combined single event 747 arrival 2063 (meso scale)



LEGEND

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

Figure 31-24 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	Greater Blue Mountains World Heritage Area	LAmax	75-80 dBA
Runway	Parks and reserves	60-65 dBA	80-85 dBA
Airfields		65-70 dBA	85-90 dBA
Buildings		70-75 dBA	>90 dBA

0 2.25 4.5 9
Kilometres

Figure 31-25 Combined single event Airbus A320 arrival 2063

31.4.3 Noise over 24 hours

31.4.3.1 N70 contours – 2063 scenario

N70 contours for the Prefer 05 and Prefer 23 operating strategies in 2063 are shown in Figure 31–26 and Figure 31–27. 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. Additional residential areas in Horsley Park, Kemps Creek and Mount Vernon would experience an increased frequency of noise events. Parts of Kemps Creek are predicted to experience more than 200 events per day above 70 dBA for both operating strategies, while Mount Vernon would experience between 100 and 200 events per day above 70 dBA under the Prefer 05 strategy and more than 200 events per day above this noise level under the Prefer 23 strategy.

Table 31–8 shows the population estimated to be affected by aircraft noise above 70 dBA in 2063. Comparing the two operating strategies, there is little difference between the total number of people estimated to experience five or more noise events above 70 dBA; similarly, there are only small differences in the size of the exposed population within each respective N70 contour.

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

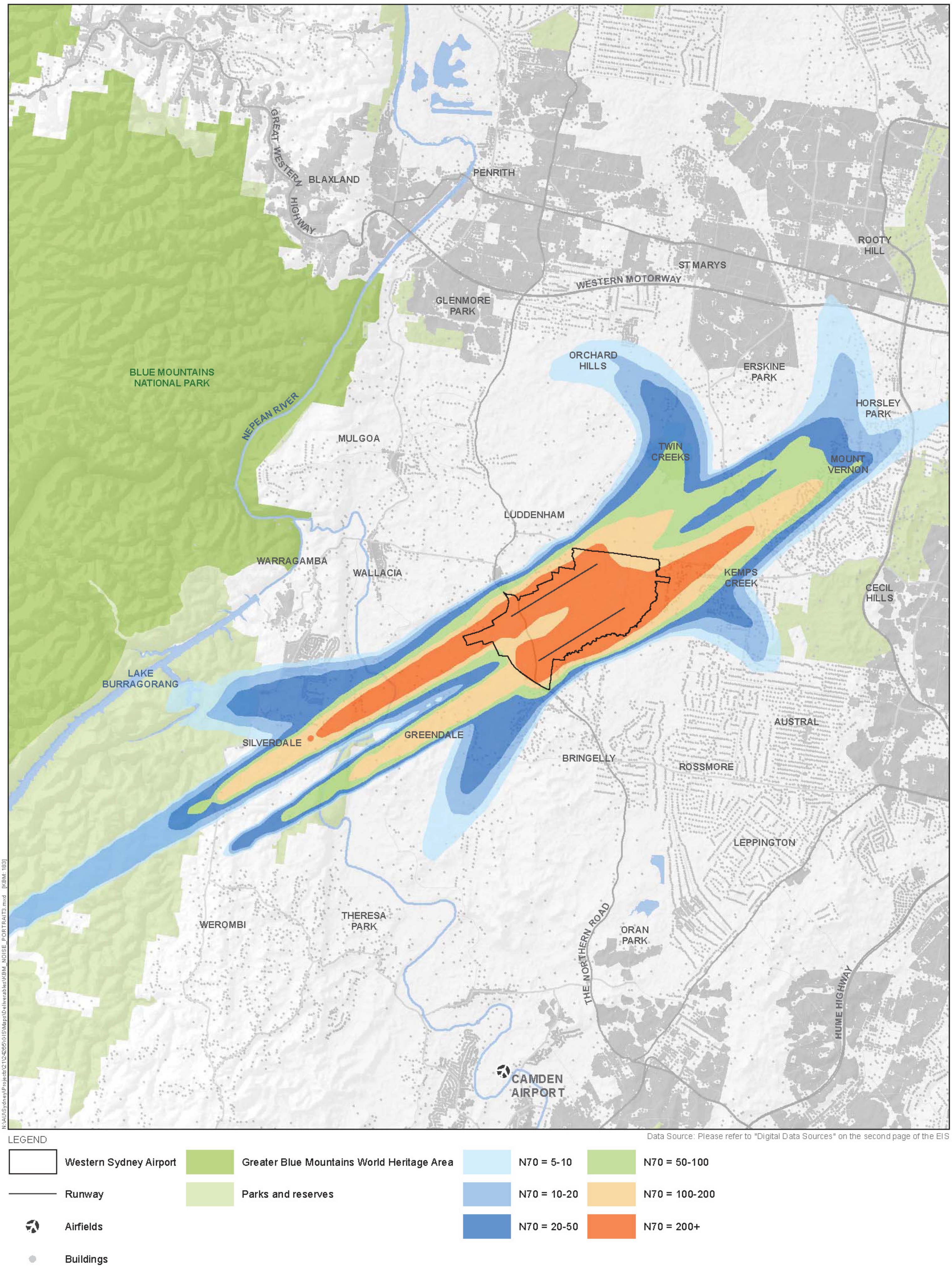
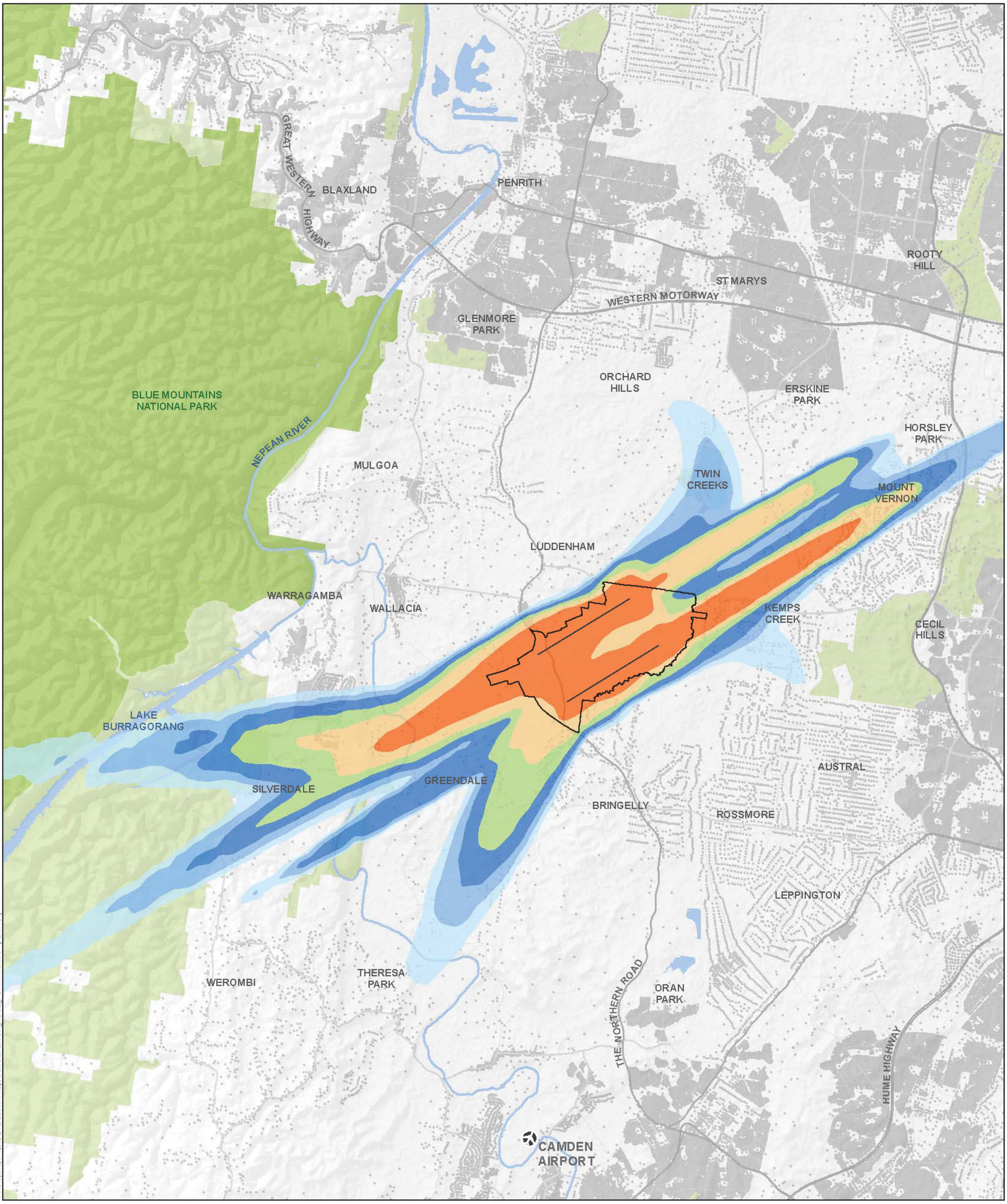


Figure 31-26 - N70 contours for Prefer 05 operating strategy (2063)



LEGEND

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+

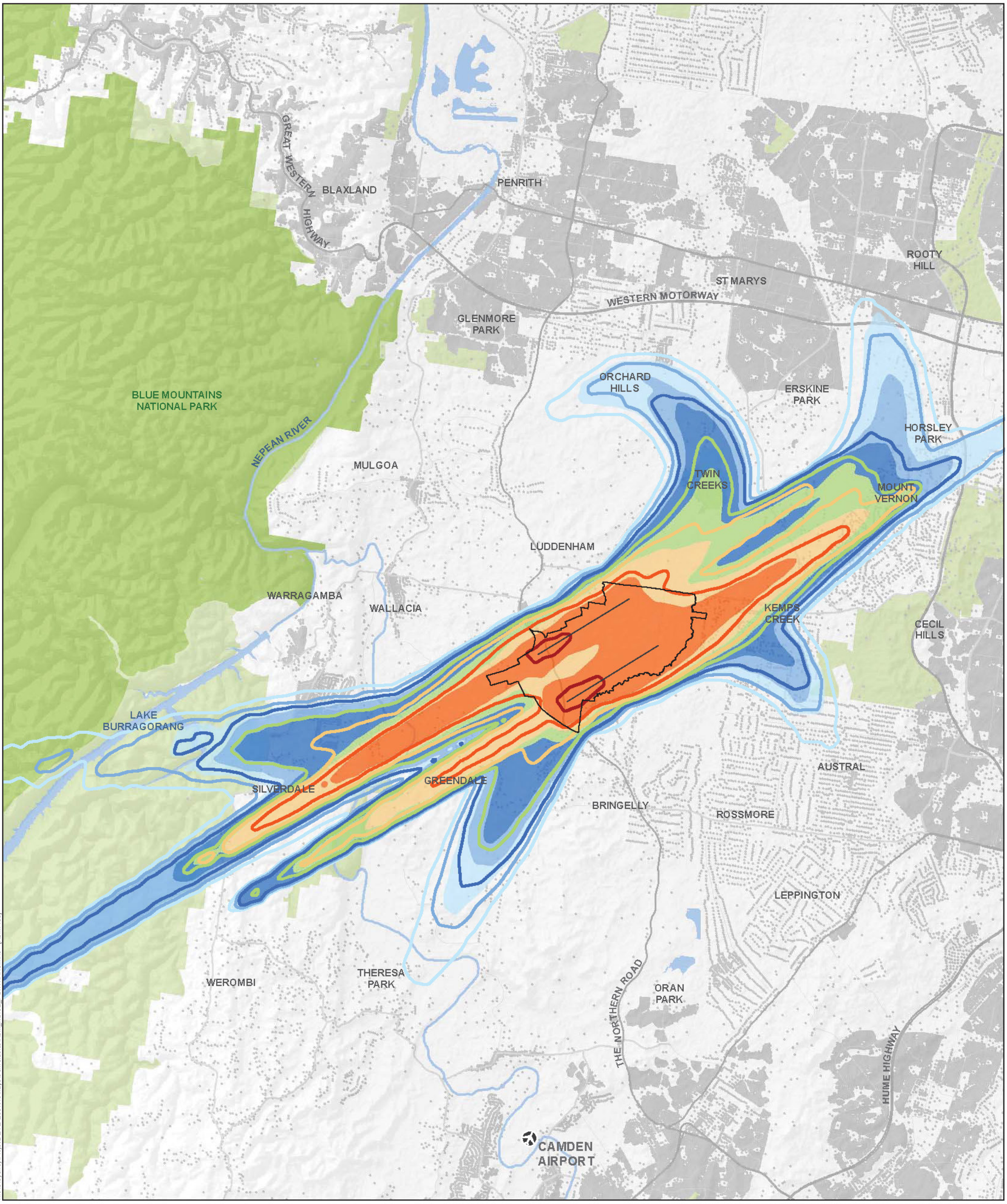
Data Source: Please refer to "Digital Data Sources" on the second page of the EIS

0 1 2 4 Kilometres

Figure 31-27 - N70 contours for Prefer 23 operating strategy (2063)

31.4.3.2 90th percentile N70 contours – 2063 scenario

Figure 31–28 and Figure 31–29 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.



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+

N70 90th Percentile

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

0 1 2 4
Kilometres

Figure 31-28 - 90th percentile N70 contours for Prefer 05 operating strategy (2063)

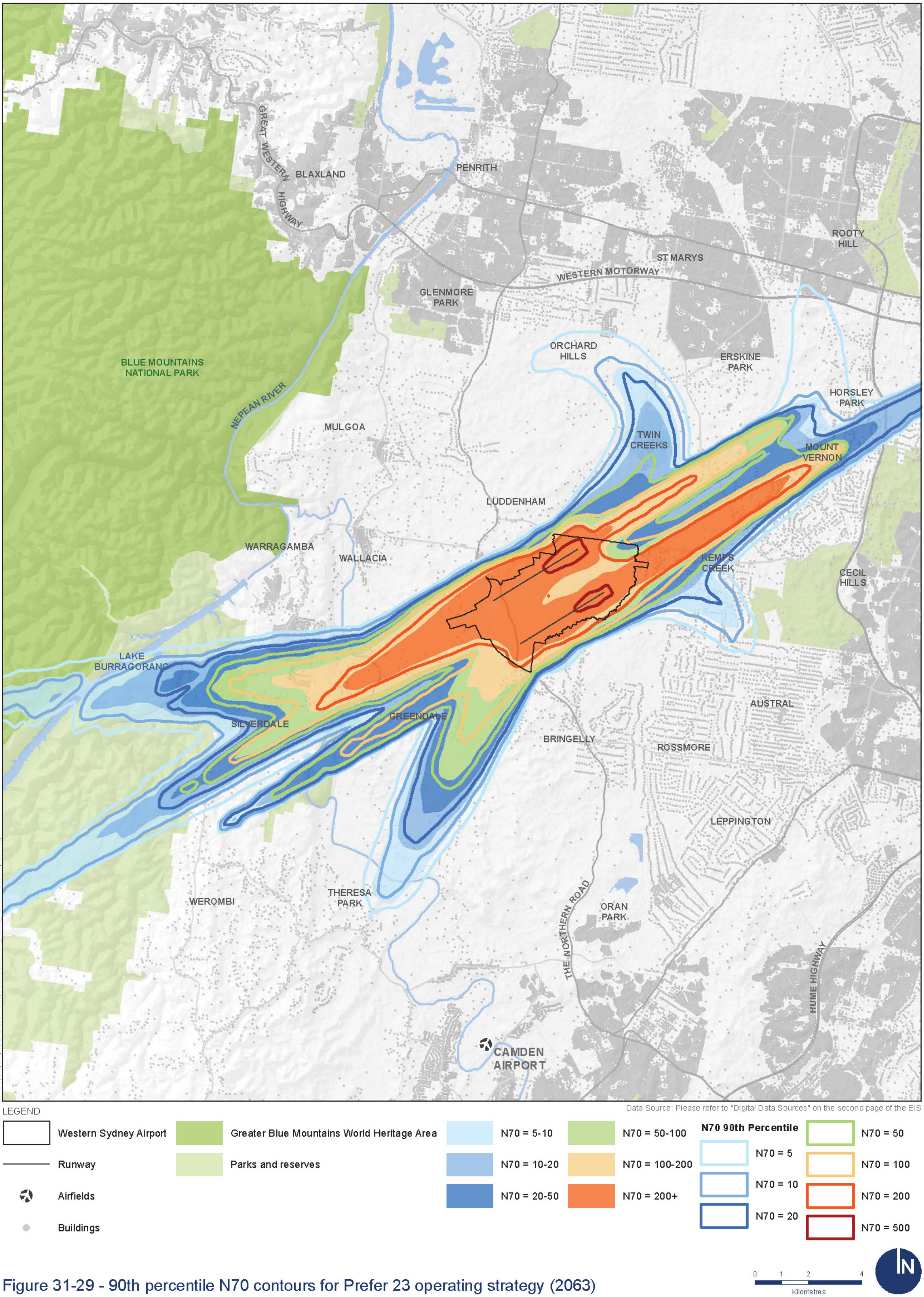


Figure 31-29 - 90th percentile N70 contours for Prefer 23 operating strategy (2063)

31.4.4 Night time noise

31.4.4.1 N60 contours – 2063

The average 2063 night time N60 contours for operating strategies Prefer 05 and Prefer 23 respectively are shown in Figure 31–30 and Figure 31–31. 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-west of the airport site such as Silverdale would be more affected under the Prefer 23 operating strategy. Areas in close proximity to the airport site including Luddenham and Greendale remain affected to a similar extent as the 2050 scenario.

Table 31–9 shows the population 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. Analysis for 2063 does not consider the use of alternative night time operating modes for noise mitigation purposes. As noted in Section 31.2, the use of alternative operating modes, such as head-to-head operations may result in a lower number of residents experiencing night time noise 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, representing the predicted number of events per night exceeding 60 dBA on a ‘worst case’ night, are presented in Appendix E1 (Volume 4). For the Prefer 05 operating strategy, the worst case noise contours cover substantially more area than the average contours, while in the Prefer 23 operating strategy, the impacted areas are almost the same.

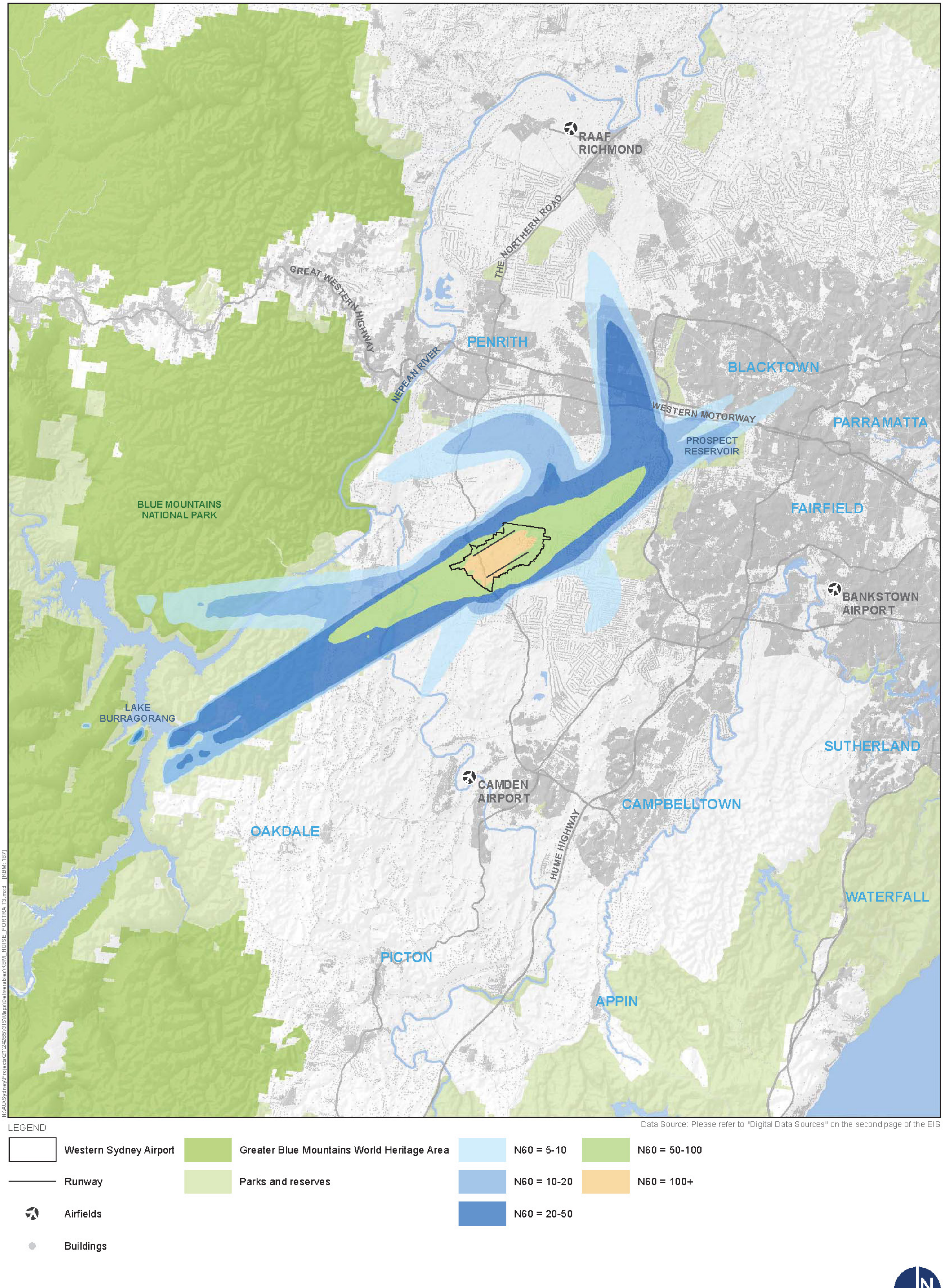


Figure 31-30 - N60 contours for Prefer 05 operating strategy (2063)

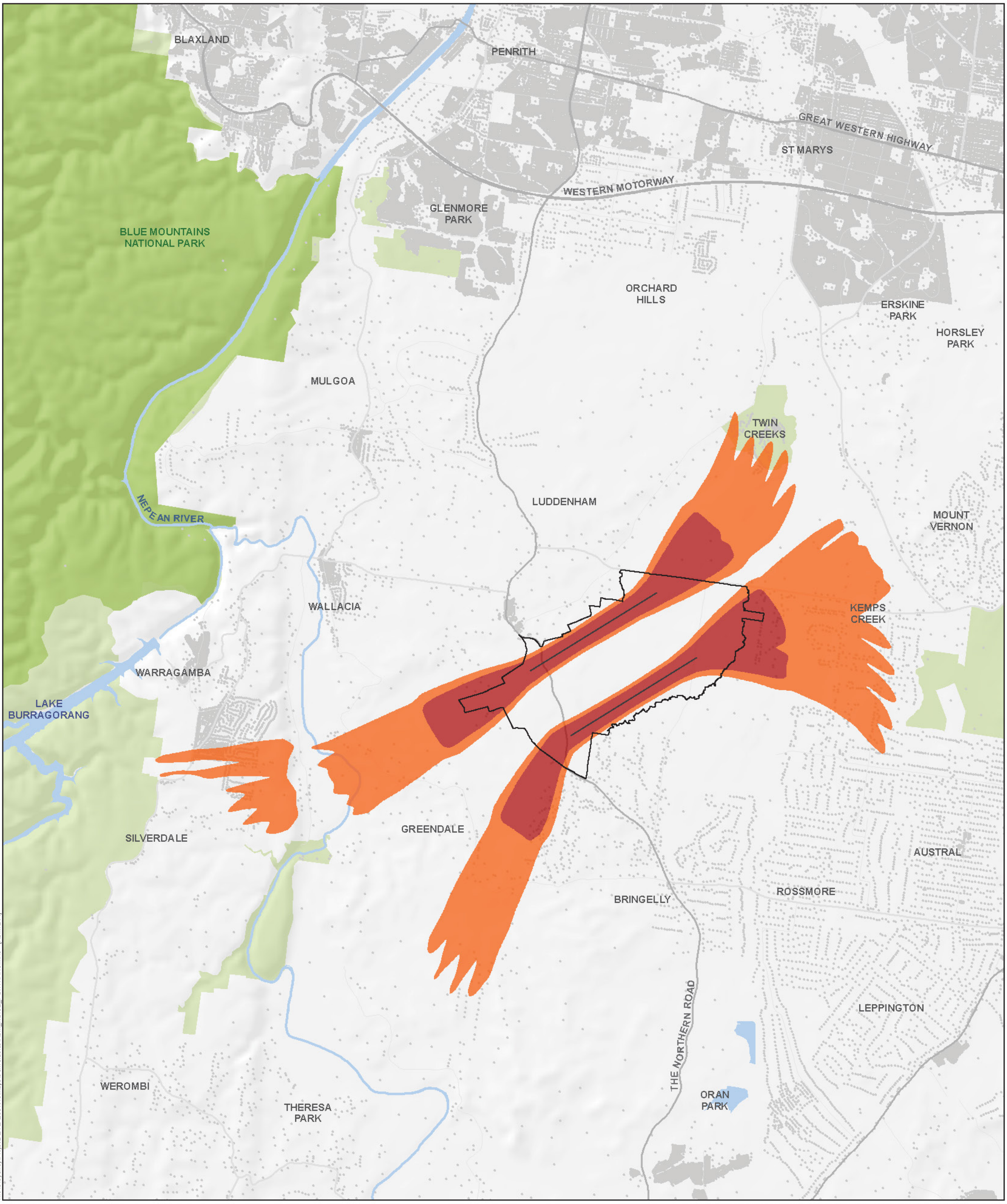
Figure 31-31 - N60 contours for Prefer 23 operating strategy (2063)

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 31–32 shows 85 dBA and 90 dBA noise level contours for a Boeing 747 aircraft departure (stage length 9). 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 the proposed airport in 2063.



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

LEGEND

Western Sydney Airport

Runway

Buildings

Greater Blue Mountains World Heritage Area

Parks and reserves

LAmax

85-90 dBA

>0 dBA

Figure 31-32 85 dBA and 90 dBA L_{Amax} contours B747 Departure (2063)

0 0.75 1.5 3
Kilometres

31.5 Ground-based noise

31.5.1 Approach

Ground- based operational noise emissions from the long term development would be primarily associated with aircraft engine ground running, which is required 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 contribute significantly to potential noise impacts at nearby receivers.

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

The long term development anticipates the commissioning of a second runway sometime around the early 2050s. 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 31–33. The long term assessment of ground-based noise therefore focuses on this scenario.

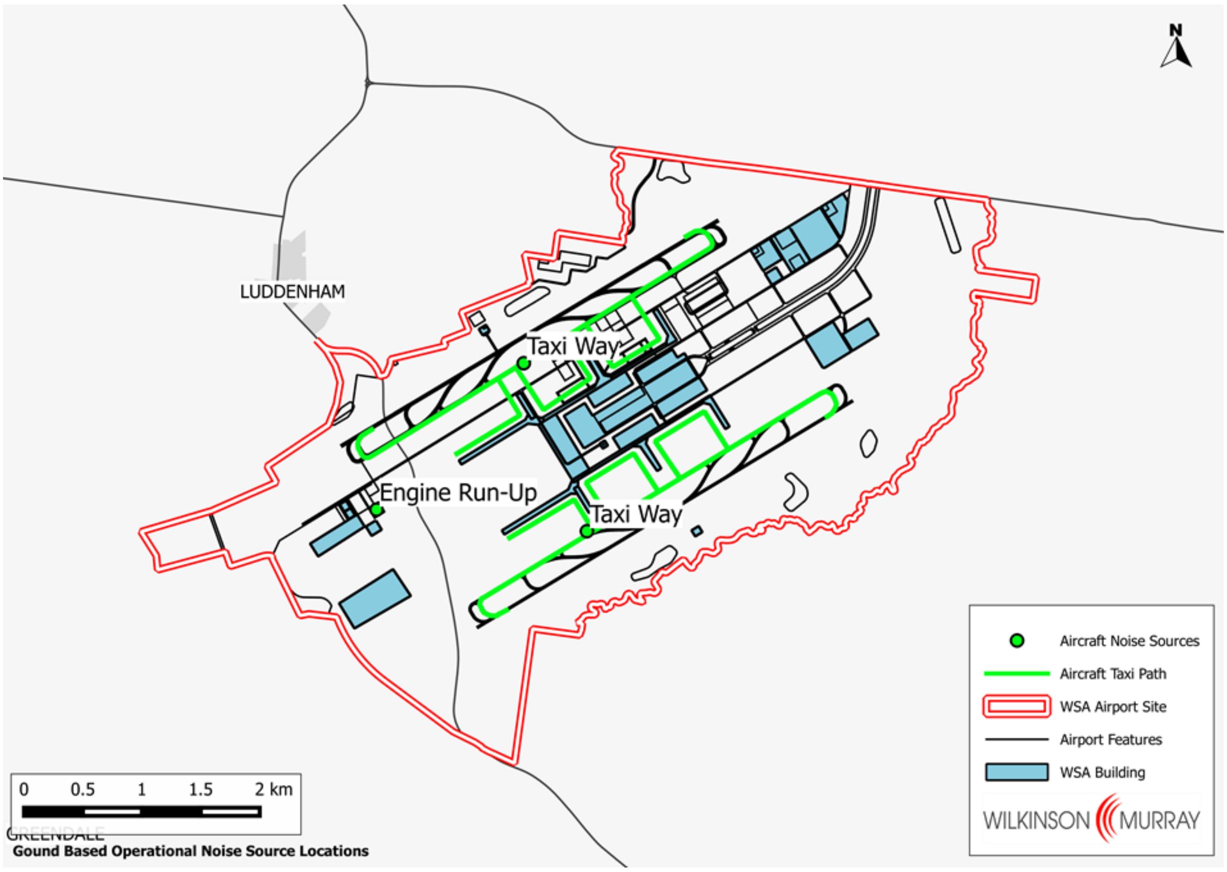


Figure 31–33 Ground-based noise sources

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—the predictions discussed are based on noise levels of aircraft currently used in Australia. New generation quieter aircraft would be introduced well before 2063 and the use of existing aircraft types in the assessment can therefore be considered conservative. The methodology for the assessment of airport operational noise presented in Chapter 11 (Volume 2a) is also 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 incremental. Noise would be assessed as part of the approval process for any future major airport development under the Airports Act. It is, however, noted that construction beyond the Stage 1 development would occur in the context of an operating airport and that the background noise environment would be substantially different compared to today.

The noise generated by road traffic has also been assessed as part of the ground-based operations noise assessment. This assessment included predictions of noise level increases during the day and night time using the CoRTN procedure (see Chapter 11 (Volume 2a)).

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. Noise levels have been calculated for aircraft engine ground running and aircraft taxiing. The resulting contours are shown in Figure 31–34 and Figure 31–35 respectively.

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. Figure 31–34 shows the effect of shielding by aircraft maintenance buildings, the size and location of which are taken from the revised draft Airport Plan. If these buildings are not ultimately constructed or the location of the engine run-up bay relative to these assumed facilities changes through detailed design, then the noise exposure pattern from ground run-up operations would also change. Ground run-up events would also likely occur more frequently in the long term.

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.

Figure 31–34 and Figure 31–35 show that elevated noise levels would be experienced in the immediate vicinity of the proposed airport, particularly around Luddenham.

The assessment of traffic noise indicates that noise emissions would exceed the adopted noise criteria at two locations on Elizabeth Drive and the M12 Motorway, and on a section of Adams Road. Prior to the long term development of the airport, the area surrounding the airport site will be dramatically altered by several decades of development, including new and enhanced road and rail infrastructure. It is expected that the background noise levels in many areas will also increase as a result of the urbanisation process more generally. Therefore, the predicted increases in traffic noise levels would not likely represent substantial change against background conditions. In addition, the planning and approvals for any new infrastructure would consider traffic noise impacts as a result of predicted use, and appropriate noise controls would be implemented into its design.

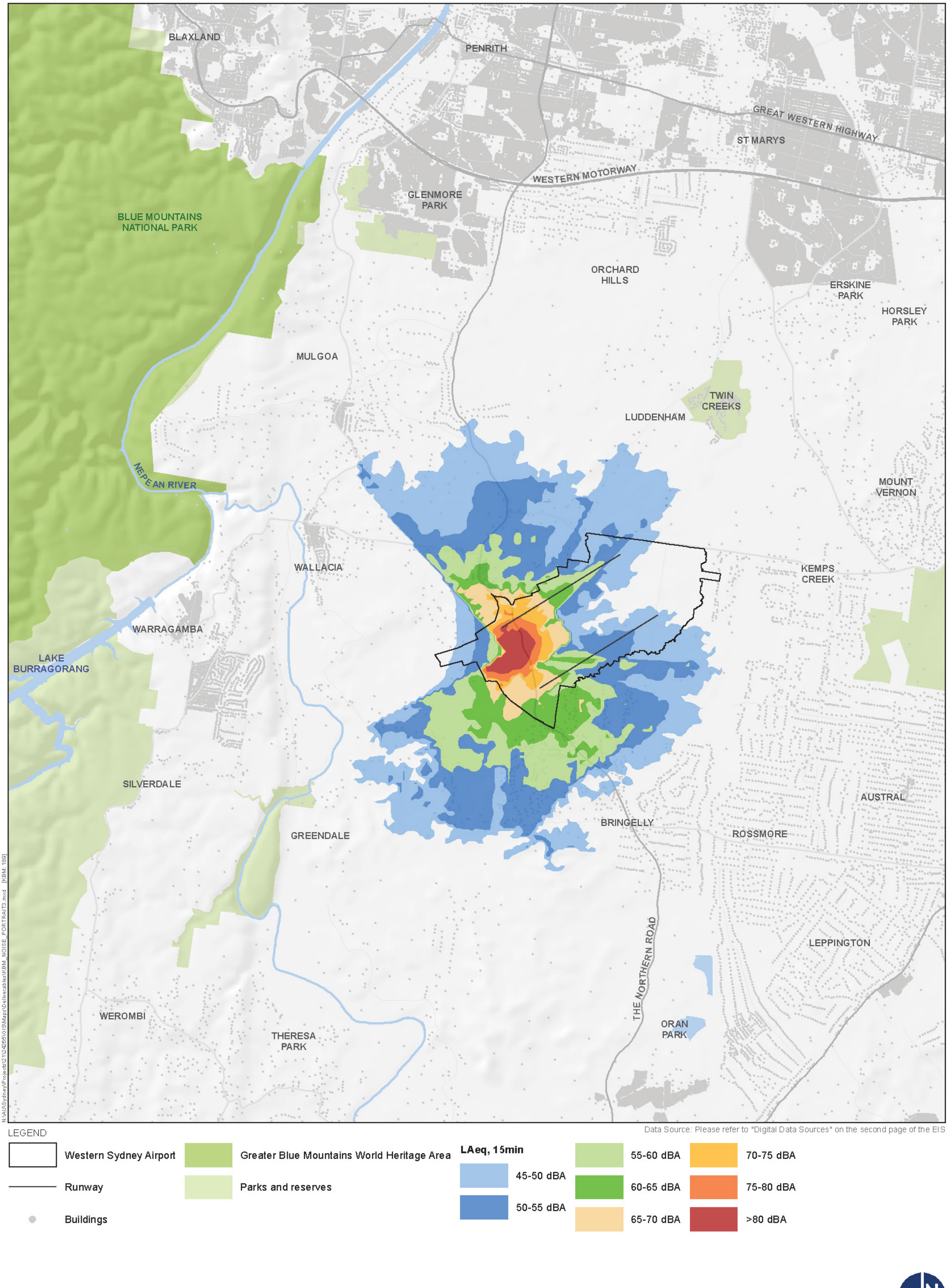


Figure 31-34 - Worst case L_{Aeq} noise level for engine run-up (2063)

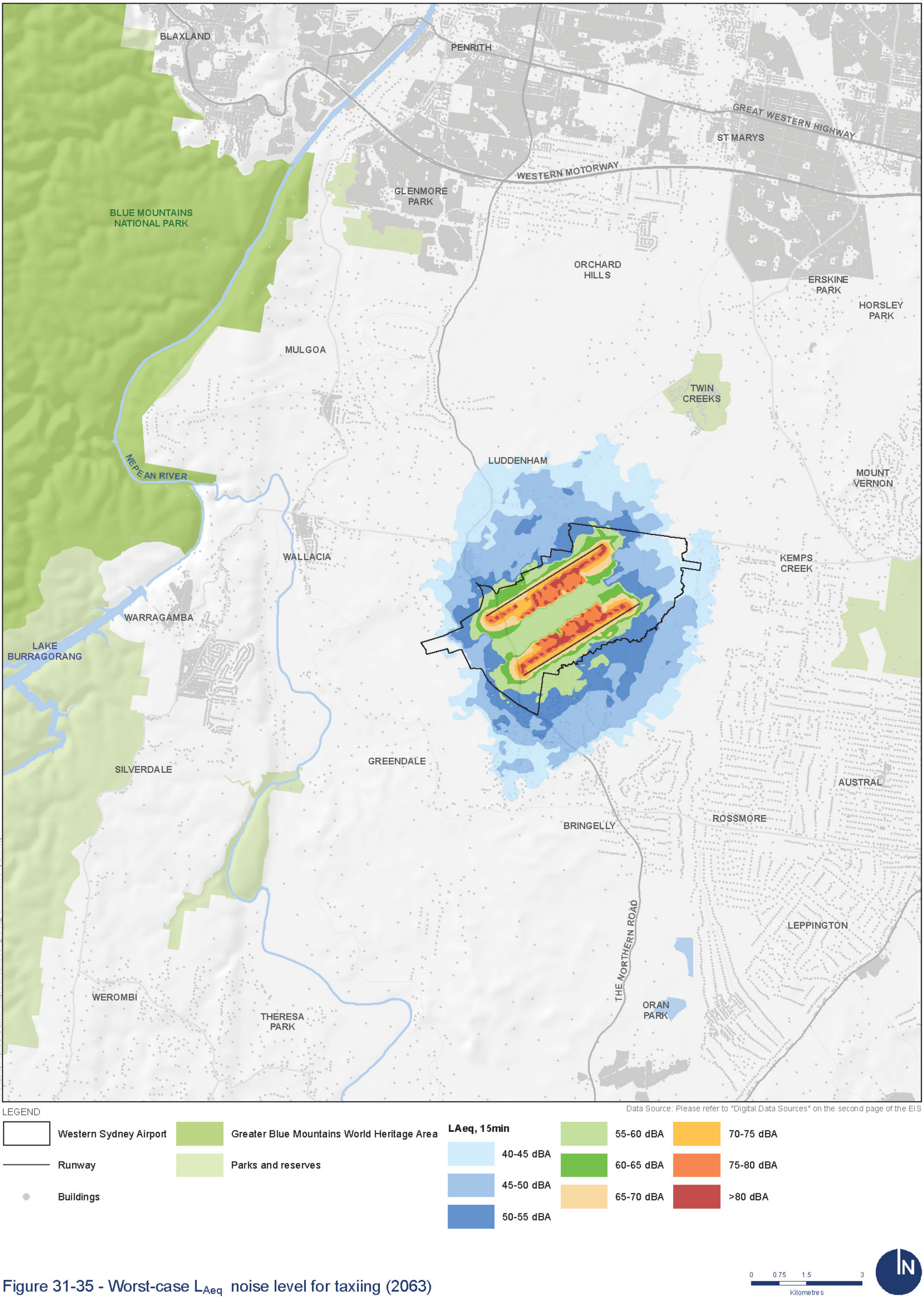


Figure 31-35 - Worst-case L_{Aeq} noise level for taxiing (2063)

31.6 Considerations for future development stages

As discussed in Chapter 10 (Volume 2a), the identification of potential airport operating modes, including noise abatement opportunities, would be an important consideration in future formal airspace design processes for both single and parallel runway 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 impacts and provides respite periods, and implementing land use controls and other operating practices (e.g. use of continuous descent approaches, restrictions on use of reverse thrust at night, etc.).

The ALC will be required to include an environment strategy in its first airport master plan which must detail the sources of environmental impact associated with civil aviation operations at the airport; the monitoring to be carried out in connection with the environmental impact; and the measures to be carried out to prevent, control or reduce this impact. The environment strategy is required to include the proposed systems of testing, measuring and sampling to be carried out for possible or suspected excessive noise. Procedures on how, where and when engine run-ups would be permitted would be established under the environment strategy for the proposed airport. Each master plan including the environment strategy is subject to a public consultation process and requires approval from the Infrastructure Minister.

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

The assessment of airport noise impacts has considered both aircraft overflight and ground-based noise sources for a 37 million passengers per year airport development and an 82 million passengers per year development. These assessment scenarios are currently anticipated to occur in about 2050 and 2063 respectively.

The flight paths and procedures to be used by aircraft using the proposed airport 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 affected by aircraft noise beyond the proposed Stage 1 operations.

For the 2050 assessment scenario, maximum noise levels of over 85 dBA from the loudest aircraft operations (long-range departures by a Boeing 747 aircraft or equivalent), 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, St Clair 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 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, St Clair 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 operations. Other operating strategies are predicted to result in more people 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 selection of one operating strategy over another would have less influence on the number of people exposed to various levels of aircraft noise following the commencement 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 population 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 affected by increased airport traffic.

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 the townships of Warragamba and Wallacia. Areas such as Kemps Creek, Mount Vernon and parts of Horsley Park and Silverdale are predicted to be within the 20 ANEC contour due to operation of the second runway.

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 an ANEF and an environment strategy to manage noise emissions from the operation of the proposed airport. The master plan 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.

Ground-based noise levels are not expected to change significantly between the proposed Stage 1 operations and the maximum single runway capacity scenario expected around 2050. It is not anticipated that taxiing and engine run-up noise levels would increase, but these types of noise would be expected to be more frequent in the 2050 scenario.

A second runway (anticipated to be required around 2050) would be accompanied by increased aircraft activity and additional noise sources. 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. However, ground run-up events would likely occur more frequently in the long term. An increase in the extent of the 2063 aircraft taxiing noise contours reflect the increased number of aircraft movements, particularly in the southern portion of the site and therefore extend further south as a result of the commissioning of the second runway.

Noise associated with aircraft operations at the proposed airport would 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 of the Stage 1 development presented in Chapter 12 (Volume 2a) and is based on technical assessments of local air quality and greenhouse gas emissions (see Appendix F1 (Volume 4)) and regional air quality (see Appendix F2 (Volume 4)).

Local air quality is concerned with the emission of pollutants directly from activities associated with the proposed airport (primary emissions). Regional air quality, on the other hand, considers the formation of ozone (O^3) through photochemical reactions involving primary emissions from the proposed airport.

Both assessments were undertaken at a spatial scale appropriate to the emissions being assessed and the spatial extent over which impacts would be evident. Air emissions in the local air quality assessment were modelled up to around five kilometres from the airport site, while ozone was modelled for the NSW Greater Metropolitan Region, equalling about 55,000 square kilometres.

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 data collected from monitoring stations in the vicinity of the airport site. Air quality impacts associated with the operation of the airport were modelled at representative sensitive receivers located in the vicinity of the airport site.

Air quality parameters that were assessed include nitrogen oxides (NO_x), particulate matter (known as PM_{10} and $PM_{2.5}$), carbon monoxide (CO), sulfur oxides (SO_x), air toxics and greenhouse gases (CO_2-e). odour (from aircraft exhaust and the on-site wastewater treatment plant), regional air quality impacts (ozone) and greenhouse gas emissions.

The adoption of a worst case for assumed operations at the long term development means that actual air emissions from the operating long term development may be lower than predicted. The worst case includes the assumed use of on-board auxiliary power units (instead of mains power at airport gates) and the exclusion of emissions reductions that could be expected from use of proposed rail connections and improvements in aircraft technology.

The assessment of the long term development forecasts emissions approximately 50 years into the future and also assumes no improvement in background air quality conditions. Given the assumed worst case operations at the long term development and the adopted background air quality, it can be concluded that the emission estimates are conservative.

The methodology for the air quality assessment is discussed in greater detail in Chapter 12 (Volume 2a) and Appendix F (Volume 4).

32.3 Existing environment

Existing meteorology was characterised from climatic data collected over five years (2010–2014) at an automatic weather station situated at Badgerys Creek operated by the Bureau of Meteorology. The collected data indicate the following:

- average wind speed of 2.6 metres per second;
- wind predominantly from the south-west;
- annual average temperature of 17°C;
- hottest month is January (average 23°C);
- coldest months are June/July (average 10 –11°C); and
- average annual relative humidity of 73 per cent.

Existing air quality was characterised from air quality monitoring data collected over ten years (2005–2014) at monitoring stations operated by the NSW Office of Environment and Heritage. Monitoring stations include Bringelly, Macarthur/Campbelltown West, Liverpool and Richmond. The collected data indicate the following:

- nitrogen oxides (including nitrogen dioxide) was well below the relevant criteria;
- particulate matter occasionally exceeded the relevant criteria, likely to be associated with surrounding population centres or events such as bushfire; and
- ozone exceeded the relevant criteria on multiple occasions.

Further information on the existing meteorology and air quality in the region of the airport site is provided in the air quality assessment for the Stage 1 development presented in Chapter 12 (Volume 2a).

32.4 Assessment of impacts during operation

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

32.4.1 Emissions

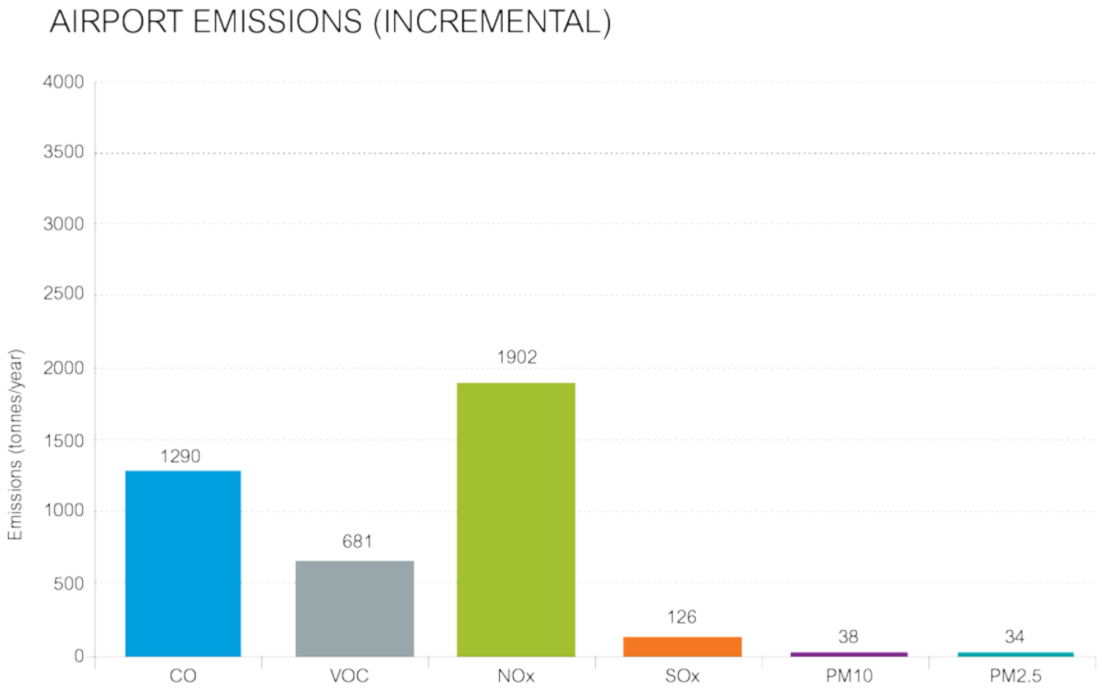
The emissions of criteria pollutants (as defined in Chapter 12 (Volume 2a)) from the long term development are presented in Figure 32–1. Incremental emissions comprise emissions solely from the airport site, namely emissions from aircraft, auxiliary power units, ground support equipment, parking facilities, 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 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 92 and 93 per cent respectively of nitrogen oxides and sulfur oxides 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 background traffic on the external roadways account for an estimated 65 per cent of PM_{10}, 59 per cent of $PM_{2.5}$, 53 percent of carbon monoxide and 29 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.



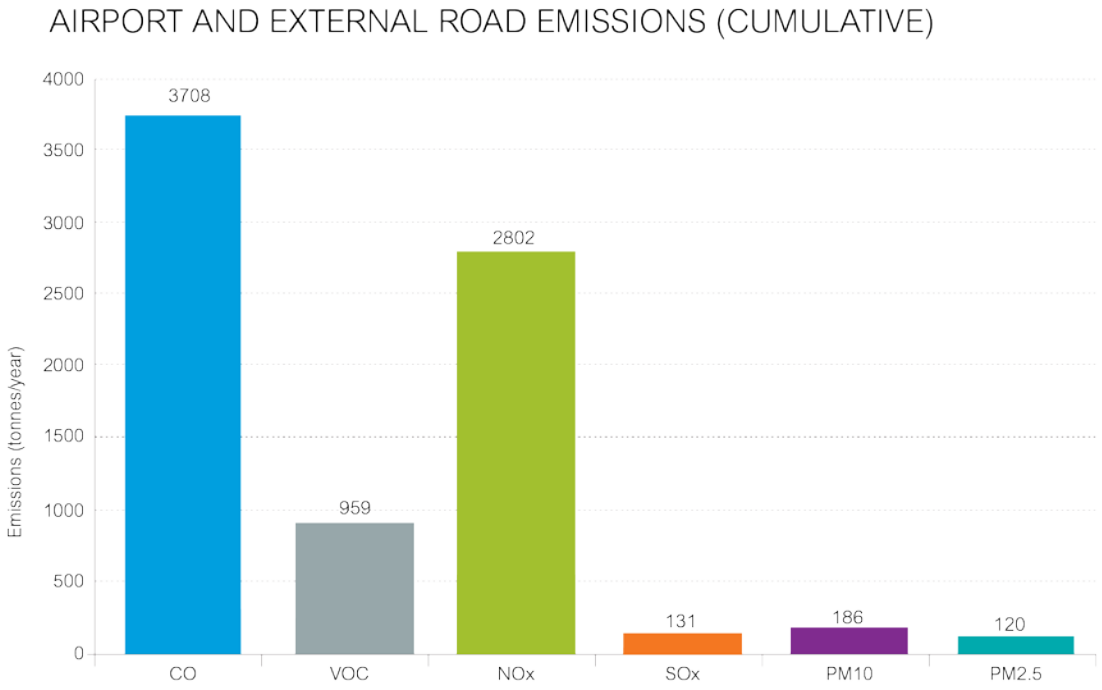
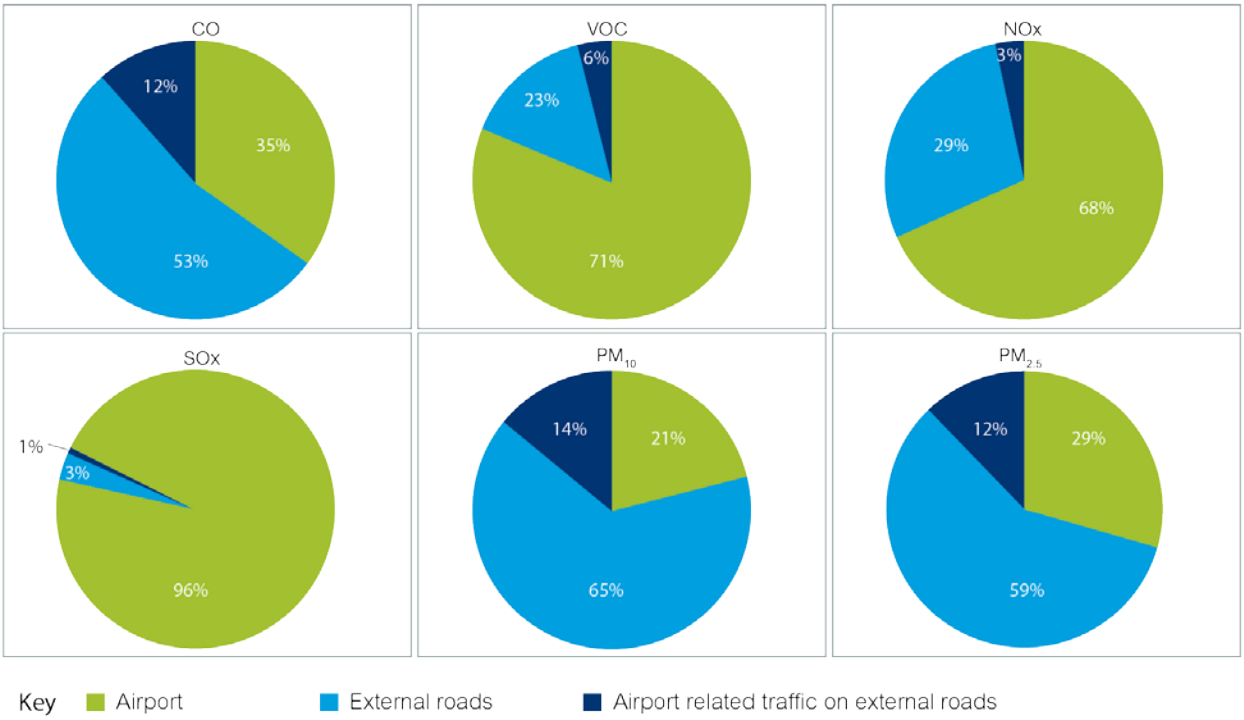


Figure 32–1 Airport and external road emissions (incremental and cumulative) for the long term development

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}		$PM_{2.5}$	
Proposed airport	1,290	35%	681	71%	1,902	68%	126	96%	38	20%	34	28%
Aircraft engines	729	56%	132	19%	1,756	92%	116	93%	8	21%	8	23%
Ground support equipment	159.2	12%	7.2	1%	15.0	1%	1.7	1%	1.0	3%	1.0	3%
Auxiliary power units	17.8	1%	1.8	0%	64.4	3%	6.6	5%	3.9	10%	3.9	11%
Parking facilities	126.8	10%	13.7	2%	5.7	0%	0.1	0%	0.3	1%	0.2	0%
Terminal traffic	181.6	14%	17.8	3%	38.1	2%	0.4	0%	8.3	22%	4.7	14%
Stationary sources	15.3	1%	507.0	43%	21.6	1%	0.4	0%	1.6	4%	1.6	5%
Boilers	14.5	1%	1.0	0%	17.8	1%	0.1	0%	1.3	4%	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	0.0	0%	441.4	65%	0.0	0%	0.0	0%	0.0	0%	0.0	0%
Generators	0.8	0%	0.2	0%	3.8	0%	0.3	0%	0.3	1%	0.3	1%
Paint and Solvent	0.0	0%	63.2	9%	0.0	0%	0.0	0%	0.0	0%	0.0	0%
Training Fires	61.1	5%	2.0	0%	0.5	0%	0.1	0%	14.9	39%	14.9	44%
Airport traffic on road network	430	12%	59	6%	94	3%	1	1%	27	14%	15	12%
Background traffic on road network	1,987	54%	218	23%	807	29%	4	3%	122	65%	71	59%
Total	3,708	100%	959	100%	2,802	100%	131	100%	186	100%	120	100%

Note: CO = Carbon monoxide, VOC = Volatile organic compounds, NO_x = Nitrogen oxides, SO_X= Sulfur oxides,
PM_{10} = Particulate matter with a diameter less than 10 μm, $PM_{2.5}$ = Particulate matter with a diameter less than 2.5 μm

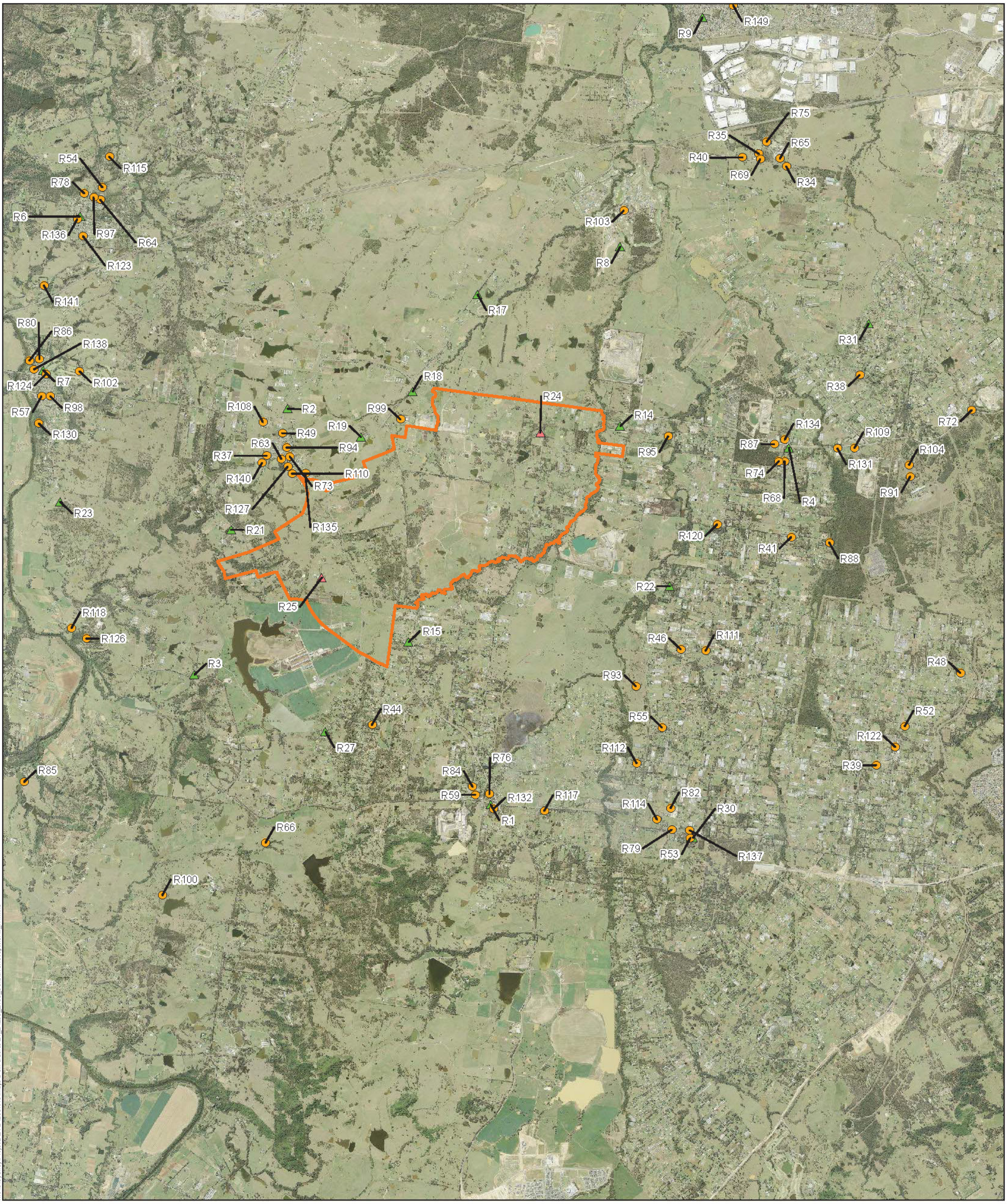


Note: CO = Carbon monoxide, VOC = Volatile organic compounds, NOx = Nitrogen oxides, SOx = Sulfur oxides, PM_{10} and $PM_{2.5}$ = Particulate matter

Figure 32–2 Proportion of emissions from airport and external roads for the 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 (PM10 and PM2.5) for the long term development. Figure 32–3 shows the location of representative sensitive receptors in the vicinity of the airport site.



LEGEND

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

- Airport site
- Community
- Residential
- Airport site

0 0.5 1 2
Kilometres

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.

The results of the dispersion modelling show predicted nitrogen dioxide concentrations are expected to be below the annual criteria at all assessed sensitive receptors.

Exceedances of the one-hour average air quality assessment criteria may be experienced at eight of the 20 selected sensitive residential and onsite receptors. These elevated concentrations are predicted to occur for between one and two hours per year.

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	*Hours > 320*	62	320	*Hours > 320*	62
R1	Bringelly	237	0	17	243	0	23
R2	Luddenham	111	0	22	119	0	28
R3	Greendale, Greendale Road	347	1	22	367	1	24
R4	Kemps Creek	223	0	17	234	0	26
R6	Mulgoa	188	0	18	205	0	19
R7	Wallacia	241	0	17	247	0	18
R8	Twin Creeks	155	0	21	178	0	27
R14	Lawson Road, Badgerys Creek	517	1	34	538	1	43
R15	Mersey Rd, Greendale	343	2	31	350	2	34
R17	Luddenham Road	310	0	22	312	0	27
R18	Adams & Elizabeth Drive	229	0	38	231	0	49
R19	Adams & Anton Road	211	0	47	212	0	51
R21	Willowdene Ave and Vicar Park Lane	408	1	24	440	1	30
R22	Rossmore, Victor Ave	242	0	18	253	0	23
R23	Wallacia, Greendale Rd	342	1	15	347	1	17
R24	Badgerys Creek 1 NE	335	1	55	365	2	52
R25	Badgerys Creek 2 SW	281	0	23	284	0	26
R27	Greendale, Dwyer Rd	116	0	14	118	0	16
R30	Rossmore residential	312	0	14	326	1	20
R31	Mt Vernon residential	345	1	22	349	1	27

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. As shown, predicted concentrations of PM_{10} comply with the 24-hour and annual criteria at all assessed sensitive 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	25
R1	Bringelly	3.7	0.1	5.6	1.3	46	18
R2	Luddenham	1.7	0.3	6.0	1.4	45	18
R3	Greendale, Greendale Road	5.7	0.3	7.4	0.6	43	18
R4	Kemps Creek	2.6	0.2	8.8	1.6	46	19
R6	Mulgoa	1.8	0.1	3.5	0.4	43	17
R7	Wallacia	1.3	0.1	3.1	0.4	43	17
R8	Twin Creeks	2.2	0.2	4.4	1.1	44	18
R14	Lawson Road, Badgerys Creek	9.6	0.7	13.6	2.4	46	19
R15	Mersey Rd, Greendale	6.1	0.5	11.7	1.3	46	18
R17	Luddenham Road	3.4	0.2	5.5	1.3	45	18
R18	Adams & Elizabeth Drive	5.3	0.6	11.2	2.8	46	20
R19	Adams & Anton Road	5.3	0.8	9.0	1.6	45	19
R21	Willowdene Ave and Vicar Park Lane	5.9	0.3	7.6	1.4	44	18
R22	Rossmore, Victor Ave	4.1	0.2	8.0	1.2	45	18
R23	Wallacia, Greendale Rd	2.3	0.1	3.8	0.4	43	17
R24	Badgerys Creek 1 NE	31.6	8.9	18.2	3.8	46	21
R25	Badgerys Creek 2 SW	3.6	0.5	4.9	1.1	44	18
R27	Greendale, Dwyer Rd	1.4	0.1	3.0	0.5	43	17
R30	Rossmore residential	1.7	0.1	4.8	1.3	45	18
R31	Mt Vernon residential	4.2	0.2	6.4	1.0	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.

The results of the dispersion modelling show predicted $PM_{2.5}$ concentrations are expected to be below the 24-hour at all assessed sensitive receptors.

Predicted $PM_{2.5}$ concentrations were predicted exceed the current annual criteria (8 µg/m^3) at three sensitive receptors. All receptors were predicted to exceed the planned 2025 annual criteria (7 µg/m^3), however this was attributable to predicted background levels.

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

Receptor	Receptor description	Airport (µg/m^3)		Airport + external roadways (µg/m^3)		Cumulative – airport + external roadways + existing background (µg/m^3)	
		24-hour	Annual	24-hour	Annual	24-hour	Annual
Assessment criteria		n/a	n/a	n/a	n/a	25 (20[a])	8 (7[a])
R1	Bringelly	2.4	0.1	3.5	0.8	16	8
R2	Luddenham	1.5	0.2	3.5	0.9	15	8
R3	Greendale, Greendale Road	4.3	0.2	5.4	0.4	14	7
R4	Kemps Creek	2.0	0.1	5.6	1.0	16	8
R6	Mulgoa	1.6	0.1	2.5	0.3	14	7
R7	Wallacia	1.1	0.1	1.8	0.3	14	7
R8	Twin Creeks	1.6	0.2	2.9	0.7	14	8
R14	Lawson Road, Badgerys Creek	6.8	0.6	9.0	1.5	18	9
R15	Mersey Rd, Greendale	4.6	0.5	8.1	0.9	16	8
R17	Luddenham Road	2.8	0.2	4.0	0.8	15	8
R18	Adams & Elizabeth Drive	3.8	0.5	7.2	1.7	16	9
R19	Adams & Anton Road	4.0	0.6	6.1	1.1	15	8
R21	Willowdene Ave and Vicar Park Lane	4.0	0.2	5.2	0.9	15	8
R22	Rossmore, Victor Ave	2.9	0.2	5.1	0.8	15	8
R23	Wallacia, Greendale Rd	1.7	0.1	2.6	0.3	14	7
R24	Badgerys Creek 1 NE	18.6	5.3	11.8	2.4	19	9
R25	Badgerys Creek 2 SW	2.3	0.4	3.2	0.8	14	8
R27	Greendale, Dwyer Rd	1.1	0.1	1.8	0.3	14	7
R30	Rossmore residential	1.2	0.1	3.2	0.7	15	8
R31	Mt Vernon residential	2.9	0.2	4.6	0.6	14	8

[a]NEPM-AAQ aim by 2025

32.4.3 Fuel jettisoning

Emergency fuel jettisoning refers to an emergency situation where an aircraft must jettison fuel in order to land safely – typically an emergency landing. Emergency fuel jettisoning is not a standard procedure and furthermore most domestic aircraft are incapable of doing it.

It is mandatory for fuel jettisoning events to be reported. In 2014, from around 698,856 registered civilian domestic air movements and 31,345 international air movements, there were 10 instances of fuel jettisoning. This equates to about 0.001 per cent of all aircraft movements.

Notwithstanding the rarity of fuel jettisoning events, the potential impacts on local air quality would be further limited by the rules in place for fuel jettisoning to occur. These rules demand that pilots take reasonable precautions to ensure the safety of people and property and, where possible, conduct a controlled jettison at an altitude of above 6,000 feet (approximately 1.8 kilometres).

Given the rarity of fuel jettisoning globally, the known low occurrence in Australian airspace, the standards in place, along with the high evaporation rates known to occur at high altitude, authorised fuel jettisoning associated with the operation of the proposed airport is unlikely to cause environmental or social impacts.

The operational conditions for emergency fuel jettisoning are discussed further in Chapter 7 (Volume 1).

32.4.4 Regional air quality (ozone)

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 the *Air Emissions Inventory for the Greater Metropolitan Region in New South Wales* (EPA 2012) which shows that airport operations account or less than three per cent of emissions in the region.

Projected emissions for sources other than the proposed airport (such as commercial, industrial and on-road mobile sources) are not available for the 2063 scenario. The assessment therefore considered the long term development in 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 (Volume 2a).

Historical dates in January and February 2009 were selected to represent the meteorological conditions that have historically led to peak ozone formation. The model has effectively captured this peak ozone formation with the addition of future emissions.

Table 32–5 and Table 32–6 detail the one-hour and four-hour maximum ozone concentrations, respectively, in different modelling scenarios. They show the overall peak value predicted in the wider Sydney basin for the 2030 base case (no airport) and the overall peak value predicted in the wider Sydney basin for the 2063 airport case (airport emissions plus the 2030 base case) on the identified date. In both tables the right-hand column details the largest change, within the Sydney basin, in maximum daily ozone concentration between the 2063 airport case and the 2030 base case, as a result of the additional emissions from the longer term airport development.

For the modelled days, the largest change between the 2063 airport case and the 2030 base case does not occur at the same location as the peak value, hence the peak value does not increase by the amount of the largest difference.

Both the 2030 base case and the 2063 airport case exceeded the National Environment Protection Measure (NEPM) Ambient Air Quality (AAQ) criterion of 100 parts per billion for all but one day of analysis. The NEPM is a national monitoring and reporting protocol. The purpose of the NEPM AAQ is to evaluate trends in air quality over time across the general population and to guide air quality management strategies.

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, while on four days the peak predicted one-hour ozone concentration increased by a maximum of 0.2 parts per billion (ppb).

Larger ozone increases were modelled for the 2063 airport case than for the 2030 airport case. The highest change in daily maximum one-hour ozone concentration, from the addition of 2063 airport emissions, was 12.5 parts per billion, while the second highest was 5.7 parts per billion. The average of the second to fourth highest increases in daily maximum one-hour ozone rose from 1.2 parts per billion for 2030 to 4.6 parts per billion for 2063.

Table 32–5 – Maximum daily predicted one-hour ozone concentration (long term development)

Date	2030 base case peak value (ppb)	2063 airport case peak value (ppb)	2063 airport case – 2030 base case largest difference (ppb)
06/01/2009	149.1	149.2	2.0
07/01/2009	129.8	130.0	12.5
14/01/2009	106.6	106.6	5.7
29/01/2009	124.1	124.1	1.6
30/01/2009	107.4	107.4	2.4
31/01/2009	109.4	109.4	2.2
04/02/2009	103.8	103.8	3.4
05/02/2009	119.6	119.6	1.7
06/02/2009	112.5	112.5	3.4
07/02/2009	133.7	133.7	1.7
08/02/2009	148.6	148.7	2.6
20/02/2009	98.3	98.4	4.6

The daily maximum predicted four-hour ozone concentrations are presented in Table 32–6. The peak predicted four-hour ozone concentration is unchanged in seven of the days analysed and increased in five of the days by a maximum of around 0.3 parts per billion. The highest change in daily maximum four-hour ozone concentration, from the addition of 2063 airport emissions, was 6.5 parts per billion, while the second highest was 5.9 parts per billion. The average of the second to fourth highest increases in daily maximum four-hour ozone is 3.8 parts per billion.

Increases in ozone occurring downwind of the airport site would be greater in 2063 than in 2030. However, there would also be reductions in daily maximum ozone, due to ozone suppression by nitrogen oxide emissions, in the vicinity of the airport site and on some days extending 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 greater in 2063.

Some predicted increases in one-hour and four-hour ozone levels are substantially greater than the maximum allowable increment of one part per billion defined in the NSW tiered procedure for ozone assessment. However, the predicted increases occur under a hypothetical scenario of the long term airport development occurring within the context of 2030 background levels as 2063 background levels cannot be accurately predicted. This does not take into account the commercial, industrial and infrastructure development that would occur in the region up until 2063. Emissions data for operation of the long term development also assume a worst case (see Section 32.2).

Table 32–6 Maximum daily predicted four-hour ozone concentration (long term development)

Date	2030 future base case peak value (ppb)	2063 airport case peak value (ppb)	2063 airport case – 2030 future base case largest difference (ppb)
06/01/2009	126.2	126.5	1.9
07/01/2009	115.3	115.6	5.9
14/01/2009	98.7	98.9	1.7
29/01/2009	95.9	95.9	2.3
30/01/2009	78.2	78.2	2.5
31/01/2009	99.9	99.9	2.3
04/02/2009	97.3	97.3	3.1
05/02/2009	108.7	108.7	1.7
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	6.5

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. As electricity is a Scope 2 emission, Scope 1 emissions would account for the remaining 20 per cent – primarily through fuel combustion and fugitive emissions at 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 airport of departure, as is common 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)
Scope 1 and 2					816,430
Scope 1	Ground support equipment	Transport diesel oil	6	ML	16,910
		Transport gasoline	13	ML	30,728
	Auxiliary power unit	Stationary gasoline (jet fuel)	33	ML	88,566
	Boilers	Stationary natural gas	11,735,513	m^3	23,674
	Generators	Stationary diesel oil	0.05	ML	143
	Fire training	Stationary kerosene	0.03	ML	74
	Wastewater treatment plant	N/A	9,782	ML	6,092
	Fugitive emissions	Transport gasoline (jet fuel)	8030	ML	846
	Fugitive emissions	Transport diesel oil	6	ML	0.7
	Fugitive emissions	Transport gasoline	13	ML	1
Scope 2	Electricity	N/A	755,112,000	kWh	649,396
Scope 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 (Volume 4).
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 (Volume 2a).

Air quality matters associated with the proposed airport would also be regulated under the Airports (Environment Protection) Regulations 1997.

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 oxides 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 concentrations were only predicted for the key criteria pollutants (nitrogen dioxide, PM_{10} and $PM_{2.5}$).

The results of the dispersion modelling for nitrogen dioxide found that there would be no exceedances of the annual average air quality assessment criteria at any of the assessed sensitive receptors. Eight assessed sensitive receptors were predicted to exceed the one-hour air quality assessment criteria for between one and two hours per year.

The results of the dispersion modelling for PM_{10} found that there would be no exceedances of the annual or 24-hour average air quality assessment criteria at the assessed sensitive receptors.

The results of the dispersion modelling for $PM_{2.5}$ found there would be no exceedances of the 24-hour average air quality assessment criteria. Predicted concentrations exceeded the annual criteria (8 $\mu g/m^3$) at three sensitive receptors. All receptors were predicted to exceed the planned 2025 annual criteria (7 $\mu g/m^3$), however this was attributable to predicted background levels.

The maximum predicted one-hour and four-hour ozone concentrations increased by a maximum of 0.2 to 0.3 parts per billion during the operation of the long term development. Both the predicted base case and the long term airport case were generally above the NEPM criteria. Larger ozone incremental increases in the surrounding localities were recorded for the long term development compared to the Stage 1 development, driven primarily by the increase in precursor emissions.

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 airport has been undertaken.

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

33.2 Methodology

The methodology used for assessing the long term development was consistent with that used for the proposed Stage 1 development (see Chapter 15 (Volume 2a) for more details). Two modelling 'scenarios' were developed for the purpose of this assessment.

- 'Without airport' which represents the likely transport network improvement and likely population and employment size and distribution without consideration of the expected additional demand generated by the proposed airport; and
- '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) (STM3) 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 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.

The assumed road network for the 2063 assessment year is generally consistent with the model used to assess the Stage 1 development, with the addition of the proposed Castlereagh Highway and the proposed Outer Sydney Orbital. The Outer Sydney Orbital has been included in the network for assessment purposes. However, this road is still subject to investigation by the NSW Government and no construction timeframe has been announced.

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 Stage 1 assessment.

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 2051 transport network provided with the STM model.

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 is 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 as described below.

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 the VCR 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*[3] outlines Level of Service (LoS) criteria for mid-block sections of road based on the VCR. A summary of the LoS criteria is presented in Table 33–1.

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

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

Level of Service (LoS)	Uninterrupted flow facilities (Motorways)	Uninterrupted flow facilities (Arterial and collector roads)	Volume/capacity ratio
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, airport employees and freight. The expected trip generation for each of these is considered in Sections 33.3.1, 33.3.2 and 33.3.3 respectively. The consequential transport network impacts 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 Airport Lessee Company and would be subject to separate authorisation under the *Airports Act 1996*.

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 (Volume 2a), 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 STM3. The process of determining passenger trips from flight movements, passenger movements and an assignment to different transport modes is summarised below.

33.3.1.1 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.

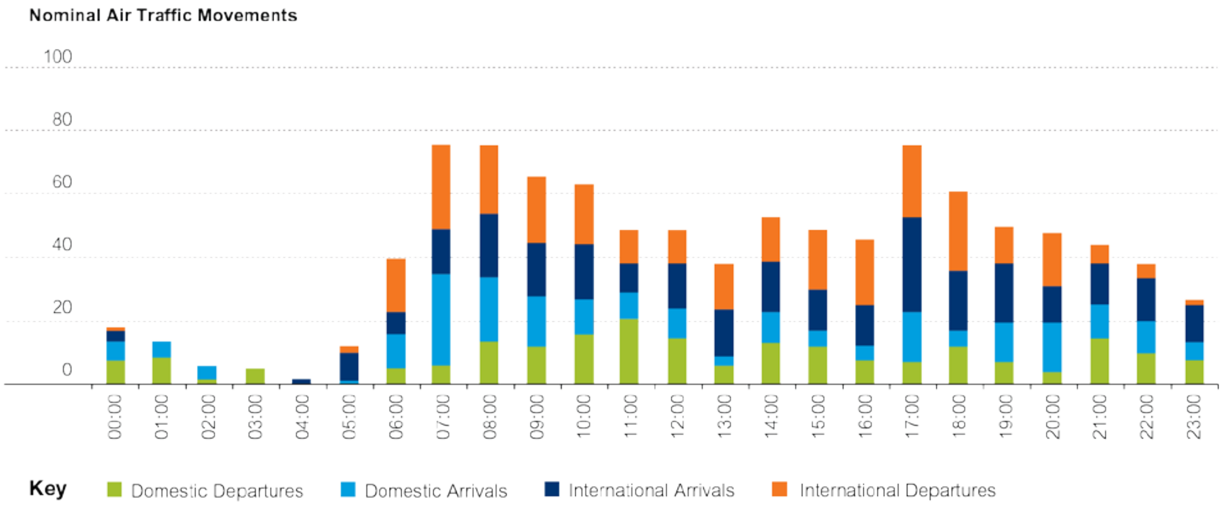


Figure 33–1 Hourly flight arrivals / departures

In 2063, there are expected to be a total of 1,006 passenger flights per day of which 576 are expected to be domestic and 430 are expected to be international. During the peak hour, there are expected to be 76 passenger flights of which 40 are expected to be arrivals (domestic and international) and 36 are expected to be departures (domestic and international).

33.3.1.2 Passenger movements

For each domestic and international flight, a profile for the passengers entering and exiting the proposed airport was determined based on the Sydney Airport Land Transport Model, (as explained in Section 15.2.2), to generate a ground transport demand profile. The ground transport demand profile is shown in Figure 33–2.

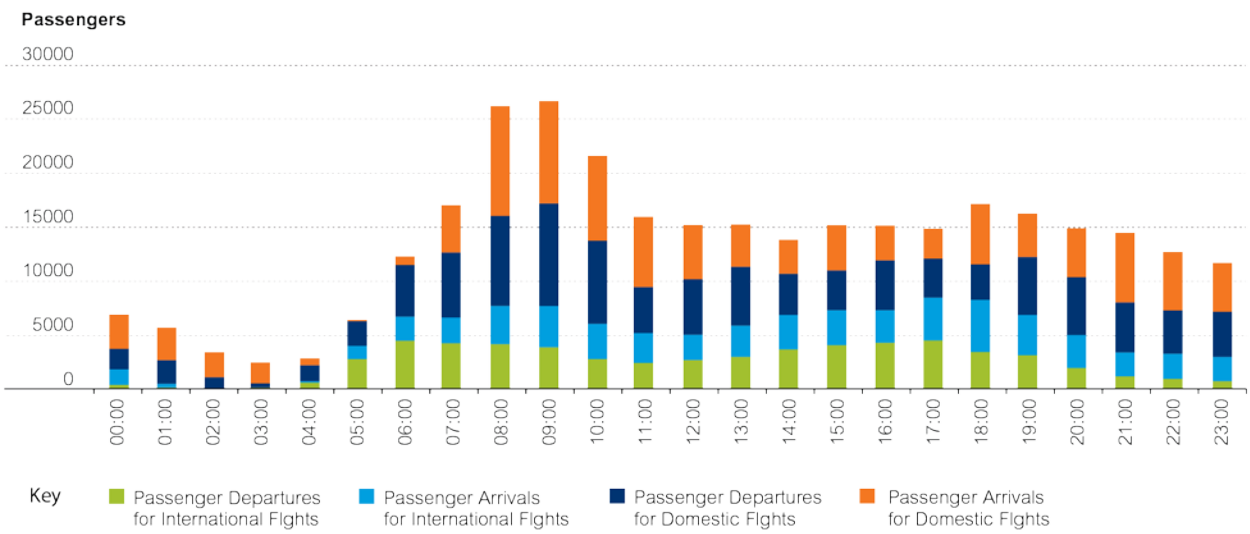


Figure 33–2 2063 ground transport demand per hour

33.3.1.3 Transport mode split

The Sydney Airport Land Transport Model (and its assumed mode split) was 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 then applied (with, for example, longer times assumed for international kiss ‘n’ fly passengers when compared to their domestic counterparts).

Figure 33–3 shows the number of forecast passenger arrivals via ground transport at the airport. Figure 33–4 shows the total departures expected via ground transport from the proposed airport.

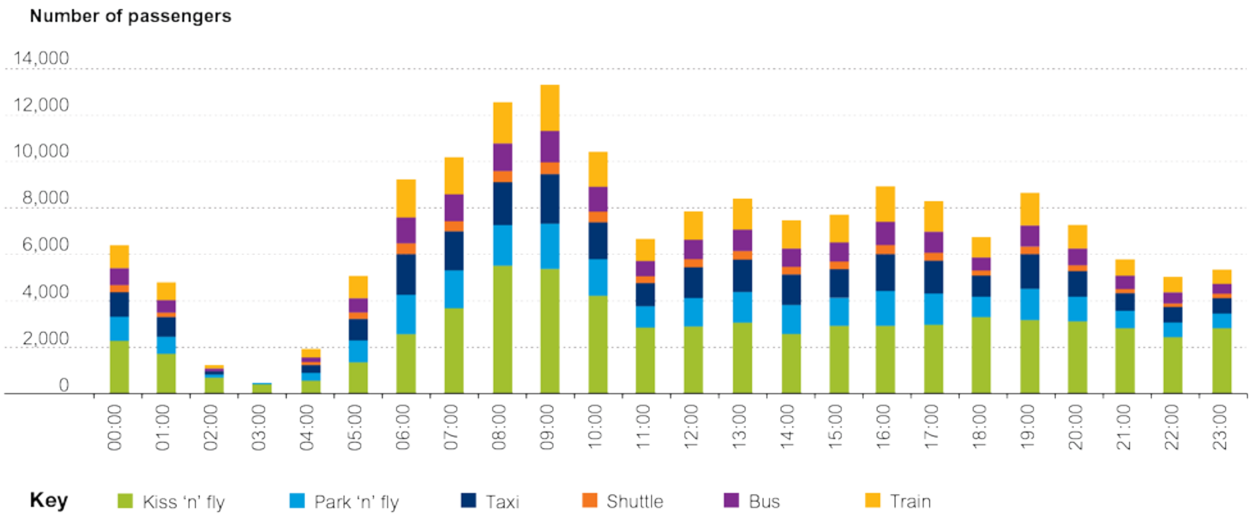


Figure 33–3 Total passenger arrivals at the airport via ground transport

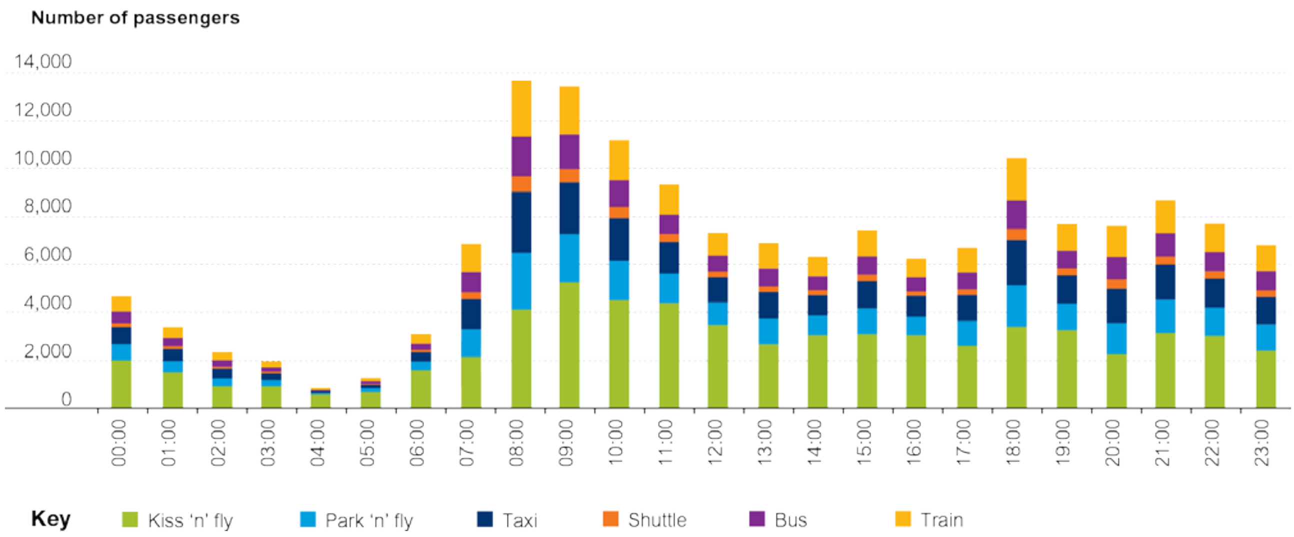


Figure 33–4 Total passenger departures at the airport via ground transport

33.3.1.4 Traffic generation

The trips (by mode) shown in Figure 33–3 and Figure 33–4 were assigned to vehicles entering and exiting the airport site to determine the passenger related traffic generation (excluding vehicle movements that only circulate internally within the airport site, such as some taxi movements).

Figure 33–5 shows that in 2063, 6,782 vehicles are predicted to enter the airport site during the peak hour between 9.00 am and 10.00 am. The figure also shows a peak arrival volume of 4,479 during the period 4.00 pm to 5.00 pm. Figure 33–6 shows that in 2063, there is predicted to be 6,795 passenger vehicles leaving the proposed airport during the peak period between 9.00 am and 10.00 am. The figure also shows a peak departure volume of 5,242 vehicles during the period between 6.00 pm and 7.00 pm.

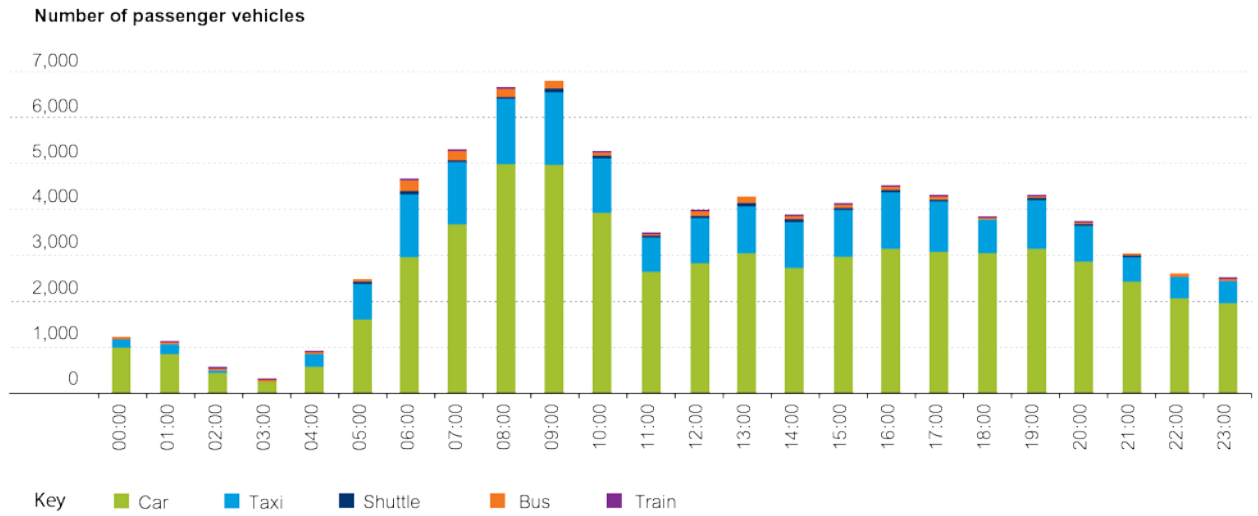


Figure 33–5 Passenger vehicles entering the airport site

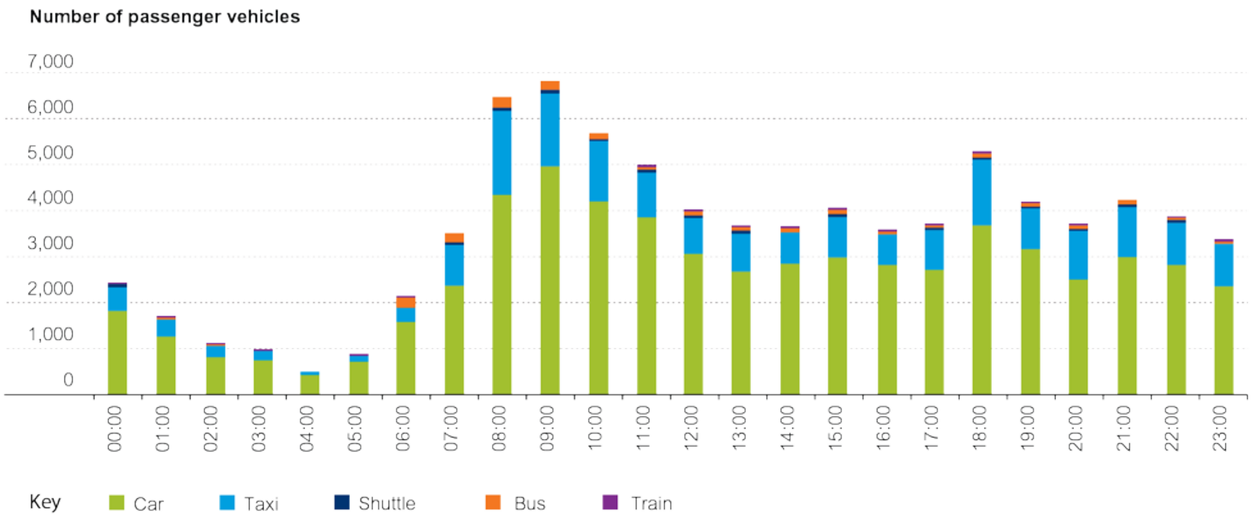


Figure 33–6 Passenger vehicles leaving the airport site

33.3.2 Employee trips

33.3.2.1 Employees and shifts

Based on a ratio of 750 employees per one million annual passengers, the number of employees required at the proposed airport in 2063 is estimated to be 61,500. Consistent with the experience at Sydney Airport and other international airports, it was assumed that up to 80 per cent of employees (49,200) 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	984
Airfield day	05:00	13:00	3	1,476
Airfield afternoon	13:00	21:00	3	1,476
Terminal support morning	06:00	13:00	10	4,920
Terminal support afternoon	13:00	20:00	10	4,920
Terminal supplementary morning	06:00	10:00	14	6,888
Terminal supplementary afternoon	15:00	19:00	14	6,888
Office early start	07:00	17:00	21	10,332
Office later start	09:00	19:00	23	11,316
			Total	49,200

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 shown in Figure 33–7. The profile acknowledges that some employees would arrive in the hour before their shift starts and/or leave in the hour after their shift finishes.

Figure 33–7 Employee arrival and departure profile

Figure 33–7 shows that the peak arrival for the AM peak period would be 11,070 employees (between 6.00 am and 7.00 am) and the PM peak departure for employees (between 6.00 pm and 7.00 pm) would be 8,610 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 expected distribution of arrivals and departures respectively by mode. It can be seen that for arriving employees, the dominant transport modes are train and cars. For departing employees, the primary transport mode is by train.

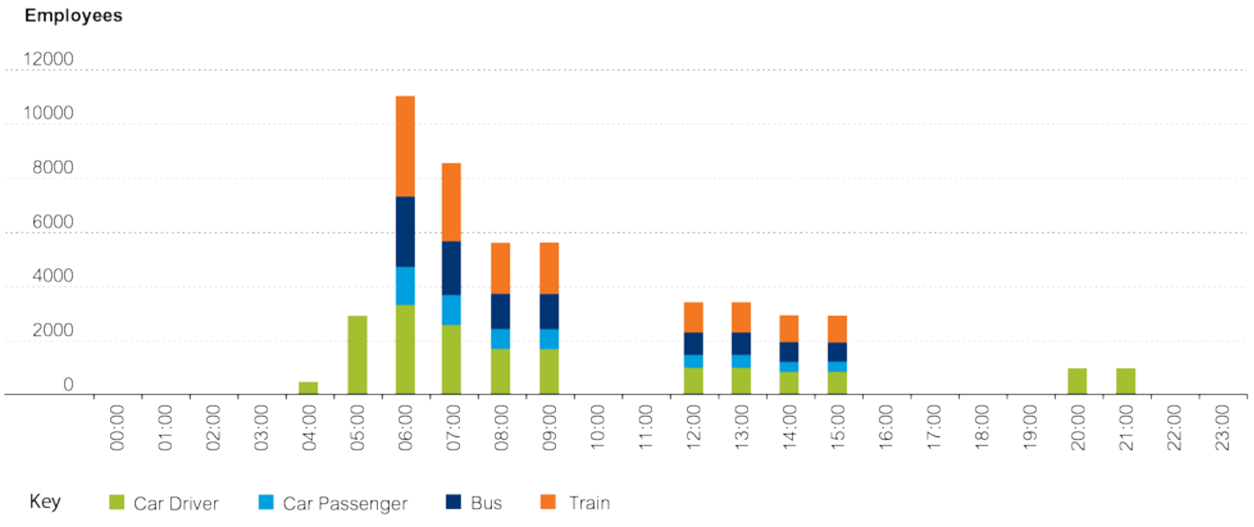


Figure 33–8 2063 employee arrivals by mode and time of day

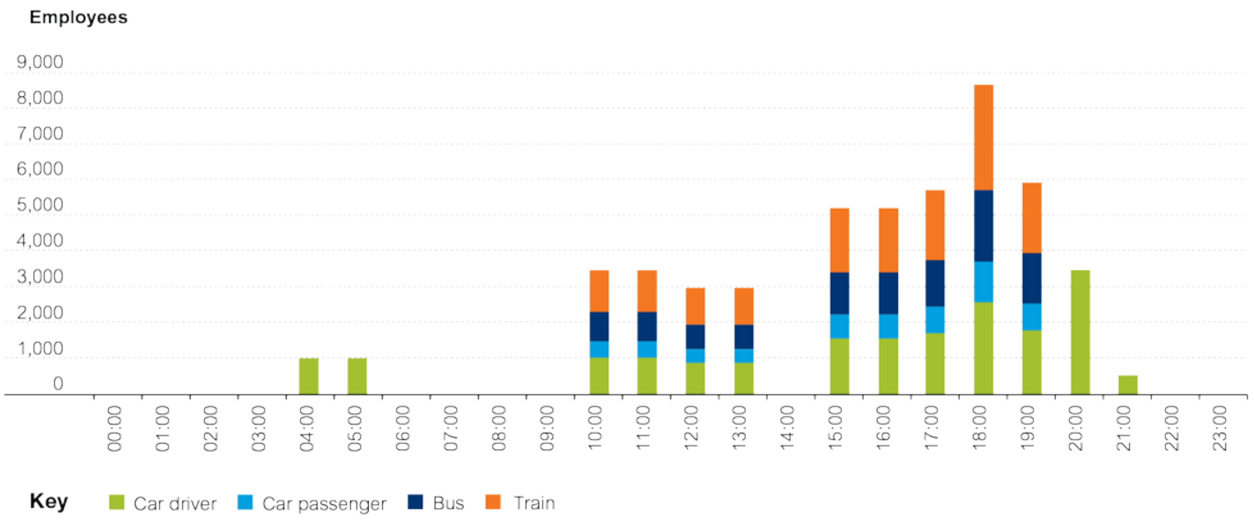


Figure 33–9 2063 employee departures by mode and time of day

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. The figures show that the employee traffic generation peaks are expected to be outside the main traffic peaks of 7.00 am to 9.00 am, and 4.00 pm to 6.00 pm.

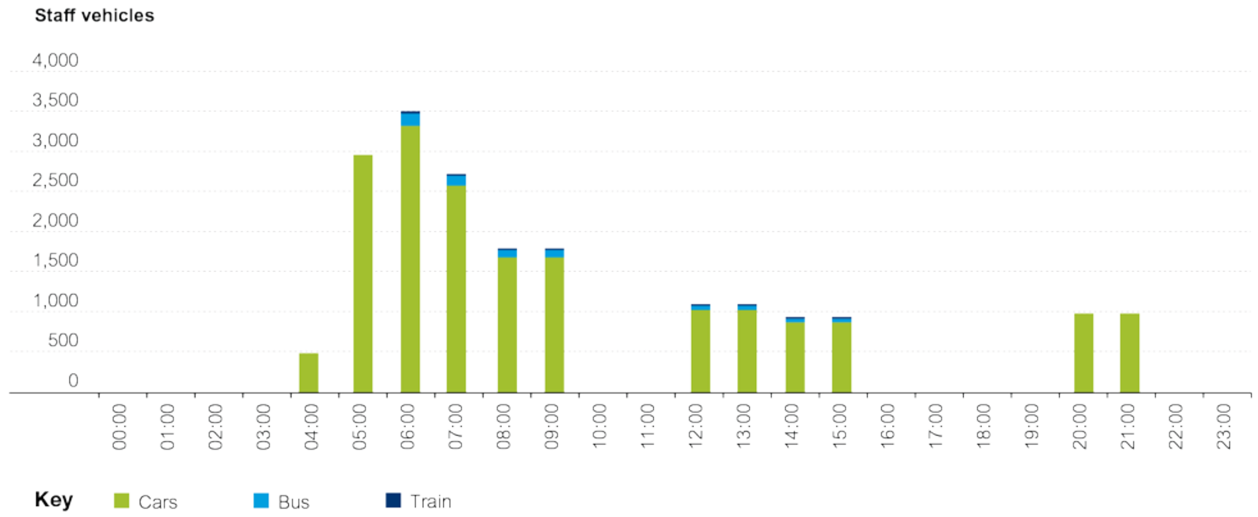


Figure 33–10 2063 employee vehicle arrivals by mode

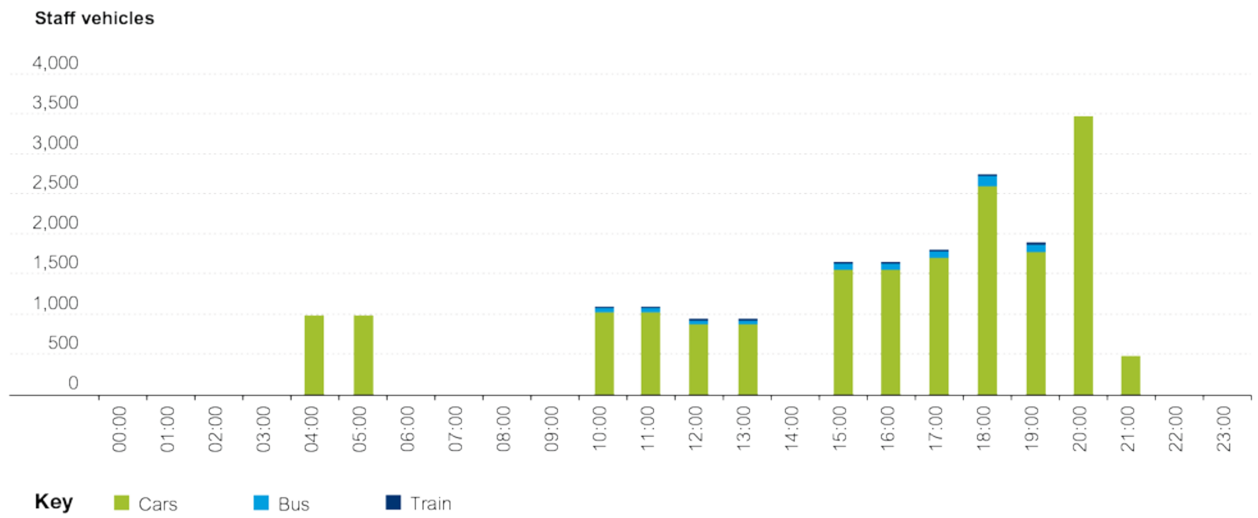


Figure 33–11 2063 employee vehicle departures by mode

33.3.3 Freight trips

Freight demand has been identified for air freight cargo with aviation fuel assumed to be supplied by pipeline in this analysis. 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 1,800,000 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) adopted for the assessment.

Table 33–4 2063 two-way truck movements

Vehicle type	2063 annual movements	2063 daily movements	2063 hourly movements	2063 passenger car equivalents per hour
Heavy Rigid Truck (12.5 metres long)	137,647	458.82	38.24	76.47
Semi-Trailer (19 metres long)	18,000	60.00	5.00	15.00
B-Double (23 -26 metres long)	5,455	18.18	1.52	7.58

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 by period, with a 24-hour total.

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

	AM Peak	Interpeak	PM Peak	Evening	24-Hour
Accessing Airport					
Passengers	5,944	4,597	4,290	2,400	83,534
Airport Workers	2,250	815	3,728	685	19,220
Freight	45	45	45	3	537
Total (Accessing)	8,239	5,456	8,063	3,088	103,291
Egressing from Airport					
Passengers	4,958	4,762	3,728	2,605	83,534
Airport Workers	-	672	1,681	806	19,557
Freight	45	45	45	3	537
Total (Egressing)	5,002	5,479	5,454	3,414	103,628

Notes: Each peak period is presented as the average hourly trip generation of that period.
AM peak (7.00am to 9.00am), Interpeak (9.00am to 3.00pm), PM peak (3.00pm to 6.00pm), Evening (6.00pm to 7.00am)

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 Land Release Area;
- Western Sydney Employment Area;
- Western Sydney Priority Growth Area;
- Greater Macarthur Land Release Investigation Area; 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 a South West Rail Link Extension from Leppington to St Marys via the proposed airport is operational.

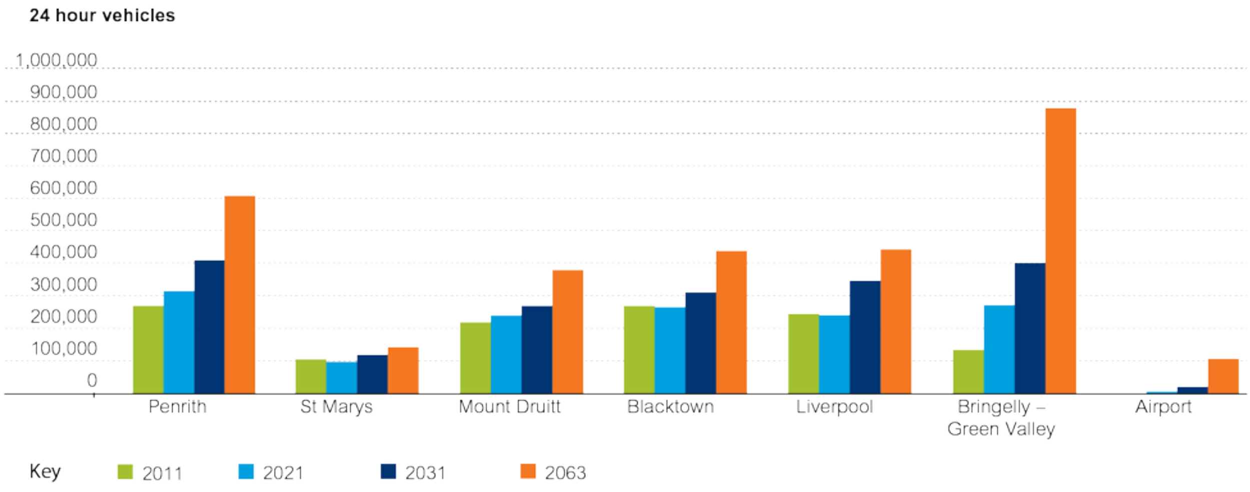


Figure 33–12 Vehicle movements originating in the vicinity of the airport site (24 hour)

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 a predicted 103,000 or so 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 road network performance

As noted in Section 33.3.4, operation of the indicative long term airport is predicted to result in 103,291 vehicles accessing the airport site and 103,628 vehicles leaving the site each day. The slight discrepancy in accessing and egressing totals is due to park-and-fly trips where access and egress profiles are calculated separately and external taxi trips where the inbound and outbound occupancy rates differ.

It should be noted that because of the significant time horizon being forecast and the lack of available information on possible future road network upgrades beyond 2041, the 2063 airport demand forecasts have been assigned to a 2051 road network. For example, no local road infrastructure works are assumed beyond those identified as part of the Western Sydney Infrastructure Plan and no upgrade of Elizabeth Drive has been assumed. As a result, it is reasonable to suggest this analysis of road network performance is a worst-case scenario and that additional traffic capacity infrastructure would be provided in the 20 years between 2041 and 2063.

Table 33–6, Figure 33–13 and Figure 33–14 show the 2063 network conditions for the Without Airport and With Airport assessment scenarios, for the respective AM and PM peak periods. With or without the proposed airport, the road network is forecast to be considerably congested by 2063. The key findings of the assessment are provided below for different classes of road.

33.3.6.1 Motorways

- With the airport, traffic volumes on the M12 near the entrance to the airport increase by between 1,000 and 3,000 vehicles per hour compared to the Without Airport scenario. This additional traffic causes the level of service to degrade to a lower performance level (LoS D).
- With the airport, traffic volumes on the M7 near the M12 are predicted to increase by less than 20 per cent of Without Airport volumes. The most congested sections of the M7, between Fifteenth Avenue and the M4, move from LoS E to LoS F.
- With the airport, the Outer Sydney Orbital carries less than 1,000 additional vehicles per hour to and from the north of Elizabeth Drive compared to the Without Airport scenario and retains a performance level of LoS D or better.
- With the airport, traffic volumes do not change significantly on the Outer Sydney Orbital to the south of Elizabeth Drive compared to the Without Airport scenario because only north facing ramps are assumed at the Elizabeth Drive interchange. Furthermore, no interchange is present between the M12 and Outer Sydney Orbital.
- With the airport, volume increases on the rest of the motorway network are less than 10 per cent of the Without Airport volumes.

33.3.6.2 Arterial roads

- With the airport, The Northern Road has traffic volume increases of up to 40 per cent, although this equates to less than 1,000 passenger car units (pcu) per hour. In the AM peak, LoS on The Northern Road increases from C/D to E/F between Bringelly Road and the M4.
- Elizabeth Drive is predicted to have a LoS F in the Without Airport scenario. Elizabeth Drive carries a substantial amount of airport traffic. The greatest increase is inbound towards to the airport in the AM peak and outbound in the PM peak. The changes in predicted traffic volumes compared to the Without Airport scenario next to the airport entrance are approximately 1,220 pcu per hour in the AM peak and 910 pcu per hour in the PM peak. In the counter-peak direction, a reduction in demand is shown. This is due to drivers re-routeing trips that would have used Elizabeth Drive if the airport was not there, by choosing another route due to the localised congestion.

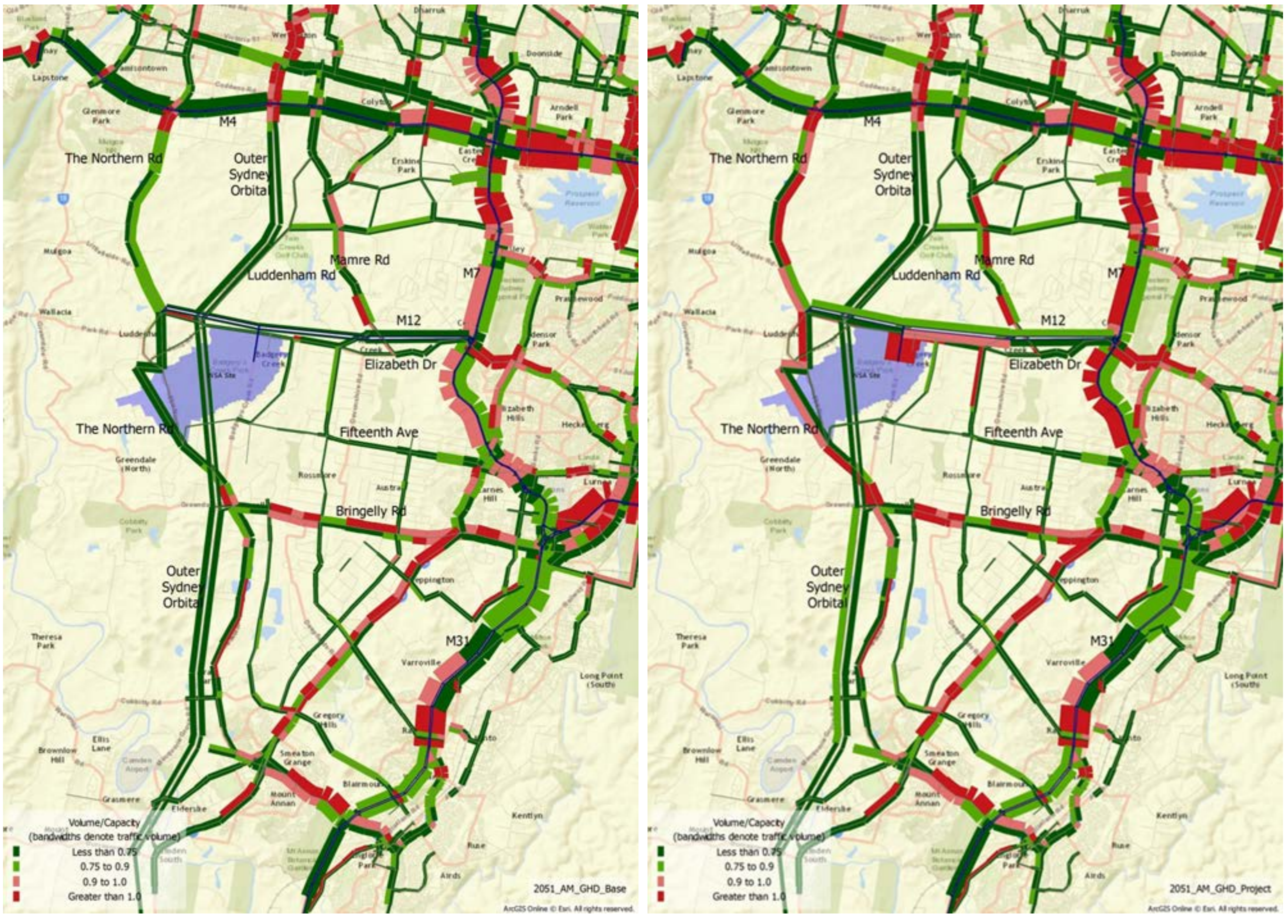
33.3.6.3 Local roads

- With the airport, Luddenham Road experiences traffic volume increases of between 40 and 60 per cent (southbound in the AM peak and northbound in the PM peak) compared to the Without Airport scenario—an increase of at most approximately 200 pcu per hour. While predicted LoS changes from A/B to B/C as a consequence of the airport traffic, so Luddenham Road is predicted to continue to operate within capacity in the With Airport scenario.
- With the airport, Mamre Road traffic volumes generally increase by less than 20 per cent compared to the Without Airport scenario, which equates to an increase of less than 100 pcu per hour, changing the LoS from E to F in the AM peak in the most congested section.
- The proposed airport is predicted to increase the volume of traffic on the north-south routes in the study area, such as Lawson Road (LoS change from C to D on most congested section) and Western Road (LoS change from D to E/F).

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

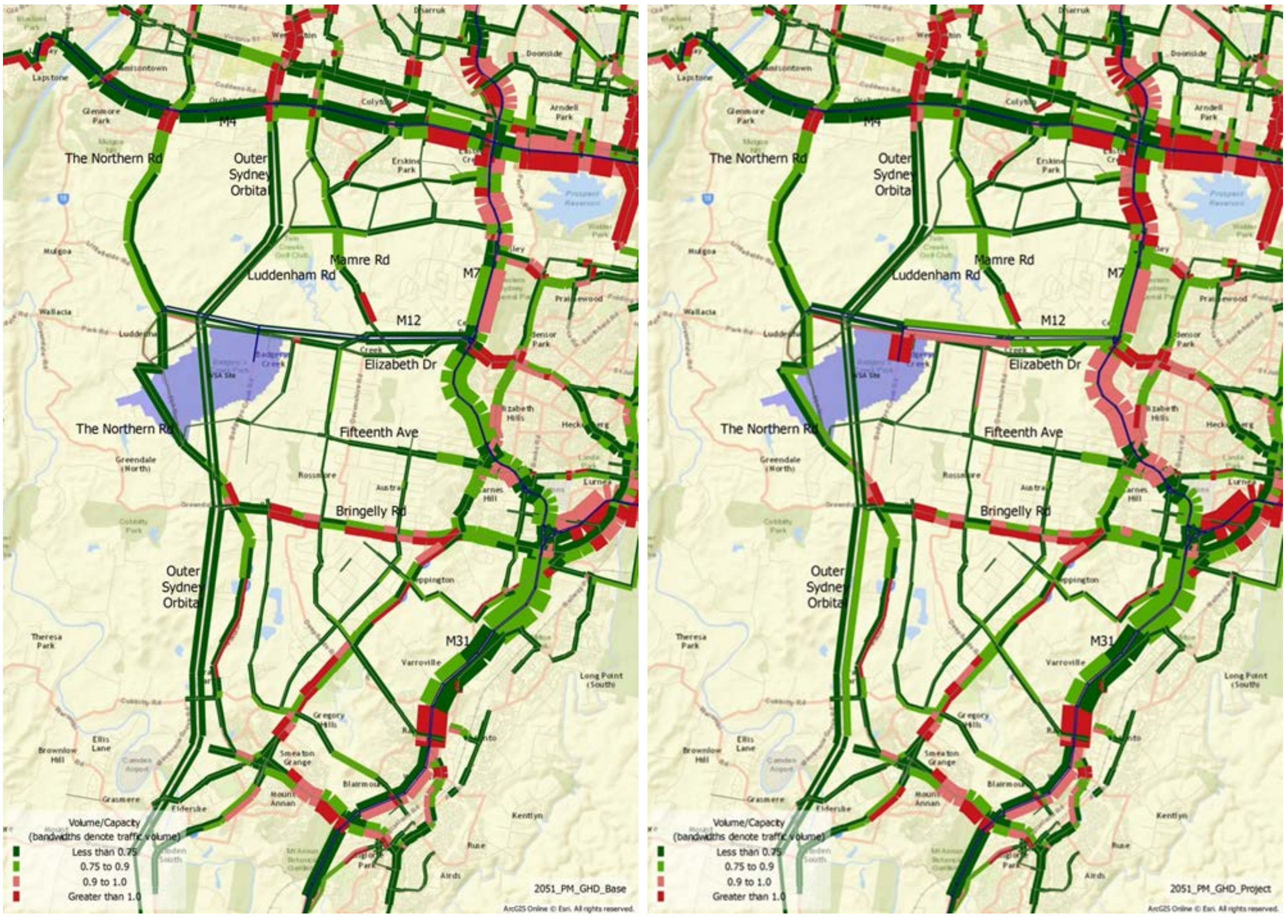
Id	Road	Location	Without Airport				With Airport			
			AM Peak		PM Peak		AM Peak		PM Peak	
			Nbd/Ebd	Sbd/Wbd	Nbd/Ebd	Sbd/Wbd	Nbd/Ebd	Sbd/Wbd	Nbd/Ebd	Sbd/Wbd
1	The Northern Road	North of Elizabeth Drive	D	D	D	C	**E**	D	**C**	**D**
2	The Northern Road	South of M4	F	F	F	F	F	F	F	F
3	The Northern Road	South of Bringelly Road	D	C	C	D	**E**	C	C	D
4	M4	West of Mamre Road	D	C	C	D	D	C	C	D
5	M4	West of M7	F	D	D	F	F	D	D	F
6	M7	South of M4	F	F	F	E	F	F	F	**F**
7	M7	South of Elizabeth Drive	E	D	D	D	**F**	D	**E**	**E**
8	M5	East of M7	F	E	E	F	F	E	**F**	F
9	M31	South of Campbelltown Road	D	D	D	D	D	D	D	D
10	Narellan Road	North of Tramway Drive	E	F	E	E	E	F	E	E
11	Bringelly Road	West of Cowpasture Road	E	E	D	F	E	E	D	F
12	Cowpasture Road	At M7	F	D	E	E	F	**E**	E	E
13	Elizabeth Drive	East of M7	F	F	F	F	F	F	F	F
14	Elizabeth Drive	West of M7	F	C	F	C	F	**D**	F	C
15	Elizabeth Drive	West of Mamre Road	A	A	A	B	A	**B**	A	B
16	Elizabeth Drive	East of the Northern Road	F	C	D	E	F	**E**	**E**	**F**
17	Mamre Road	North of Elizabeth Drive	E	B	C	C	**F**	**C**	**D**	**D**
18	Mamre Road	South of M4	E	D	F	D	E	D	F	D
19	Luddenham Drive	West of Mamre Road	B	B	A	B	B	**C**	**B**	**C**
20	Lawson Road	South of Elizabeth Drive	C	A	B	C	**D**	A	B	C
21	Western Road	South of Elizabeth Drive	D	C	C	D	**F**	C	C	**E**
22	Fifteenth Avenue	West of Cowpasture Road	C	C	C	C	C	C	C	C
23	M12	West of M7	C	B	C	C	**D**	**C**	**D**	**D**
24	M12	West of Mamre Road	A	A	A	A	**D**	**E**	**D**	**E**
25	M12	East of The Northern Road	A	A	A	A	**D**	**C**	**B**	**B**
26	Outer Sydney Orbital	North of Elizabeth Drive	C	C	C	C	C	C	C	C
27	Outer Sydney Orbital	South of Elizabeth Drive	C	B	B	B	C	B	B	B

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.
The Outer Sydney Orbital will not pass through the airport site. This is a limitation of the modelling software which can only show roads as straight lines.

Figure 33–13 2063 AM Peak Volume/Capacity – Without Airport (Left), With Airport (Right)



Note: Volume/capacity ratio bandwidth definitions are outlined in Table 33–1.
The Outer Sydney Orbital will not pass through the airport site. This is a limitation of the modelling software which can only show roads as straight lines.

Figure 33–14 2063 PM Peak Volume/Capacity – Without Airport (Left), With Airport (Right)

33.4 Considerations for future development stages

Table 15-13 in Chapter 15 (Volume 2a) sets out the broad mitigation and 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 airport in the long term.

For the proposed airport to reach its long term capacity, rail services would be required to be introduced. For this reason, the Australian and NSW governments are undertaking a Joint Scoping Study on the Rail Needs for Western Sydney, including the proposed airport. The Scoping Study will consider the best options for future rail links, including decisions about timing and rail service options, both directly to the airport site and within the Western Sydney region. Planning for rail connections at the proposed airport is being undertaken in close consultation with Transport for NSW so that airport infrastructure considerations are aligned with Transport for NSW's planning for its rail network, including the proposed extension of the South West Rail Link.

33.5 Summary of findings

The operation of an airport in the long term is predicted to result in 103,291 vehicles accessing and 103,628 egressing the airport site each day. These additional trips would be generated in the context of substantial urban growth in Western Sydney, particularly the development of the Greater Macarthur Land Release 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 would be needed to address projected travel demand.

Long term operation of an airport would be reliant on the introduction of an airport rail connection after 2031. Even with a South West Rail Link extension, the identified increases in demand for 2063 show that detailed planning is required to preserve additional road corridors to cater for the population and travel growth associated with the airport and surrounding urban development.

It is recommended that more detailed planning is undertaken to address this envisioned road capacity shortfall such that potential future upgrades are not constrained by encroachment from surrounding 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 surface water hydrology and geomorphology (Appendix L1 (Volume 4)), surface water quality (Appendix L2 (Volume 4)) and groundwater (Appendix L3 (Volume 4)). The assessment contained in this chapter builds on the assessment of impacts associated with the Stage 1 development (see Chapter 18 (Volume 2a)).

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 (Volume 4). A summary of the regulatory and policy settings relevant to the management of water resources at the airport site is presented in Chapter 18 (Volume 2a).

The hydrologic, hydraulic and water quality models used in the assessment include representations of the water management system incorporated into the concept design of the indicative long term development. This water management system would comprise a series of grassed swales to convey runoff from the developed areas within the airport site, and a series of bio-retention and flood detention basins to manage flow quality and quantity prior to discharge to the receiving waters. Low flows are diverted and treated in the bio-retention system, while the higher flows are designed to bypass the bio-retention system and discharge directly into the flood detention basins. The flood detention basins then provide controlled release to the receiving waters in a way that mimics the natural flows as closely as possible over a range of storm durations and magnitudes.

The water management system would be largely constructed during the Stage 1 development and would be expanded to cater for the long term development. Notably, this would include the addition of Basin 4 and 5 on the southern side of the airport site in the Badgerys Creek catchment and an increase in the capacity of the bio-retention system as shown on Figure 34–1.

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

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

Table 34–1 Bio-retention and detention basin volumes (long term development)

Basin	Bio-retention (ha)	Flood detention (kl)	Discharge
Basin 1	1.8	125.000	Badgerys Creek
Basin 2	0.55	39,000	Badgerys Creek
Basin 3	0.6	100,000	Badgerys Creek
Basin 4	1.1	82,000	Badgerys Creek
Basin 5	0.5	65,000	Badgerys Creek
Basin 6	1.1	101,000	Oaky Creek
Basin 7	1.0	117,000	Oaky Creek (via tributary)
Basin 8	0.4	59,000	Duncans Creek (via tributary)
Basin 9	0.15	-Na	Duncans Creek

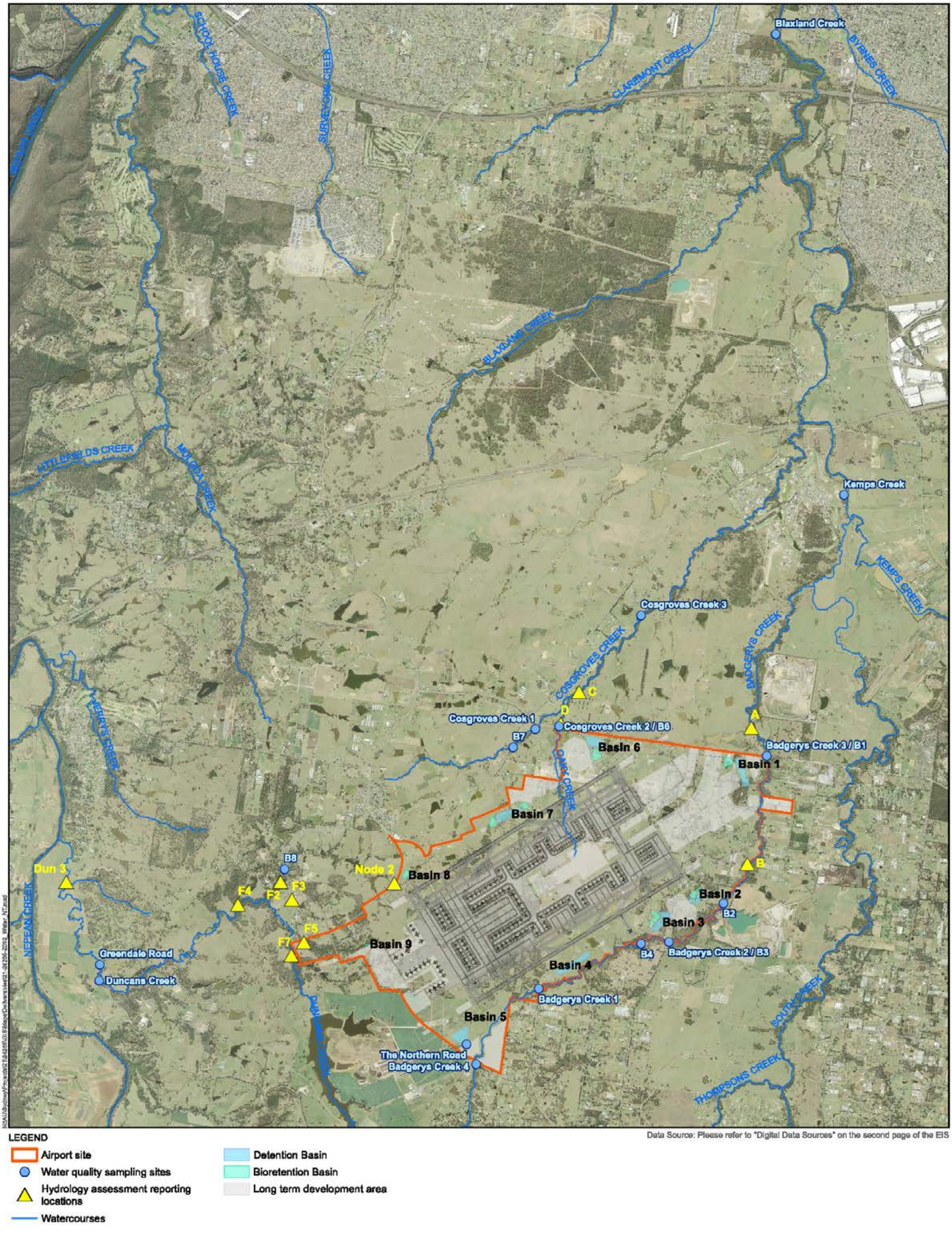


Figure 34-1 - Surface water management system and sample sites

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 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:

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

The varying respective depths of each aquifer and their limited hydraulic conductivity mean there is low potential for connectivity between groundwater aquifers 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 in Chapter 18 (Volume 2a).

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. Badgerys Creek would be preserved within the environmental conservation zone along the south-eastern boundary of the airport site.

The concept design of the long term development includes expanding the water management system with the addition of two detention basins to control the flow of surface water (see 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 (long term development)

Location	Catchment area (existing) (ha)	Catchment area (long term) (ha)	Impervious area (existing) (%)	Impervious area (long term) (%)
Badgerys Creek at Elizabeth Drive	2,361	2,332 ↑	12	↑30
Oaky Creek at Elizabeth Drive	361	270 ↓	10	↑47
Cosgroves Creek at Elizabeth Drive	550	647 ↑	14	↑39
Badgerys Creek at South Creek	2,799	2,775 ↑	12	↑28
Cosgroves Creek at South Creek	2,165	2,179 ↓	14	↑25
Duncans Creek at Nepean River	2,379	2,380 ↓	14	↑15

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

The proposed water management 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 the critical duration storm event for the long term development at a range of reporting locations are summarised in Table 34–3 and compared to the equivalent storm event for the existing catchment. The results 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 for the equivalent storm duration. No changes to flood levels are expected to affect dwellings or other infrastructure surrounding the airport site.

Localised changes in flow duration, volume and velocity would also 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 (long term development)

Location	1 year ARI peak flows (m^3/s)		100 year ARI peak flows (m^3/s)	
	Existing	Long term	Existing	Long term
Location A	27.1	28.9	136.6	136.7
Location B	25.7	26.2	120.7	118.8
Location C	21.7	15.8	114.5	76
Location D	7.4	3.0	34.3	12.5
Location F2	5.8	4.1	22.5	20.0
Location F3	2.6	2.4	10.4	9.5
Location F4	2.8	2.8	14.3	14.3
Location F5	2.1	2.7	7.9	11.7
Location F7	3.8	4.6	17.4	19.5
Node 2	2.9	0.9	12.2	4.3
Dun3	8.8	8.8	35.9	35.9

Peak flows have been determined for the critical duration storm event for the long term development. Peak flows of the equivalent storm event have then been modelled for the existing catchment.

34.4.2 Surface water quality

Modelling the impact of surface water runoff pollutants on the receiving water environment has been undertaken for suspended solids, nutrients (phosphorous and nitrogen) and gross pollutants. The modelling has considered the effectiveness of the proposed water management system to meet the objectives for the receiving waters with respect to:

- average annual pollutant loads (kg/year)
- pollutant retention targets for urban development; and
- average pollutant concentrations.

34.4.2.1 *Average annual pollutant loads*

In assessing the average annual loads, the post development levels are compared to those under existing conditions. This approach is similar to the NORBE (Neutral OR Beneficial Effect) approach to water quality management, which aims to manage the post development pollutant loads discharging from a site, such that the water quality is equal to or better than the pre-development or existing loads. This approach is typically extremely difficult to achieve when modifying land use from a rural to an urbanised or developed catchment.

The volume of surface water flows leaving the airport site during the long term development would increase as a result of changes to sub-catchment areas and increases in impervious surfaces. This will result in an increase to the total pollutant loads released from the site largely as a function of the increased volumes of surface water run-off leaving the airport site.

Modelled pollutant loads downstream from the airport site are presented in Table 34–4, with the percentage change in these pollutant loads compared to existing conditions (pre-development) shown in brackets for comparison. 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.

Table 34–4 Annual flows and pollutant loads downstream from the airport site

Location	Flow (ML)	Average Annual Loads (kg/yr)			
		Suspended solids	Phosphorous	Nitrogen	Gross pollutants
Local impacts					
Basin 1 outlet (to Badgerys Creek)	1,300 (+157%)	69,600 (+21%)	269 (+161%)	1,750 (+91%)	3,990
Basin 2 outlet (to Badgerys Creek)	402 (+613%)	15,200 (+129%)	80.2 (+821%)	541 (+549%	617
Basin 3 outlet (to Badgerys Creek)	577 (+287%)	19,300 (-4%)	104 (+358%)	764 (+252%)	467
Basin 4 outlet (to Badgerys Creek)	1,090 (+1,299%)	38,100 (+756%)	199 (+499%)	1,440 (+393%)	345
Basin 5 outlet (to Badgerys Creek)	638 (+145%)	77,200 (+116%)	193 (+220%)	1,050 (+98%)	5,090
Basin 6 outlet (to Oaky/Cosgroves Creek)	1,030 (+177%)	50,700 (-3%)	209 (+175%)	1,370 (+100%)	2,520
Basin 7 outlet (to Cosgroves Creek)	1,050 (+514%)	40,800 (+35%)	191 (+380%)	1,400 (+254%)	789
Basin 8 outlet (to Duncans Creek)	313 (+161%)	16,000 (-2%)	63.2 (+170%)	419 (+98%)	0
Basin 9 outlet (to Duncans Creek)	182 (+238%)	8,970 (+25%)	46.1 (+434%)	289 (+281%)	539
Badgerys Creek 1	1,190 (+27%)	117,000 (+16%)	294 (+61%)	2,030 (+18%)	7,970
Badgerys Creek 2	2,840 (+78%)	224,000 (+24%)	605 (+84%)	4,480 (+46%)	9,210
Badgerys Creek 3	5,540 (+102%)	391,000 (+22%)	1,160 (+105%)	8,550 (+63%)	15,100
Regional impacts					
Cosgroves Creek 1	2,540 (+154%)	177,000 (+12%)	506 (+130%)	3,810 (+75%)	3,690
Cosgroves Creek 3	3,210 (+89%)	273,000 (+7%)	653 (+77%)	5,280 (+45%)	5,580
Duncans Creek	2,710 (+18%)	352,000 (+11%)	578 (+21%)	4,930 (+17%)	6,580

Location	Flow (ML)	Average Annual Loads (kg/yr)			
Kemps Creek	25,300 (+12%)	2,970,000 (+2%)	5,090 (+13%)	49,600 (+8%)	84,800
Blaxland Creek	36,300 (+13%)	3,980,000 (+3%)	6,940 (+14%)	66,800 (+8%)	127,000

34.4.2.2 Pollution retention targets

The efficacy of the water management system in reducing pollutant loads leaving the airport side was modelled and assessed in accordance with the *Water Sensitive Urban Design: Technical Guidelines for Western Sydney* (WSUD Guidelines).

The WSUD Guidelines specify pollutant retention targets as a practical way of treating urban stormwater quality. These targets recognise that urban development will typically lead to an increase in pollutant loads in comparison to rural land uses. The focus is therefore on managing the pollutant loads to acceptable levels rather than maintaining the existing load levels as undertaken under the NORBE approach.

The results presented in Table 34–5 show that the bio-retention basins proposed as part of the water management system effectively reduce pollutant loads. The drainage system would be refined during detailed design, with consideration given to enlarging the bio-retention basin areas to improve the efficacy in reducing pollutant loads. This will be particularly required for Basin 5 and 9 where the WSUD guidelines retention targets are not achieved.

Table 34–5 Pollutants retained by drainage system at airport site

Location	Suspended solids (%)	Phosphorous (%)	Nitrogen (%)
Guideline value	80	45	45
Basin 1 outlet (to Badgerys Creek)	79.3	58.2	45.4
Basin 2 outlet (to Badgerys Creek)	86.9	63.7	46.9
Basin 3 outlet (to Badgerys Creek)	87.1	63.4	46.4
Basin 4 outlet (to Badgerys Creek)	88.5	67.2	46.3
Basin 5 outlet (to Badgerys Creek)	56.3	42.4	31.9
Basin 6 outlet (to Oaky/Cosgroves Creek)	81.6	59.6	45.1
Basin 7 outlet (to Cosgroves Creek)	86.5	65.2	45.2
Basin 8 outlet (to Duncans Creek)	83.5	63.7	45.4
Basin 9 outlet (to Duncans Creek)	81.8	55.1	41.0

34.4.2.3 Pollutant concentrations

Pollutant concentrations are readily monitored and have a direct correlation with the relative health of waterways and ecosystems. Both the Airports (Environment Protection) Regulations 1997 (AEPR) and Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC) refer to pollutant concentrations in the setting of trigger levels and pollutant limits. To allow for climatic, topographic and other site-specific considerations, the AEPR and the ANZECC guidelines allow for the development of local standards or site specific trigger levels specific to the existing water quality and environmental values for the catchment as described in Chapter 18 (Volume 2a).

The predicted surface water quality discharges during the operation of the long term development were modelled at upstream, downstream and major outflow locations in and around the airport site. The results were compared with modelling of existing surface water quality discharges from the airport site to determine the impact of the long term development upon pollutant concentrations. The model results are summarised in Table 34–6 for comparison with ANZECC Guidelines default trigger levels for slightly disturbed ecosystems in lowland rivers, AEPR limits, and interim local site trigger levels established for the airport site catchment.

The results show that pollutant concentrations would typically decrease at most downstream locations. Despite the water management system for the long term development leading to general improvements in pollutant concentrations locally and regionally, the improvements would not be sufficient to meet the AEPR limits or default values in the ANZECC guidelines. However, using the interim site trigger levels established for the airport catchment, the long term development water quality is found to satisfy the site specific water quality objectives for suspended solids, total phosphorus, and total nitrogen at all the locations.

These results can be attributed to the degraded nature of the existing catchments which have not met ANZECC Guidelines default trigger levels for several years. Nevertheless, it is noted that development of the proposed airport does not preclude the opportunity to make further improvements in downstream water quality in South Creek in the future, to work towards satisfying the NSW Water Quality Objectives.

Table 34–6 Surface water quality at the airport site and downstream

Location	Existing (mg/L)			Long term development (mg/L)		
	Suspended solids	Phosphorous	Nitrogen	Suspended solids	Phosphorous	Nitrogen
AEPR Limits	< 10% change from Seasonal Mean	0.01	0.1	< 10% change from Seasonal Mean	0.01	0.1
ANZECC	40	0.05	0.5	40	0.05	0.5
Interim local limits	23.2	0.92	6.2	23.2	0.92	6.2
Basin 1	22.1	0.14	1.54	↓13.0	↓0.11	↓0.88
Basin 2	22.1	0.09	1.25	↓13.3	↑0.11	↓0.91
Basin 3	21.9	0.09	1.26	↓10.6	↑0.11	↓0.84

Location	Existing (mg/L)			Long term development (mg/L)		
Basin 4	20.7	0.38	2.91	↓9.70	↓0.12	↓0.82
Basin 5	23.0	0.17	1.74	↓14.2	↓0.11	↓0.87
Basin 6	22.5	0.15	1.60	↓12.5	↓0.11	↓0.87
Basin 7	22.2	0.15	1.59	↓9.5	↓0.12	↓0.81
Basin 8	23.2	0.13	1.52	↓2.9	0.13	↓0.63
Basin 9	20.4	0.10	1.26	↓13.4	↑0.11	↓0.92
Badgerys Creek 1	21.5	0.14	1.48	↓15.0	↓0.12	↓0.98
Badgerys Creek 2	21.8	0.15	1.55	↓13.3	↓0.12	↓0.95
Badgerys Creek 3	21.9	0.15	1.55	↓13.3	↓0.12	↓0.95
Cosgroves Creek 1	22.7	0.15	1.61	↓12.5	↓0.12	↓0.94
Cosgroves Creek 3	22.5	0.15	1.58	↓12.8	↓0.12	↓0.95
Duncans Creek	22.1	0.14	1.54	↓14.8	↓0.12	↓1.04
Kemps Creek	21.0	0.13	1.45	↓13.9	↓0.12	↓1.01
Blaxland Creek	20.9	0.13	1.39	↓13.7	↓0.12	↓0.99

34.4.3 Reclaimed water irrigation

An estimated 15.4 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 as appropriate management practices would be adopted, such as balancing storages and appropriate scheduling to avoid excessive irrigation. In addition, the reclaimed water would be of relatively high quality and with appropriate management would be unlikely to negatively impact on surface water and groundwater.

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:

- 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 the waste water treatment and reclaimed water reuse scheme in accordance with relevant guidelines at the time of operation, or transport of waste water offsite to the Sydney Water treatment 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 AEPR or equivalent regulations 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 a 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 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. Refinement of the modelled water management system would occur during detailed design of the proposed airport development.

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 sensitive ecological receptors or beneficial uses of the groundwater system.

35 Planning and land use

35.1 Introduction

The long term development of the proposed airport would affect existing and future land use of surrounding land. The proposed airport would operate in the context of the broader urbanisation of Western Sydney, which is likely to be well advanced by the time of the long term development.

The need for a second Sydney airport, and its potential location at Badgerys Creek, has already been subject to consideration over a number of decades by successive Australian, State and local governments. As such, numerous planning instruments are already in place or would be in place by the time of operation of the long term development. Most recently, the proposed airport is anticipated by the establishment of the Western Sydney Priority Growth Area and others.

This assessment builds on previous studies and considers how the proposed airport would affect rural-residential, 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. 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 understood to occur progressively in stages that expand on the size of the Stage 1 development.

35.2 Methodology

A specialist report on planning and land use impacts of the proposed airport was prepared for this EIS (see Appendix N (Volume 4)) The 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 this 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 supports a variety of vegetation types and 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 need to be 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, which would be the main access road to the airport site and link the M7 Motorway and The Northern Road;
- The Northern Road, which would be realigned to the west of the airport site; and
- the Outer Sydney Orbital, to the west of the airport site.

35.3.2 Surrounding land

The proposed airport and associated operations would occur across a number of local government areas (LGAs). The airport site itself is located within Liverpool LGA, bordering the Penrith LGA to the north. To the west of the airport site is the Blue Mountains LGA while the Wollondilly, Camden and Campbelltown LGAs lie generally toward the south. To the east of the airport site are the Bankstown, Fairfield and Blacktown LGAs.

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 1996*. The application of Commonwealth legislation to the proposed airport is discussed further in Chapter 3 (Volume 1).

The airport master plan 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* (AS 2021) would continue to provide guidance on the siting and construction of buildings in the vicinity of airport 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 planning initiatives

A number of strategic planning initiatives and associated land release areas are planned for Western Sydney that would facilitate urban growth. These include:

- Western Sydney Priority Growth Area;
- Western Sydney Employment Area;
- South West Priority Growth Area;
- North West Priority Growth Area; and
- Greater Macarthur Priority Growth Area.

Western Sydney Priority Growth Area

The Western Sydney Priority Growth Area is a strategic planning initiative that aims to provide jobs, homes and services in the land around the proposed airport. The extent of the Western Sydney Priority Growth Area is shown in Figure 35–1.

The Western Sydney Priority Growth Area is expected to be the primary planning initiative to coordinate housing and employment growth in the area and promote compatible developments around the airport site. This will help to maximise the benefits and minimise the impacts of the proposed airport.

An accompanying Land Use and Infrastructure Strategy is under development to guide new infrastructure investment, identify new homes and jobs close to transport, and coordinate services in the Western Sydney Priority Growth Area. A new special infrastructure contribution levy will be established to cover the cost of regional road infrastructure, strategic land use planning costs and environmental protection measures.

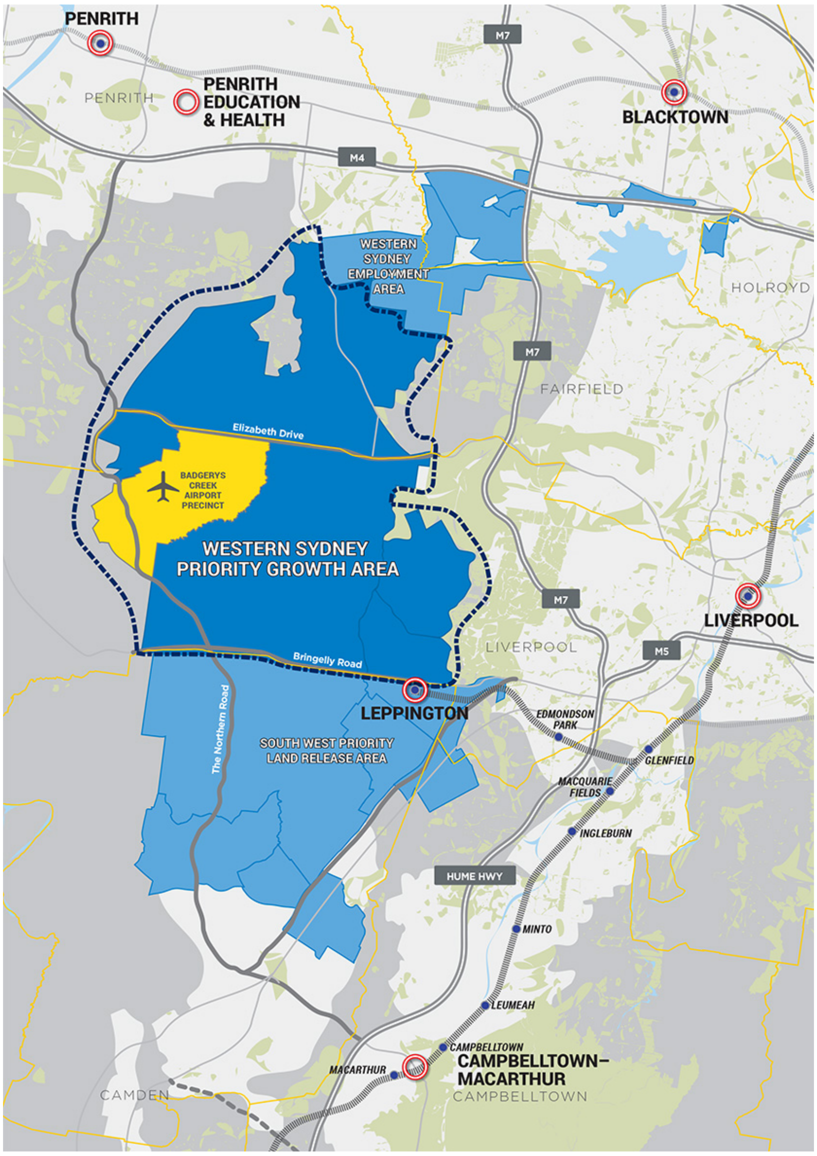


Figure 35–1 Western Sydney Priority Growth Area

Western Sydney Employment Area

The Western Sydney Employment Area is a strategic planning initiative that aims to provide businesses in Western Sydney with land for industry and employment including transport, logistics, warehousing and office space. The Western Sydney Employment Area is adjacent to the Western Sydney Priority Growth Area and is shown in Figure 35–1. The Western Sydney Employment Area would provide opportunities for residents of Western Sydney to work locally.

Previously the NSW Government had intended to extend the Western Sydney Employment Area to the south, including the area which is now the airport site. Following the Australian Government announcement in April 2014 to locate an airport at Badgerys Creek, the plans for the extension of the Western Sydney Employment Area were replaced with the introduction of the Western Sydney Priority Growth Area which will be focussed on ensuring compatible employment and housing development around the airport site.

South West Priority Growth Area

The South West Priority Growth Area is a strategic planning initiative dedicated to providing housing in Western Sydney. The associated land release area is adjacent to the Western Sydney Priority Growth Area and is shown in Figure 35–1.

The South West Priority Growth Area involves development of communities in precincts including Oran Park, Turner Road, East Leppington, Austral and Leppington North, Edmondson Park and Catherine Fields. Collectively the developments would create around 40,000 residences along with local amenities such as schools, public parks, employment areas and town centres. Planning is ongoing for other precincts such as Lowes Creek and Marylands.

North West Priority Growth Area

The NSW Government established the North West Priority Growth Area in 2005 to encourage sustainable planning on Sydney's urban edge and provide housing in the north west of Sydney that is close to employment, schools and other services.

The North West Priority Growth Area is approximately 10,000 hectares in size and over time, approximately 70,000 new dwellings will be built. The NSW Government has also planned upgrades to transport infrastructure to support new housing.

Greater Macarthur Priority Growth Area

The NSW Government released a preliminary strategy and proposed amendments to *State Environmental Planning Policy (Sydney Region Growth Centres) 2006* in late 2015 to incorporate land in Menangle Park, Mount Gilead and Wilton as future residential and employment areas in Sydney's far south. The preliminary strategy identifies opportunities to deliver up to 35,000 homes in Menangle Park and Mount Gilead and in a new town at Wilton.

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 the Stage 1 development, along with the implementation of the strategic planning initiatives described in Section 35.4.2.2, 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 the operation of the long term development would likely be minimal.

35.5.1.2 Employment lands

The expansion of the proposed airport following the Stage 1 development would continue to support the development of the adjacent Western Sydney Priority Growth Area. 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 Land Use Plan (part of the revised draft Airport Plan) identifies land use zones for retail and commercial development within the airport site. While specific business 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:

- 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);
- Bents Basin State Conservation Area (Greendale); and
- Burragorang Recreation Area (Silverdale).

Long term noise modelling discussed in Chapter 31 identifies potential noise impacts on these locations. While operation of the long term development may have impacts on the amenity of these sites, impacts on recreational lands are not currently addressed under *AS 2021.* The specific impacts of operation of the future airport would depend on the final flight paths which will be developed in accordance with the requirements of the Airports Act or the relevant instrument in place at the time of operations. Impacts of the long term development 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 and declared for the proposed airport as part of ongoing operations planning.

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

35.5.2.2 Public Safety Zones

The Australian Government is working with the states and territories on the development of a national standard for public safety zones (PSZs) to be incorporated into the NASF. PSZs are an area of approximately 1,000 metres x 250 metres at the ends of runways in which development is constrained. They are based on runway use statistics correlated against international crash data. PSZs minimise the risk of damage by aircraft during landing or take off by ensuring any development within the zone does not add unduly to existing levels of risk.

Where a PSZ is identified, additional scrutiny might be considered for new developments that:

- increase residential use and population density in the zone;
- attract large numbers of people, such as retail or entertainment developments;
- involve institutional uses, such as schools and hospitals;
- involve the manufacture or depot storage of noxious and hazardous materials; and
- attract significant static traffic.

35.5.2.3 *Aircraft noise*

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

The planning and land use implications of aircraft noise impacts are determined using the ANEF. Table 35–1 identifies the recommended development types within ANEF zones, as outlined in AS 2021. The aircraft overflight noise technical report prepared for the EIS (see Appendix E1 (Volume 4)) 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.

ANEF contour charts, with a 20-year timeframe, are also expected to be produced progressively over the life the airport in accordance with the requirements of the Airports Act. As such, an ANEF contour chart will be produced prior to operation of the long term development.

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 along with the relevant local councils would be consulted to ensure applicable environmental planning instruments are amended as necessary to include future ANEF forecasts and supporting AS 2021-compliant building siting and development controls as they are completed.

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.

35.5.2.4 Lighting

The proposed runway orientation limits the possible areas that would be affected by approach lighting and runway lighting. Lighting intensity restrictions will apply for non-aviation activity, such as road lighting, in the immediate vicinity of the runways. The maximum intensity of light sources where they have the potential to cause confusion or distraction to pilots within a 6 km radius of an airport may be determined under regulation 94 of the *Civil Aviation Regulations 1988*.

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 (LED) 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.

35.5.2.5 Other aviation safety considerations

The Department of Infrastructure and Regional Development would liaise with the NSW Department of Planning and Environment and the relevant local councils to seek the adoption of the necessary guidelines in applicable environmental planning instruments. This will ensure future development in the vicinity of the proposed airport does not impede safe aircraft operations in accordance with the NASF and other requirements.

35.5.2.6 Air quality

An air quality assessment was prepared for the EIS to forecast the potential air quality impacts on 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 (see Chapters 32 and 39).

Modified land use zoning for employment generation and other less sensitive land uses would reduce the potential for local air quality impacts on future 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.

35.5.2.7 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 the onsite portion of Badgerys Creek Road and all pre-existing onsite roads as required.

The Northern Road would be realigned before the start of Stage 1 operations, along 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 Motorway while providing a direct route and access to the airport. The Outer Sydney Orbital is also likely to be developed in stages with earlier stages related to the employment lands and Western Sydney Airport opening in advance of others.

The Australian and NSW governments are undertaking a Joint Scoping Study on the Rail Needs for Western Sydney, including the proposed airport. The Scoping Study will consider the best options for future rail links, including decisions about timing and rail service options, both directly to the airport site and within the Western Sydney region. The Scoping Study will also address the question of what would it take to have rail on the airport site by the time the airport is operational. Subject to the findings of the Scoping Study, a final rail alignment will be determined in consultation with the NSW Government.

35.5.3 Additional land acquisition

Much of the land required for the construction of the long term development has been acquired by the Australian Government.

An easement or other interest will be required to accommodate High Intensity Approach Lighting (HIAL) where it protrudes beyond the site boundary at the south-western end of the second runway. Planning controls restricting development on, and adjacent to, the easement may apply.

The NSW Government is investigating options for identifying and preserving a fuel pipeline corridor to service the proposed airport in the future, however a specific corridor is yet to be identified. Arrangements for access to the fuel pipeline, which may involve an easement, would be required along the pipeline corridor 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.

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.
Operational aviation safety	Liaise with the NSW Department of Planning and Environment along with relevant local councils to seek the adoption of the necessary guidelines in applicable planning instruments to ensure future development in the vicinity of the proposed airport does not impede safe aircraft operations in accordance with the NASF and other requirements.	This would ensure surrounding land uses and developments would not pose a danger to the safe operations of the proposed airport.
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 expands, applicable environmental planning instruments may need to be amended to reflect the revised ANEF.

35.7 Summary of findings

Construction and operation of the proposed airport would change the rural-residential character of Badgerys Creek and surrounding land uses. Most of the existing rural-residential and agricultural lands currently surrounding the airport site are likely to have transitioned to alternative land uses by the time of operation of the long term development. This land use outcome has been anticipated in State and local government strategic planning for the area over a number of decades. The long term development would support continued growth of regional centres and priority growth areas.

36 Landscape and visual amenity

36.1 Introduction

An assessment of potential visual impacts due to the long term development was undertaken based on indicative concept designs with the inclusion of two operating 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 is 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 landscape and visual amenity assessment of the long term development 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 characteristics of the visual environment over the long term, 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 (Volume 2a). The existing environment is expected to undergo significant change over the 40 years from the commencement of operations at the proposed airport. Changes would occur both on the airport site and more broadly in south-western Sydney. The character of the region will change with further development of the South West and Western Sydney Priority Growth Areas, development in line with the Western Sydney Infrastructure Plan and the establishment of the Western Sydney Employment Area, as well as the extension of the South West Rail Link 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.

36.4 Assessment of impacts during operation

Figure 36–1 illustrates the indicative visibility of the 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. While existing structures or vegetation in the surrounding areas were not taken into account in the development of the view shed, their presence would further reduce visibility from surrounding sensitive viewpoints.

As outlined in Chapter 7 (Volume 1), 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 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 approximately 10 million annual passengers five years after opening to an anticipated 82 million annual passengers in 2063. The corresponding increase in daily aircraft movements is quantified shown in Table 36–1.

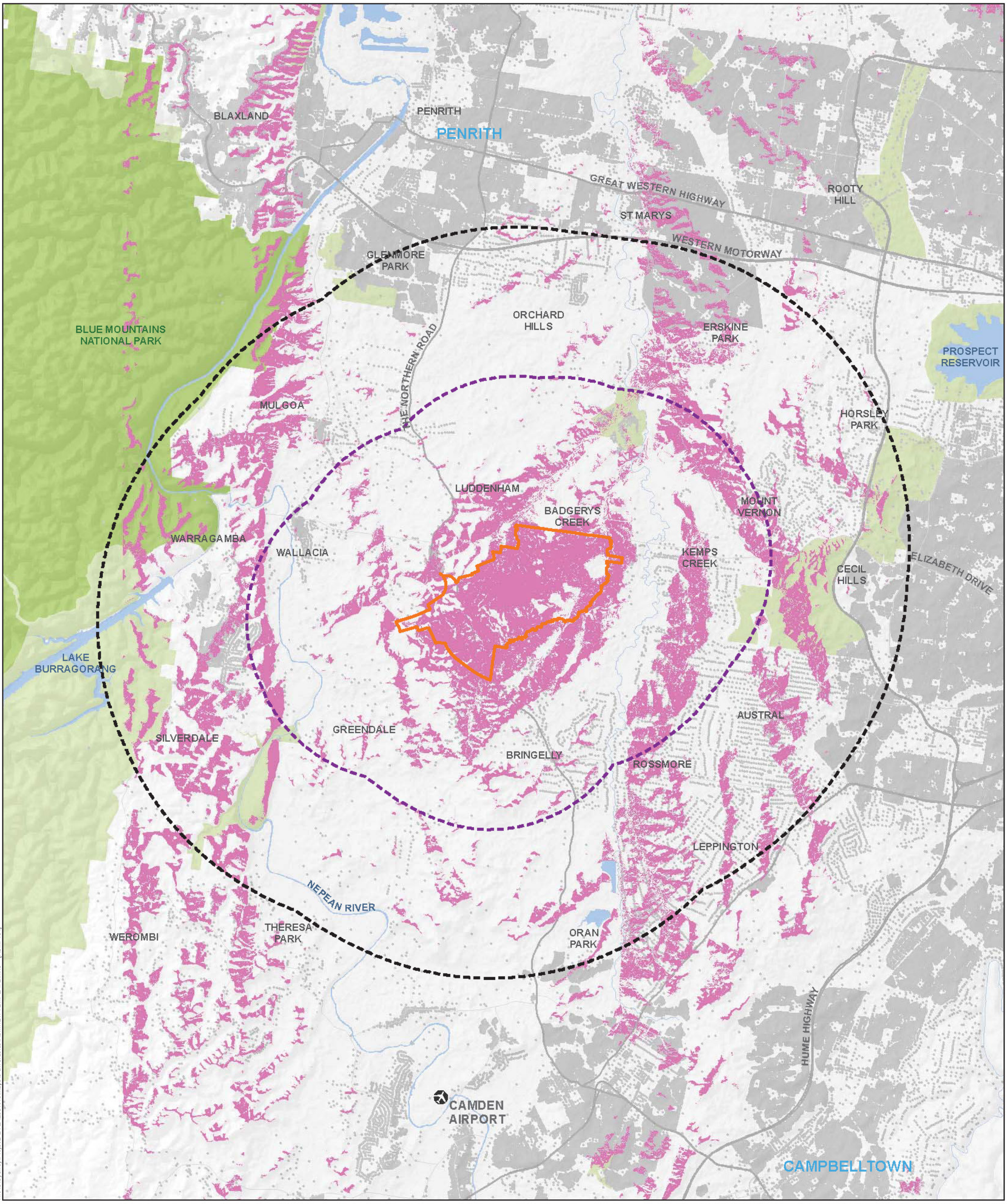
Table 36–1 Predicted aircraft movements

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. The increase would occur incrementally over a long period, building on the existing quantities of visible aircraft approaching and leaving during Stage 1 operations.

Further detailed analysis of the Sydney basin airspace will be required to be undertaken by Airservices Australia, particularly prior to commissioning of the second runway. The visual impact of aircraft overflights would be one consideration among others in that analysis.

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 (Volume 2a).

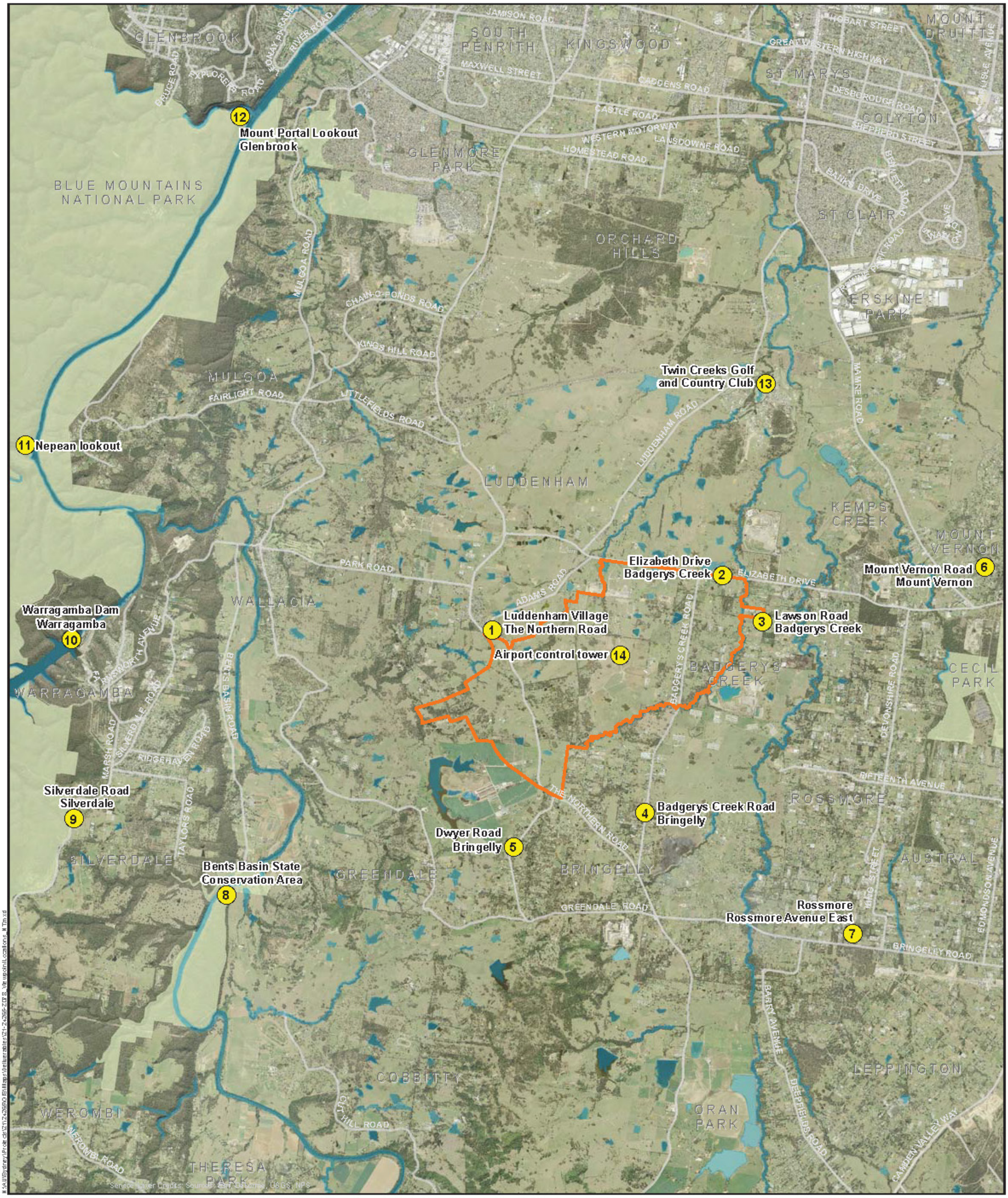


Data Source: Please refer to "Digital Data Sources" on the second page of the EIS

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

0 1 2 4
Kilometres

Figure 36-1 - Visibility of the long term development



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

Figure 36-2 - Location of viewpoints used for long term assessment

0 1 2 4
Kilometres

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 and Western Sydney Priority Growth Areas, 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 Western Sydney Priority Growth Area and Western Sydney Employment Area. 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 and Western Sydney 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 05/23 orientation. 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 and Western Sydney Priority Growth Areas, 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, the Western Sydney Priority Growth Area, 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 and Western Sydney 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 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 area 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, based on indicative flight paths. 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 will continue to change to increasingly urban with the development of the Western Sydney Priority Growth Area and the Western Sydney Employment Area, particularly looking south from the lookout, towards the airport site. 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 (Volume 2a) 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. Key considerations would be final flight paths and modes of operation, which would have implications for the visibility of overflight aircraft on surrounding communities. Measures minimise visual impact of aircraft would be considered in this process.

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 and Western Sydney Priority Growth Areas, 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.

37 Social and economic

37.1 Introduction

This chapter considers the long term social and economic impacts of the proposed airport. Specifically, it considers how the operation of a potential long term development could affect existing population, employment and land use across Sydney, particularly Western Sydney.

This chapter draws on the social impact assessment and economic analysis undertaken (see Appendix P1 and Appendix P3 (Volume 4)), plus a range of other specialty technical assessments.

The potential 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.

The operation of the long term development would result in further impacts to social amenity and lifestyle of communities, both around the airport site and in the region more broadly. Long term impacts on the amenity and lifestyle of communities in Western Sydney would increase as operations expand at the proposed airport and 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 social impact assessment has been undertaken in accordance with the EIS guidelines and industry guidelines developed by the International Association for Impact Assessment, namely the *International Principles for Social Impact Assessment* (Vanclay 2003) and *Guidance for Assessing and Managing Social Impacts of Projects* (Vanclay 2015). The assessment involved the following:

- definition of the study area, incorporating potential affected communities;
- detailed literature review of guidelines, social statistics and strategic planning documents;
- documentation of the social baseline, including targeted stakeholder consultation;
- identification and assessment of potential social benefits and impacts; and
- development of measures to enhance social benefits and manage social impacts.

The findings of other technical assessments were also a key input into the social impact assessment, including the aircraft overflight noise assessment (Appendix E1 (Volume 4)), airport ground based noise assessment (Appendix E2 (Volume 4)), local air quality assessment (Appendix F1 (Volume 4)), regional air quality assessment (Appendix F2 (Volume 4)), human health assessment (Appendix G (Volume 4)), surface transport and access assessment (Appendix J (Volume 4)), planning and land use assessment (Appendix N (Volume 4)), landscape character and visual assessment (Appendix O (Volume 4)), property values assessment (Appendix P2 (Volume 4)) and economic impact assessment (Appendix P3 (Volume 4)).

The methodology of the social impact assessment is summarised in more detail in Chapter 23 (Volume 2a) and the comprehensive social impact assessment in Appendix P1 (Volume 4).

37.3 Assessment of impacts

The long term development of the proposed airport would generate a similar range of positive and negative social impacts as outlined for the Stage 1 development. There would be impacts to economic value-add and employment, population redistribution and housing, social amenity and lifestyle (associated with noise, air quality, and other impacts), human health, social infrastructure and emergency services. In most cases, both positive and negative social impacts associated with the long term operation of the proposed airport are predicted to be greater than the impacts associated with the Stage 1 development.

37.3.1 Economic value-add and employment

37.3.1.1 Economic value-add

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 summarises the predicted economic impacts associated with the long term development.

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	$3,452
Net imports ($ millions)	$660	$-1,015	$372	$1,389	$1,406

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. The overall net 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 increased value-add in Western Sydney, the rest of Sydney and the rest of NSW, as well as a reduction in value-add for the rest of Australia, reflects the economic activity that is attracted to Sydney and NSW from all over the country and the widespread economic impacts generated by the proposed airport development. It should be noted that it is not possible for the economic modelling to predict the sources of this redistributed economic activity, particularly as it would depend on numerous economic factors at the time of operation. However, this redistribution of economic activity is not considered likely to affect any one particular region or community. It is also important to note that the proposed airport is nonetheless predicted to generate net economic benefit for Western Sydney, Greater Sydney and Australia. As such, the social implications of the redistribution of economic activity are not considered to be significant.

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 nearly $1.4 billion in profits for the rest of Sydney. There also 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 nearly $1.6 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. The proposed airport would also stimulate domestic and international trade, which is reflected in the net increase in imports in Western Sydney, NSW and Australia.

37.3.1.2 Employment redistribution

In 2063, the proposed airport is expected to support around 88,500 direct full-time jobs at the airport site. This would include around 61,500 jobs directly involved in the operation of the proposed airport, and another 27,150 jobs that could be generated at the airport site should a future airport lessee company choose to develop a business park. The development of a business park on the airport site is outside the scope of the EIS and would be subject to separate approvals.

A land use econometric model was used to assess the impact of the proposed airport on the distribution of employment growth across Sydney. The model seeks to understand how the proposed airport and surrounding land use development in Western Sydney would serve to redistribute population and employment growth. As the model assumes employment as a whole is predicted to grow in the future, areas shown to have a reduction in employment would not see a net loss in employment but rather a slowed rate of employment growth.

For the purposes of the assessment, the following Western Sydney districts are defined according to local government areas:

- Sydney South West: Liverpool, Fairfield, Camden, Campbelltown, Wollondilly;
- Sydney West: Penrith, Hawkesbury, Blue Mountains; and
- Sydney West Central: Blacktown, Canterbury-Bankstown (part), Cumberland, Parramatta and The Hills.

The analysis found that by 2063, the proposed airport would redistribute 29,200 jobs to Western Sydney. The Sydney West district is anticipated to see the largest increase with additional employment of 14,300 jobs. The Sydney South West and West Central districts would also receive substantial additional employment. These increases would largely be the result of redistribution of population and employment growth from the rest of Sydney.

Table 37–2 Long term employment changes in 2063 as a result of the proposed airport

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

Across Sydney, the strongest increases in employment growth associated with the long term development are predicted to occur within the following local government areas:

- Penrith;
- Wollondilly; and
- Blue Mountains.

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.

The long term development would therefore present opportunities for improvement in the quality of life, living conditions, and job satisfaction for those either directly employed or otherwise indirectly economically affected by the proposed airport.

The economic and employment benefits of the proposed airport would boost household incomes that could improve quality of life and living conditions of those affected. The diversity and scale of jobs created by the proposed airport in the long term would provide options for job seekers to gain employment in their preferred industry, rather than other avenues of employment.

Around 30 per cent of Western Sydney's workforce currently travel to other parts of Sydney for work. The proposed airport would also potentially reduce long travel times experienced by many residents by creating job opportunities closer to their place of residence. This would represent a lifestyle improvement as it would provide workers with more time to engage in other activities. The reduction in travel times may also represent a saving in living expenses for those affected.

Lastly, business activity and infrastructure investment attracted to Western Sydney by the proposed airport may also improve the quality and variety of social services and infrastructure available to residents.

37.3.2 Population redistribution and housing

37.3.2.1 Population redistribution

As with the regional employment growth analysis, the regional population analysis assumed that there would be no net population increase (i.e. no additional population) in Sydney as a result of the proposed airport. Instead, the land use econometric model was used to calculate the redistribution of population growth caused by changes in the desirability of places to live, largely from proximity to jobs and services, that the proposed airport is expected to generate.

Because the model's base case (i.e. if there is no airport) factors in projected future population growth in Sydney, areas that see a reduction in population growth in the analysis do not necessarily have a decline in population in absolute terms. Rather, the population of these areas would not grow by as much as they would have if there were no airport.

As outlined in Table 37–4, the Sydney West district is anticipated to see the largest additional increase in population due to the long term development of the proposed 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 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 37–3 Long term population changes in 2063 as a result of the proposed airport

Region	Long term population changes in 2063
Wester Sydney	76,300
Sydney South West	31,100
Sydney West	63,400
Sydney West Central	-18,200
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;
- Blacktown;
- Wollondilly; and
- Camden.

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.

Population redistribution into Western Sydney would likely increase demographic and cultural diversity in the region. To some extent, this process is already occurring with the movement of young people, particularly young families, to Western Sydney. Demographic changes may be particularly pronounced in areas to the west of the airport site, where many communities have relatively low cultural diversity.

37.3.2.1 Housing and accommodation

The urbanisation of Western Sydney, of which the proposed airport is a part, would create significant additional demand for housing and accommodation. This increase in demand coupled with potential change in average property values has the potential to generate housing availability and affordability issues, particularly for already disadvantaged groups. A number of strategic planning initiatives – including significant housing development – are planned in Western Sydney to deal with the current and anticipated future demand for housing.

37.3.3 Social amenity and lifestyle

This section considers the potential impacts of the long term development on lifestyle and social amenity as a result of a range of other impacts, including:

- Noise (see Chapter 31);
- Air quality (see Chapter 32);
- Traffic, transport and access (see Chapter 33);
- Planning and land use (see Chapter 35); and
- Landscape and visual amenity (see Chapter 36).

37.3.3.1 Noise

The communities that have the potential to be most impacted as a result of the indicative long term noise scenarios include Luddenham, Badgerys Creek, Bringelly, Greendale, 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.

Noise has the potential to reduce the social amenity and lifestyle experienced by affected communities. Particularly during the day and evening, noise could intermittently interrupt conversation or other activities such as watching television or listening to the radio. Noise during the night would also have the potential to affect sleep to varying degrees.

Noise would also potentially impact the attentiveness and enjoyment of children during hours of education, and hence their cognitive development. It is also reasonable to assume that noise at churches, parks or recreation facilities would degrade their utility and the value the community placed upon such social infrastructure.

Even if it does not interrupt particular activities, noise or the prospect of noise has the potential to cause annoyance, stress and anxiety. These psychological effects can have flow on effects into other areas of life within the family and community. These impacts are unpredictable in the sense they affect people differently (or not at all) and can be highly subjective.

Aside from frequency or intensity of the noise, the seriousness of the impact and the response of individuals would be dependent on a range of factors, some also subjective. These include:

- prior exposure to aircraft noise;
- lifestyle and work factors; and
- habituation over time.

Prior exposure to aircraft noise would potentially reduce the perceived seriousness of the impact. The emergence of aircraft noise where there previously was none would more reasonably be expected to trigger a negative response than an increase in flights on an existing flight path.

Lifestyle factors such as place of work, work hours and the nature of work would also be relevant. For people who work away from home, noise may be experienced solely in the work or the home environment. Noise could more reasonably be expected to trigger a negative response in the home – particularly at time of rest or recreation – but also for people who work at home. Shift workers may also be particularly affected by the level and frequency of noise events.

Airports necessarily occur in proximity to urban development. As such, there are numerous examples around the world of communities that are affected by aircraft noise. The responses of individuals to increased noise would vary. People may choose to close windows or doors in order to reduce ambient noise levels. It is reasonable to assume that, over period of time, residents who are genuinely less sensitive to noise move into noise affected areas whereas those who are more sensitive to noise tend to move out. This means that communities in noise affected areas are generally less sensitive to noise than communities in quieter areas.

The potential impacts of noise from ground operations and aircraft overflights are nonetheless a considerable potential impact of the proposed airport.

The noise assessment for the long term development is discussed in more detail in Chapter 31.

37.3.3.2 Air quality

Long term development could lead to changes in air quality for communities close to the airport site, including Luddenham, Wallacia, Greendale, Badgerys Creek, Rossmore, Mount Vernon and Kemps Creek. This predicted change in air quality may affect places where people live, work or visit including residences, workplaces and social infrastructure.

Dispersion modelling of airport emissions during the operation of the long term development indicated that there would be some exceedances of relevant air quality criteria for nitrogen oxides and particulate matter at seven sensitive receptors and fifteen sensitive receptors, respectively. Predicted ozone concentrations were also anticipated to exceed the relevant air quality criteria whether or not the proposed airport is developed, owing to the high levels of predicted background ozone. The results of the air quality assessment are discussed further in Chapter 32.

The primary social impact of emissions to air relates to human health. This potential impacts includes both the direct human health effects caused by inhalation of emissions over extended periods of time and the stress and anxiety the knowledge of these potential impacts can cause. These potential impacts are discussed in Section 35.3.4.

Aside from the potential human health impacts, the potential impacts of emissions to air on social amenity and lifestyle in affected communities are limited. Emissions to air would not be expected to directly disrupt the day to day activities comprising life, work and recreation in Western Sydney.

Some changes in behaviour could be expected as a result of perceived changes in air quality, due to the proposed airport and more generally the broader urbanisation of the region. This process of urbanisation would be gradual and, by the time of the operation of the long term development, is expected to be well advanced. Changes in behaviour would also be expected to be gradual and could include residents choosing to keep windows or doors of their residences closed to reduce their exposure to air pollution. The gradual nature of changes in air quality would not be expected to influence the choice of individuals planning to relocate to or from Western Sydney.

It is noted that improvements in emissions standards over coming decades, for both aircraft and road vehicles, would have the potential to further improve air quality at the local and regional scale.

37.3.3.3 Traffic and transport

The long term development would lead to an increase in 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. Future decisions about timing and rail service options, both directly to the airport site and within the Western Sydney region, would be relevant to any such planning and assessment.

The primary social impact of increased traffic is increased commute times and potential inconvenience due to planned transport infrastructure work. Increased commute times could affect residents travelling to and from home, work, school, health care facilities or other social infrastructure. The increased commute times could represent an inconvenience to residents in transit and their families, dependants, colleagues or others depending on the circumstances. The degree of these impacts would largely depend on the implementation of strategic transport initiatives to cope with the expected growth and urbanisation of Western Sydney, of which the proposed airport would be a component.

It is also important to note that a large proportion of the population from the Western Sydney region currently undertake long commutes on a daily basis to access work opportunities. Employment opportunities created by the long term development would potentially reduce travel times, offering prospects for improved lifestyle by allowing workers more time for leisure activities and family.

The traffic, transport and access assessment is discussed in more detail in Chapter 33.

37.3.3.4 Land use, landscape character and visual impacts

The planning and land use impacts of the long term development would essentially involve the continued growth of regional centres and further transition of surrounding rural residential and agricultural lands to more developed land uses.

By the time the long term development is in operation, changes are likely to be well advanced given predicted growth and urbanisation in Western Sydney. It is important to note that the proposed airport development is only a part of the broader transition of Western Sydney, which will have wide-ranging effects on the lives of many people.

In tandem with the predicted land use changes, the long term development would represent an incremental increase in visual impacts on the Stage 1 development, given the expansion of aviation infrastructure required and the increase in aircraft overflights. The exact location of these impacts, particularly overflights, would be dependent on further detailed analysis undertaken as part of the determination of flight paths under a future approval process.

The ongoing transition of Western Sydney, and the land use, landscape and visual impacts of the airport, would have social amenity and lifestyle impacts. In particular, these changes would result in a progressive transition in communities from quiet, rural or village lifestyles to more urban lifestyles commensurate with urban development and population growth.

Impacts to landscape character and visual amenity have a social dimension in the sense they can reduce the amenity of spaces where people live and work or visit for recreation. Visual impacts could reduce people's enjoyment of these places and the value they place on them.

Individual experience of these changes would be largely subjective. Established or long term residents who have experienced the change first hand would be more likely to regard it negatively than more recent residents or others who travel to Western Sydney for work or otherwise.

There will be residents, both long term and recent arrivals, who would view the transition of land use and landscape character as a positive, or be indifferent to it, given the associated social and economic benefits of living in an urbanised area with better access to employment, shops, services, and social infrastructure.

The planning and land use assessment is discussed in more detail in Chapter 35 and the landscape and visual amenity assessment is discussed in more detail in Chapter 36.

37.3.4 Human health

As discussed in Chapter 39, the long term development would potentially affect the health of those living in the region primarily through noise and air emissions.

The health risks due to the long term development are generally higher than those for the Stage 1 development. As discussed in Section 39.8.1, the health risks due to air emissions are highest in suburbs in the vicinity of the airport site, with the risks from ozone most pronounced to the south and south-west of the airport site. The highest health risk would be from nitrogen dioxide due to aircraft emissions. In relation to noise, the long term development is predicted to increase sleep disturbance from both aircraft overflight and airport ground-based noise, with the impact greatest in Luddenham, Greendale, Horsley Park and Kemps Creek. The assessment found that noise is not predicted to increase the risk of cardiovascular disease and noise impacts on learning and cognitive development in children are largely within acceptable limits. In relation to ground based operation noise, the assessment finds that only Luddenham Primary School, of all the educational institutions assessed, would exceed the relevant hazard quotient for indoor noise.

Although the predicted increase in health risks for the community due to the long term development are largely within acceptable limits, it is possible that a combination of actual and perceived impacts from noise, air quality and associated health risks may lead to social impacts.

Some residents may make choices such as where to live and where to send their children to school based on actual and perceived impacts. Health impacts from noise such as annoyance and sleep disturbance have the potential to change some people's behaviour. This could lead to changes in how people react to certain situations and potentially strain family and social relations. The potential amenity impacts on social infrastructure are discussed further in Section 35.3.5.

As a catalyst for development and change in Western Sydney, the proposed airport may have a long term impact on the social determinants of health for some community members. The social determinants of health are the conditions in which people are born, grow, work, live, and age, and the wider set of forces and systems shaping the conditions of daily life (WHO, 2016).

In addition to the negative impacts on health outlined above, the proposed airport may also result in reduced lifestyle and social amenity for some community members, particularly those living in areas close to the airport site. These reductions in social amenity and lifestyle may have a negative impact on the health and wellbeing of community members. Lifestyle and amenity impacts can lead to stress and anxiety for community members and result in negative impacts on community health.

The proposed airport may be the catalyst for increased employment opportunities and higher incomes, the urbanisation of formerly rural and suburban areas, improved transport infrastructure, and increased social infrastructure, including health services, in Western Sydney. Collectively, these factors could provide socio-economic benefits to some community members, and therefore lead to positive community wellbeing and health outcomes.

Potential impacts on human health are discussed further in Chapter 39.

37.3.5 Social infrastructure

Social infrastructure may include health care facilities, educational institutions and recreational facilities. This infrastructure is often provided by a variety of government agencies, local councils, non-government organisations, community groups, and private industry.

The workforce at the airport site during the long term development, coupled with the projected increase in population, would result in additional demand on social infrastructure in areas near the airport. This may affect access to 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.

37.3.5.5 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
- the Blue Mountains.

The long term operation of the proposed airport, and associated increases in overflight noise, may reduce the amenity of these recreational areas over time.

Residents and visitors to the Blue Mountains value the quiet and peaceful nature of the area. An increase in the frequency and intensity of noise in the area would potentially disturb the serenity of the area and disrupt enjoyment of the natural landscape. As aircraft overflights in the Greater Blue Mountains Area will be at relatively high altitude (typically over 5000 feet), maximum noise levels are not anticipated to exceed 55 dBA. Although audible, these noise levels would be lower than those levels predicted for areas closer to the proposed airport that could interrupt conversation or daily activities such as watching television.

Noise levels may also be reasonably expected to reduce over time as a result of improved aircraft engine design and technology advancements, which would further limit potential amenity impacts.

37.3.5.6 Emergency services

The long term development may incrementally increase demand for emergency services. Increases in the number of flights, passengers and employees on the airport site would increase the potential for incidents requiring an emergency response. In addition, increased traffic on the surrounding road network and the health issues discussed in Section 30.3.4 are factors that may increase the demand for emergency services. It is assumed that emergency services will adapt and respond to the needs of the Western Sydney community as it grows. The proposed airport is not expected to place excessive pressure on emergency services.

37.4 Summary of findings

The long term development of the proposed airport would result in both positive and negative social impacts. There would be significant economic, employment and social opportunities for the Western Sydney region, as well as 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 also 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 Western Sydney 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 international and domestic markets and supporting businesses. 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.

At the same time the long term development would have impacts on the social amenity and lifestyle of communities. The proposed airport would support the continued growth of regional centres and the transition of surrounding rural residential and agricultural lands to more developed land uses. Increases in aircraft overflights would generate noise and visual impacts that would affect the community and may reduce the amenity of places where people live, work or visit for recreation. As part of the broader urbanisation of Western Sydney, the long term development will contribute to increased demand for social infrastructure, whilst also stimulating investment in better quality social infrastructure and services in the region.

38 Greater Blue Mountains World Heritage Area

38.1 Introduction

This chapter considers the potential impacts of the proposed airport on the World Heritage and National Heritage values and other values of the Greater Blue Mountains World Heritage Area (GBMWHA) and National Heritage place. The chapter considers the potential impacts associated with the proposed Stage 1 development presented in Chapter 26 (Volume 2a) 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 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 development of the airport site and further assessment and approval requirements under the Airports Act.

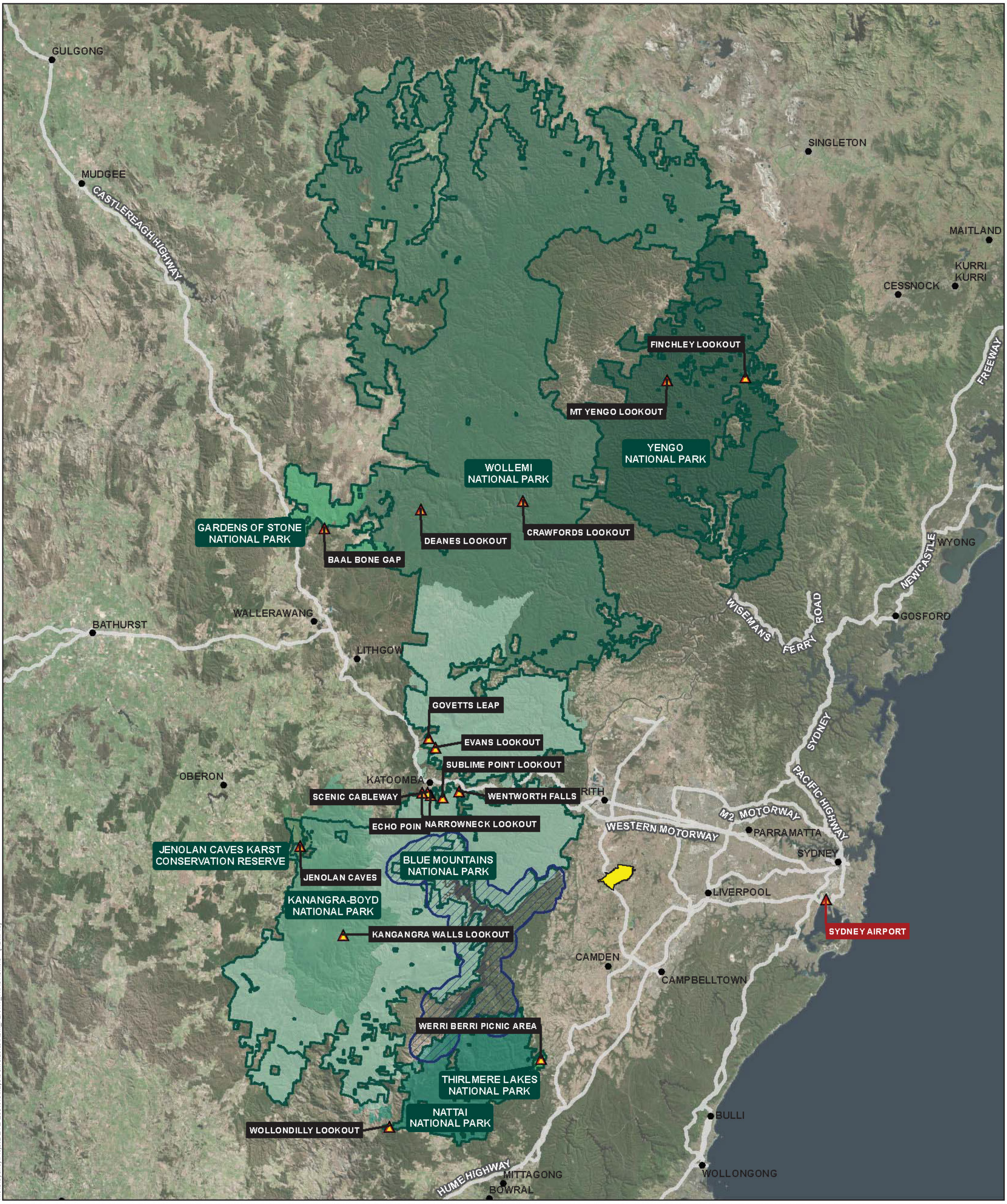
In this chapter, the term Greater Blue Mountains Area is used to refer to the area inscribed on the World Heritage List in 2000 for its outstanding universal value. The term Greater Blue Mountains World Heritage Area, or GBMWHA, is generally used elsewhere.

38.2 Environmental values

At its closest point, the GBMWHA is approximately seven kilometres from the site of the proposed Western Sydney Airport. The GBMWHA 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 adaptation and diversification of eucalypts in post-Gondwana isolation on the Australian continent (UNESCO 2015).

The GBMWHA comprises eight protected areas (see 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.



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

LEGEND

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

Figure 38-1 - Greater Blue Mountains World Heritage Area

The GBMWHA provides a significant representation of Australia's biodiversity, with 10 per cent 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 Greater Blue Mountains area was inscribed on the World Heritage List because it satisfies, in the following ways, 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 (Volume 2a).

In addition to meeting at least one of 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 GBMWHA states that the eight protected areas that comprise the GBMWHA 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 impacted the integrity of the area in the past 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). Sites of Aboriginal occupation, including important rock art provide physical evidence of the longevity of the strong Aboriginal cultural connections with the land. The conservation of these associations contributes to the integrity of the GBMWHA (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). In most cases, both the Australian and State or Territory governments are responsible for managing and protecting Australia's World Heritage properties, with State and Territory agencies taking responsibility for on-ground management where relevant.

World Heritage properties are protected under the *Environment Protection and Biodiversity Conservation Act 1999 (Cth)* (EPBC Act) and are considered 'matters of national environmental significance'. The EPBC Act provides for the development and implementation of management plans for World Heritage properties which describe aspects of the property and how it will be managed.

The New South Wales Office of Environment and Heritage manages the GBMWHA. The GBMWHA is protected and managed primarily under the following State legislation:

- 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 Greater Blue Mountains World Heritage Area 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 Area was included on the National Heritage List in 2007. The National Heritage values identified for the listing are the same as the values for the World Heritage Area. As such, the following assessment against the World Heritage values is taken to address both the National Heritage and World Heritage values of the Greater Blue Mountains Area.

In addition to the attributes recognised by the World Heritage Committee as having World Heritage value, the Greater Blue Mountains Area has a number of other important values which complement and interact with its World Heritage values (DECC 2009c). Protection of these values is considered to be integral in managing individual protected areas and the GBMWHA as a whole (DECC 2009c). Table 38–1 provides a summary of the values identified by the NSW National Parks and Wildlife Service in the GBMWHA Strategic Plan which contribute to the overall values of the area.

Table 38–1 Other important values of the GBMWHA

Value	Description
Geodiversity and biodiversity	In addition to the outstanding biodiversity of the GBMWHA, 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 GBMWHA 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, and include 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 GBMWHA 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.
Recreation and tourism	The GBMWHA has high recreational values due to the area's 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 GBMWHA constitutes a vital and highly significant contribution to its World Heritage values 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.
Social and economic	The regional economy surrounding the GBMWHA is increasingly supported by tourism. The reserves within the GBMWHA have considerable social and economic value and contribute directly and indirectly to the employment, income and output of the regional economy. While visitation data for specific locations would be highly variable, given the broad range of uses and vast area of the property, it is expected that overall visitation to the GBMWHA is increasing – reflecting the region's importance as a tourist destination.
Research and education	The GBMWHA 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 GBMWHA includes striking vertical cliffs, waterfalls, ridges, escarpments, uninterrupted views of forested wilderness, extensive caves, narrow sandstone canyons and pagoda rock formations.
Bequest, inspiration, spirituality and existence	Combining a number of the above values, the GBMWHA offers attributes that promote inspiration, serenity and rejuvenation of the human mind and spirit. These feelings are valued by individuals and society and inspire a number of creative endeavours including philosophy, painting, literature, music and photography. The contributions have, and continue to, promote a sense of place for Australians who desire such places to be protected.

Source: NSW NPWS 2009

The following areas within the GBMWHA were identified as sensitive tourist and recreation areas in relation to potential impacts of the long term development such as noise, air quality and visual 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 GBMWHA or its values from construction activities and operations associated with the proposed airport in the long term. A portion of the GBMWHA fronts the Nepean River downstream of its confluence with Duncans Creek. The Duncans Creek catchment only covers approximately 11 per cent of the airport site, the majority of which is outside of the footprint of construction works required for a second runway. The proposed adoption of best-practice water quality control measures at the airport site means there is 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 which joins the Nepean River downstream of the GBMWHA.

38.3.2 Indirect operational impacts

Operation of the proposed airport may have several indirect impacts on the GBMWHA, primarily from the overflight of aircraft. These potential impacts include:

- noise;
- air quality; and
- visual amenity.

As noted in Chapter 30, indicative flight paths developed by Airservices Australia for the long term development were used to model and assess the impact of aircraft operations. The process for establishing initial flight paths for the airport is set out in Chapter 7 (Volume 1) of this EIS. Flight paths and airport operating procedures that may be used in the long term would be subject to detailed development and approval taking into account potential impacts on the GBMWHA prior to commissioning of a second runway. Long term flight path design would be undertaken through a future approval process, which would include extensive public consultation and further environmental assessment.

38.3.2.1 Noise

The noise modelling methodology is described in detail in Appendix E (Volume 4). Noise modelling of the GBMWHA incorporates the topography of the area and as such, the height of aircraft above ground level as they overpass the GBMWHA. This captures the variance in noise across peaks and valleys within the GBMWHA. Noise levels from specific aircraft have been modelled as detailed in Appendix E1 (Volume 4). The highest predicted noise levels are associated with a departing Boeing 747 aircraft (an aircraft type that is generally being phased out by airlines), while the more common and likely future noise levels are represented by a departing Airbus A320.

In comparison to Stage 1 operations, noise events would be experienced over a wider area due to the additional flight paths associated with the second runway. Indicative noise exposure levels for long term aircraft operations are shown in Figure 38–2 and Figure 38–3. Figure 38–2 shows that a Boeing 747 aircraft operating on certain departure paths would produce noise levels exceeding 60 dBA over areas 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 latest generation of aircraft being 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 have been replaced 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. Very low-flying aircraft can cause flight response in some species, causing them to abandon nests. 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 exceed 65 dB.

Given the altitude at which flights to and from the proposed airport are likely to occur over the GBMWHA, these impacts are unlikely. While noise would increase above background levels on an intermittent basis, fauna are likely to become habituated to any increase in noise levels in the long term (Conomy et al 1998), particularly as aircraft would not be flying at low altitudes over the GBMWHA. Operation of aircraft at the proposed airport is highly unlikely to permanently alter foraging or breeding behaviour of any fauna species. Any impacts would likely be localised, with impacts occurring under the main flight paths. The majority of fauna within the vast GBMWHA 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 GBMWHA.

38.3.2.2 Air quality

Regional air quality impacts relevant to the GBMWHA have been assessed in regard to three principal elements:

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

Regional air quality (ozone)

Air pollutants can contribute to regional photochemical smog which may have an impact on the amenity of the GBMWHA. This includes ozone, formed by the photochemical reaction of precursor emissions from the proposed airport.

The National Environment Protection Measure (NEPM) is a national monitoring and reporting protocol. Its purpose is to evaluate trends in air quality with time across the general population and to guide air quality management strategies. An assessment of air quality emissions from the long term development, including the NEPM for ozone is provided in Chapter 32.

Both the 2030 base case and the 2063 'with airport' case were above the NEPM criterion on all but one day of analysis. The assessment also identified that the peak predicted 1-hour ozone concentrations between the 2030 base case and the 2063 'with airport' case were unchanged on eight of the twelve days selected for analysis. On four days, the peak predicted 1-hour ozone concentration increased by a maximum of 0.2 parts per billion (ppb).

The background ozone levels for Western Sydney regularly exceed NEPM guidelines, generally in summer months. For the long term development, changes in emissions from other sources (e.g. commercial, industrial, on-road mobile, etc.) have not been accommodated – some of which may increase and some of which may decrease. Consistent with the modelling approach adopted for the Stage 1 development, the modelling assumes worst case operations, for example, by including emissions from aircraft auxiliary power units (APUs). Fixed electrical ground power and preconditioned air are expected to be provided for aircraft at the airport gates, meaning that APUs will not generally need to be used by stationary aircraft.

The modelled contribution of emissions from the proposed airport to peak ozone levels is unlikely to be significant in a regional context. Accordingly, changes in ozone levels due to operations at the proposed airport in the long term are not expected to impact the amenity of the GBMWHA.

Contribution to climate change

Climate change is identified as a threat to the GBMWHA due to its potential to alter the frequency and intensity of fires and for increased temperatures to impact biodiversity and ecosystem function (UNESCO 2015). Greenhouse gas (GHG) emissions are identified as a contributing factor to global climate change.

In the absence of a projected GHG emissions inventory for 2063, greenhouse gas emission estimates for the long term development represent approximately 0.71 per cent of Australia's projected 2030 transport-related GHG emissions inventory. Given this small proportional contribution, the GHG emissions from the proposed airport would not represent a significant contribution to climate change.

Emissions from fuel jettisoning

Potential emissions from fuel jettisoning and their impacts on GBMWHA are assessed in Chapter 26 (Volume 2a).

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 dumps, and the strict guidelines on fuel dumping altitudes and locations. In addition, in the very unlikely event that fuel is required to be jettisoned over land, research indicates that vaporisation and dispersion of fuel occurs rapidly.

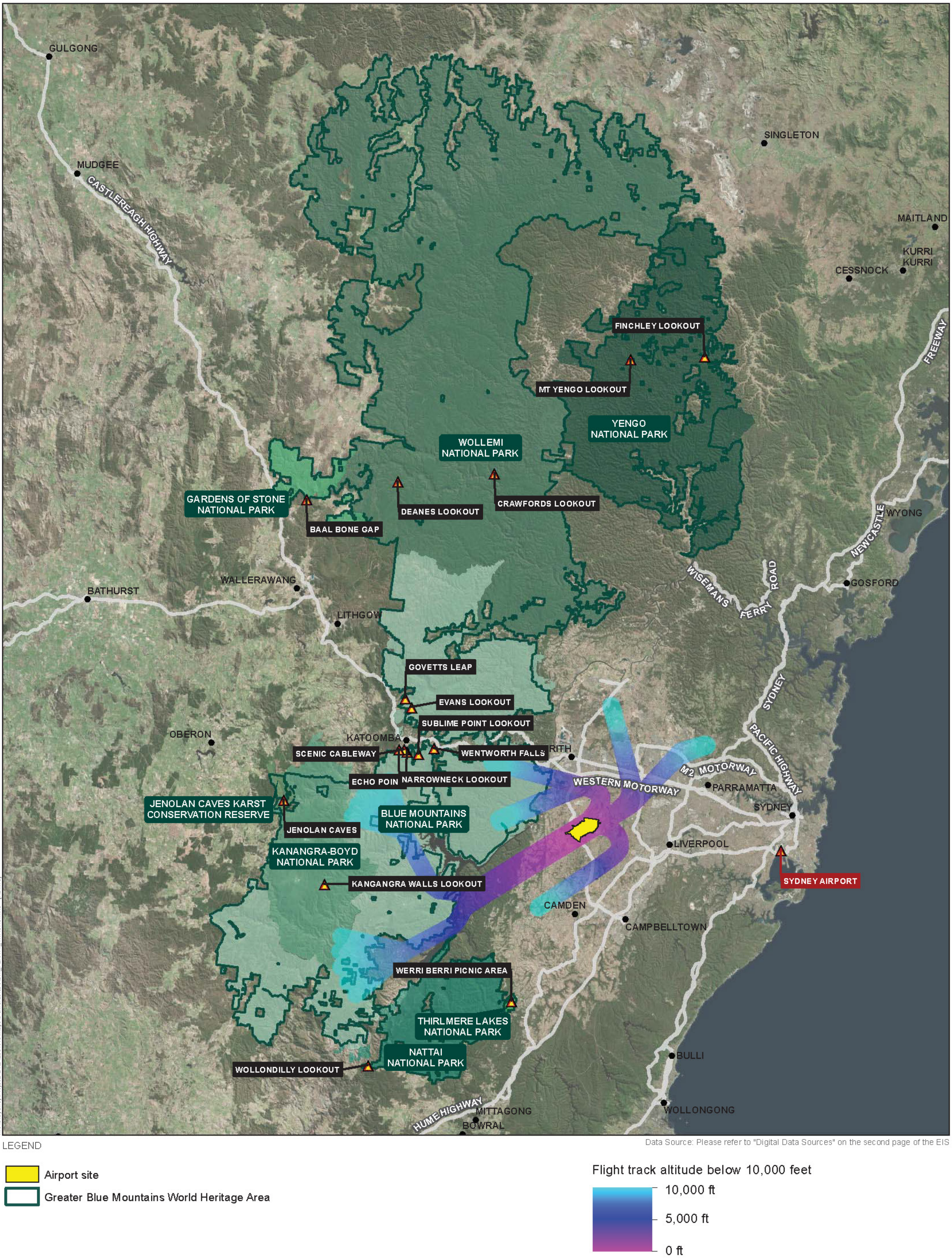
38.3.2.3 Visual amenity

Almost all aircraft departing and arriving at the airport in the long term would be at an altitude of more than 5,000 feet above sea level when passing 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 of aircraft above ground level relevant to these sensitive areas are shown in Table 38–2. No flights be expected to occur below 6,000 feet (approximately 1.8 kilometres) above ground level in the vicinity of the key sensitive areas considered in this assessment.

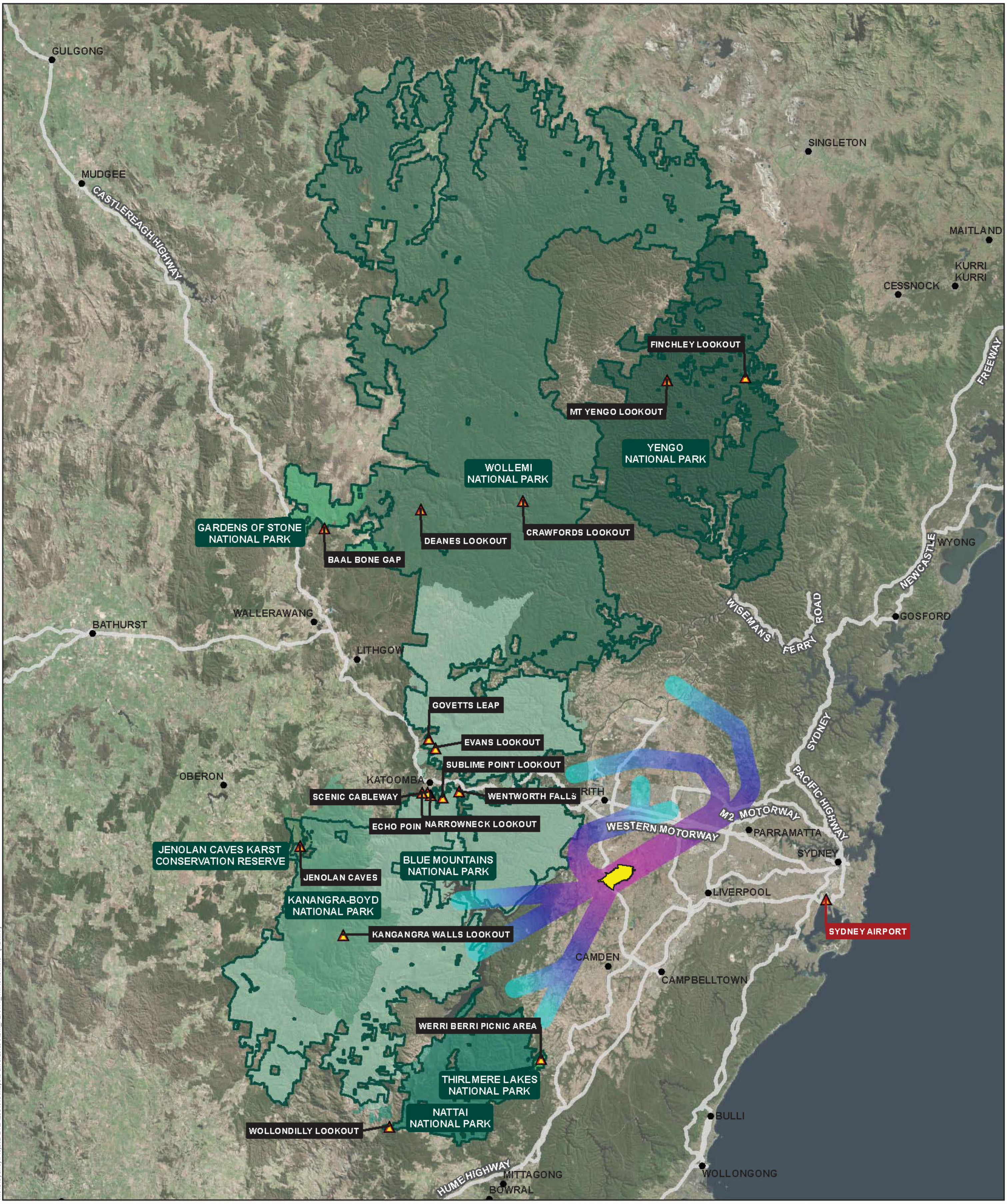
Most sensitive areas considered in the assessment are lookout locations. These typically represent higher landforms within the GBMWHA. Some areas in these key locations, frequented by tourists and recreational users, are at significantly lower altitudes such as the Jamison Valley walking tracks (1570 feet), the Starlights trail within the Nattai wilderness area (305 feet at Nattai River) and Wollemi Creek within the Wollemi wilderness area (450 feet).

The visual impact of aircraft overflights on recreational users in these lower altitude areas will be further reduced compared to the higher altitude sensitive areas considered in this assessment due to the increased separation distance.



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

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



LEGEND

Airport site

Greater Blue Mountains World Heritage Area

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

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, 23 operating mode dual runways

Table 38–2 Flight levels above key 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

Note: Flight altitudes refer to Figure 38–2 and Figure 38–3.

As shown in Photograph 38–1, aircraft at 3,000 feet are not prominent visual features although they are visible from the ground. When viewed from the key sensitive areas in Table 38–2, aircraft are likely to be at least 6,500 feet above ground level. At this altitude, intermittent aircraft movements are likely to be difficult to discern and are not considered to be visually obtrusive.

Photograph 38-1 Aircraft at approximately 3,000 feet on a clear day at a ground distance of 2.75 kilometres from the viewer

The airport site may potentially be visible from Nepean lookout and Mount Portal Lookout – both located between 13 and 14 kilometres from the airport site. A detailed assessment of the long term visual impact of the airport site is included in Chapter 36.

From these vantage points, the proposed airport would be viewed as a background feature, with closer residential areas at Wallacia, Mulgoa and Glenmore Park being more visually prominent to an observer. In the long term, the visual prominence of an airport at Badgerys Creek would also be reduced by substantial ongoing development in the Western Sydney Employment Area, the Western Sydney Priority Growth Area and South West Priority Land Release Area. The effect of the proposed airport on the visual amenity of the GBMWHA is therefore expected to be very limited.

Amenity could also be influenced by light spill from the proposed development at night resulting in sky glow. During night-time hours, lights from aircraft operations, carparks, apron lighting and other ancillary airport infrastructure may be perceptible in the distance. However, at a landscape level—and having regard to the substantial future urban development planned across the intervening landform of Western Sydney—the proposed airport would be one of many sources of night-time light contributing to urban sky glow in the long term. This contribution is unlikely to impact amenity in the GBMWHA.

38.4 Outstanding universal value

Operation of the airport in the long term would have no direct impact on the outstanding universal value of the GBMWHA. Indirect impacts on the property's outstanding universal value are 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 – Matters of National Environmental Significance, 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.

38.4.1 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 (DECC 2009c). 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.

Table 38–3 Operational impacts on the outstanding universal value of the GBMWHA

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 site and the predicted emission levels, would not 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 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 and disperses rapidly before reaching the ground. As such, air emissions 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 GBMWHA. Similarly, the significant aspects of scleromorphic flora and the existence of primitive species present in the GBMWHA are representative of evolutionary processes. No direct or indirect operational activities would have an impact on these processes in the GBMWHA 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 development would not result in direct impacts on the attributes demonstrated within the GBMWHA relevant to evolutionary processes. The indirect impacts of a long term development would not result in a World Heritage value being lost, degraded or damaged, or notably altered, modified, obscured or diminished. Accordingly, the long term development would not have a significant impact on the attributes identified for 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 in the unlikely event of an aircraft crash or from significant pollution resulting in loss of habitat or other effects on biota. Any such impacts would be localised and are unlikely to have a significant impact on biota and habitats. Noise and air emissions represent indirect impacts and given the distance from the airport and predicted emission levels would not 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 development would generally be more than 6,500 feet above ground level at most locations in the GBMWHA, and noise levels would not exceed 55 dBA. These intermittent noise levels are unlikely to disturb fauna within the GBMWHA. Air emissions from the operation of a long term airport would not represent a material contribution to climate change which may impact biodiversity. Direct emissions from fuel jettisoning would not impact biological diversity values given the rarity of such events and that fuel is unlikely to reach the ground. 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 development.	The operation of a long term development would not result in direct impacts on the examples of biological diversity present within the GBMWHA. The indirect impacts of a long term development would not result in a World Heritage value being lost, degraded or damaged, or notably altered, modified, obscured or diminished. Accordingly a long term development would not have a significant impact on the attributes identified for 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 GBMWHA or the adjoining lands. Statutory provisions which provide protection to wilderness areas and the Warragamba Dam would not change. An airport would 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 the maintenance of Aboriginal cultural practices within the GBMWHA.	A long term development would not result in the loss of any elements necessary for the property to express its outstanding universal value. A long term development would not reduce the size or change the boundary of the GBMWHA and would not impact on any features and processes that convey the property's outstanding universal value. As described in Section 38.4.2, an airport would not exacerbate existing threats to the integrity of the GBMWHA in the long term.

Table 38–4 Operational impacts on other important values of the GBMWHA

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 in the unlikely event of an aircraft crash or from significant pollution resulting in loss of biota. Any such impacts would be localised and are unlikely to have a significant impact on biota and habitats. 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 development would not have a significant impact on the geodiversity and biodiversity values associated with the GBMWHA.

Value	Attributes	Operational impacts	Assessment of significance
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 per cent of the airport site, the majority of which is outside of the footprint of construction works required for a second runway. The proposed adoption of best-practice water quality control measures at the airport site means there is 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 which joins the Nepean River downstream of the GBMWHA. 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 development would not have a significant impact on the water catchment values associated with the GBMWHA.
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 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 is 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 having regard to the noise assessment criteria. Similarly, the Coxs River and Wollondilly River valley are located in areas of little to no predicted 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 GBMWHA. Indirect impacts on recreation and tourism are considered below.	A long term development is not expected to have a significant impact on the historic heritage values associated with the GBMWHA.
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 recreation and tourism areas have been identified and assessed in regard to potential impacts from operation of a long term development. Whilst based on conservative modelling assumptions, some areas are expected to experience intermittent noise levels above 50 dBA. These areas are limited in the context of the entire World Heritage 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 significantly impacted by aircraft noise. Increased tourism in the region may be associated with higher levels of road traffic. Any long term impacts from airport induced traffic growth are expected to be catered for by ongoing planning and provision of road and other transport infrastructure. Some increases in tourism development and infrastructure may occur as a result of increased tourism numbers in the long term. However, potential impacts from these facilitated developments can be effectively managed through the implementation of existing management plans for the region.	A long term development 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 GBMWHA are generally associated with the Nattai National Park and the Wollemi National Park. Aircraft operations may also affect the Grose and Kanangra Boyd wilderness areas within the Blue Mountains and Kanangra Boyd National Parks. 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 limit 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. However, this is unlikely to eventuate in the long term as this aircraft type is gradually being phased out by airlines. 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. In the long term the airport would be only one component of an expanded urban area when viewed from distant vantage points and only one of many sources of night-time light contributing to urban sky glow. A potential increase in tourism in the long term may impact the wilderness experience of some areas.	A long term development is not expected to have a significant impact on the wilderness values associated with the GBMWHA.
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 GBMWHA in the long term and, as such, the availability of the area for scientific investigation and research would not be limited.	A long term development would not have a significant impact on the research and education values associated with the GBMWHA.

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 GBMWHA would be more than 6,500 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 and the distance of the airport site from vantage points within the GBMWHA, it is not expected that a significant impact would occur as a result of the operation of an airport in the long term.

Note values for Social and Economic, and Bequest, Inspiration, Spirituality and Existence are addressed in the above table within the values of Recreation and Tourism and Wilderness respectively

38.4.2 Influence on existing threats

Table 38–5 provides a description of the influence of the long term development 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	The long term development would provide progressively increasing aviation capacity in the Sydney region, which could also parallel a growth in tourism and visitation to the GBMWHA. Such an increase in tourism may influence the 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 existing management plans which are in place for the World Heritage property. 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 and tourism infrastructure development.
Invasion by pest species including weeds and feral animals	All aircraft arriving in Australia from overseas are subject to Australian biosecurity requirements administered by the Australian Government. The airport and airlines using it would be required to comply with all Australian laws relating to biosecurity, similar to existing Australian airports. 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 in the unlikely event of an aircraft crash or from 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 make a marginal contribution to national transported-related GHG emissions. A contribution of 0.71 per cent to 2030 predicted 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 development is not considered to be a contributing factor to this threat.

38.5 Considerations for future development stages

Mitigation and management of potential noise impacts on the GBMWHA would be achieved through the planning and implementation of appropriate airspace and flight path design and airport operating procedures to support long term 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* (see Chapter 7 (Volume 1)).

The current assessment, based on indicative long term airspace management arrangements, shows that the impacts of an airport at Badgerys Creek on the Greater Blue Mountains, including the World Heritage and other values of the GBMWHA, are not likely to be significant. Opportunities to further reduce the noise and visual impact from aircraft flying over wilderness and other areas of the GBMWHA would be considered in finalising formal airspace and operational arrangements.

38.6 Summary of findings

At its closest point, the GBMWHA is approximately seven kilometres from the airport. As such, no direct impacts are expected on the World Heritage or National Heritage values from future construction activities or operations at the proposed airport in the long term. 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 GBMWHA Strategic Plan. The assessment considered noise, air quality and visual amenity from aircraft overflights, lighting and traffic.

The assessment's findings are that a long term development would not have a significant impact on the World Heritage and other values of the GBMWHA. In particular, the indirect impacts of airport operations 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 considers the impacts of the long term development on 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.

The detailed design of the long term development would be undertaken in accord with the master planning provisions of the *Airports Act 1996* and would therefore be subject to further assessment and approval requirements.

This chapter provides an overview of the likely scale of potential impacts associated with the long term development, and considerations for future development, with regard to the following issues:

- biodiversity;
- topography, geology and soils;
- Aboriginal heritage;
- European heritage;
- resources and waste;
- hazards and risks; 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 listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the *Threatened Species Conservation Act 1995* (TSC Act), and 78 exotic species have been identified or are predicted to occur at the airport site. Field surveys confirmed the presence and distribution of five native vegetation communities and two non-native vegetation communities at the airport site, including local occurrences of one community listed under the EPBC Act and three communities listed under the TSC Act. The condition of these vegetation communities varies and includes 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. Vegetation at the airport site is mapped in Figure 39–1.

A total of 173 terrestrial fauna species, including one threatened species listed under the EPBC Act and a further 10 threatened species listed under the TSC Act, and a number of introduced species have been identified at the airport site. Another 28 threatened fauna species were considered likely or possible to occur at the airport site.

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 503 hectares of vegetation on the southern portion of the airport site not included in the environmental conservation zone. The majority of this vegetation—about 409 hectares—consists of exotic grassland, cleared land and cropland dominated by exotic species and noxious and environmental weeds, with the remainder consisting of native grassy woodland and open forest with some farm dams. Vegetation removal by vegetation zone is summarised in Table 39–1.

The removal of vegetation—in addition to the loss of streams, 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.

In principle, land needed for the long term development that supports vegetation and habitats of conservation significance would not be cleared until it is required for future aviation development or other associated uses. Any proposal to clear such land, or any other land, in the interim would be subject to the requirements of the Airports Act and the EPBC Act. 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 for the 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	37.5
Poor condition Grey Box – Forest Red Gum grassy woodland on flats (HN528)		CEEC	14.2
Good condition Grey Box – Forest Red Gum grassy woodland on hills (HN529)	CEEC	CEEC	7.3
Poor condition Grey Box – Forest Red Gum grassy woodland on hills (HN529)		CEEC	3.4
Good condition Forest Red Gum – Rough-barked Apple grassy woodland (HN526)		EEC	18.6

Vegetation zone	Conservation status under applicable legislation		Direct impact (hectares)
	EPBC Act status	TSC Act status	
Poor condition Forest Red Gum – Rough-barked Apple grassy woodland (HN526)		EEC	5.3
Good condition Broad-leaved Ironbark – Grey Box – *Melaleuca decora* grassy open forest (HN512)	CEEC	EEC	0.5
Poor condition Broad-leaved Ironbark – Grey Box – *Melaleuca decora* grassy open forest (HN512)		EEC	0.5
Good condition farm dams on floodplain (HN630)			6.3
Total native vegetation			93.6
Non-native vegetation zones			
Exotic grassland			243.1
Cleared land or cropland			166.3
Total non-native vegetation			409.4
Total vegetation			503.0

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 (see Chapter 16 (Volume 2a)). 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, 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 (see Chapter 16 (Volume 2a)). 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 are 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
- the risk of introducing 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 (Volume 4). Assessments of significance were prepared based on the assumption that the entire airport site would be developed.

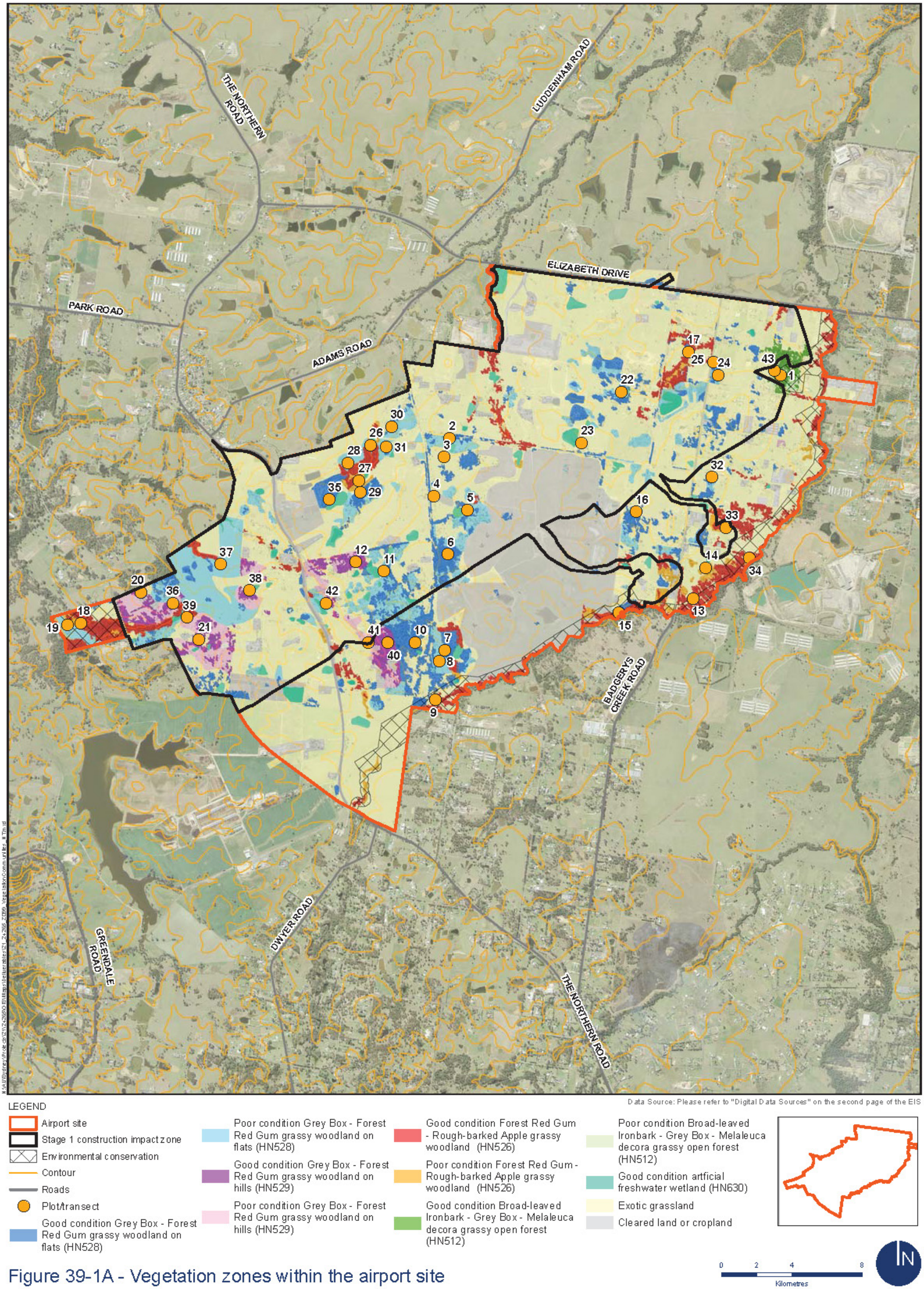
A significant impact was determined for Cumberland Plain Woodland and the Grey-headed Flying-fox. Construction and operation of the long term development would also have a significant impact on plants and animals on Commonwealth land. The key findings of the assessments are summarised in Chapter 16 (Volume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

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 (Volume 2a).

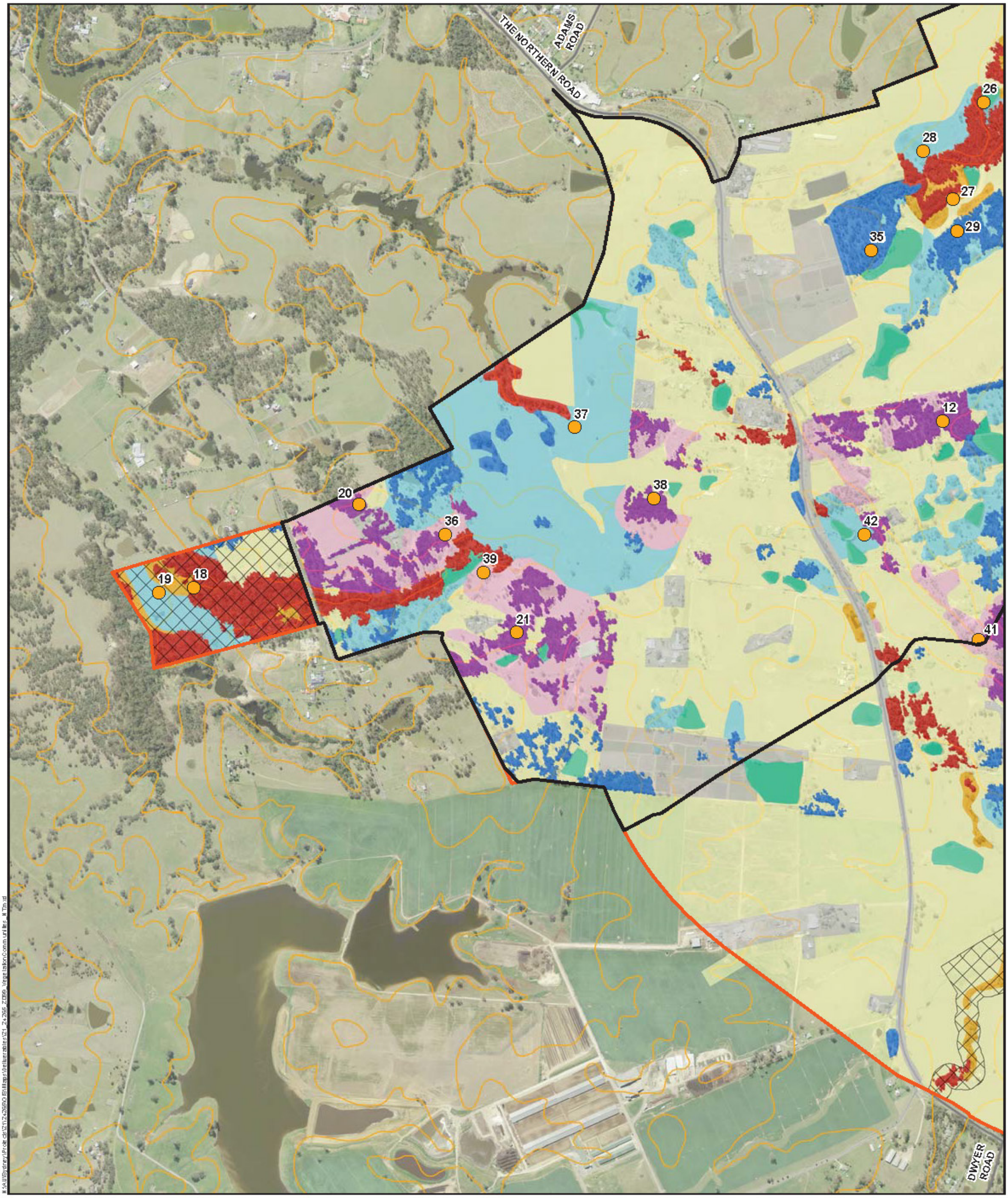
39.2.5 Considerations for future development

Chapter 16 (Volume 2a) 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.



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

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

- Airport site
- Stage 1 construction impact zone
- Environmental conservation
- 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 39-1B - Vegetation zones within the airport site

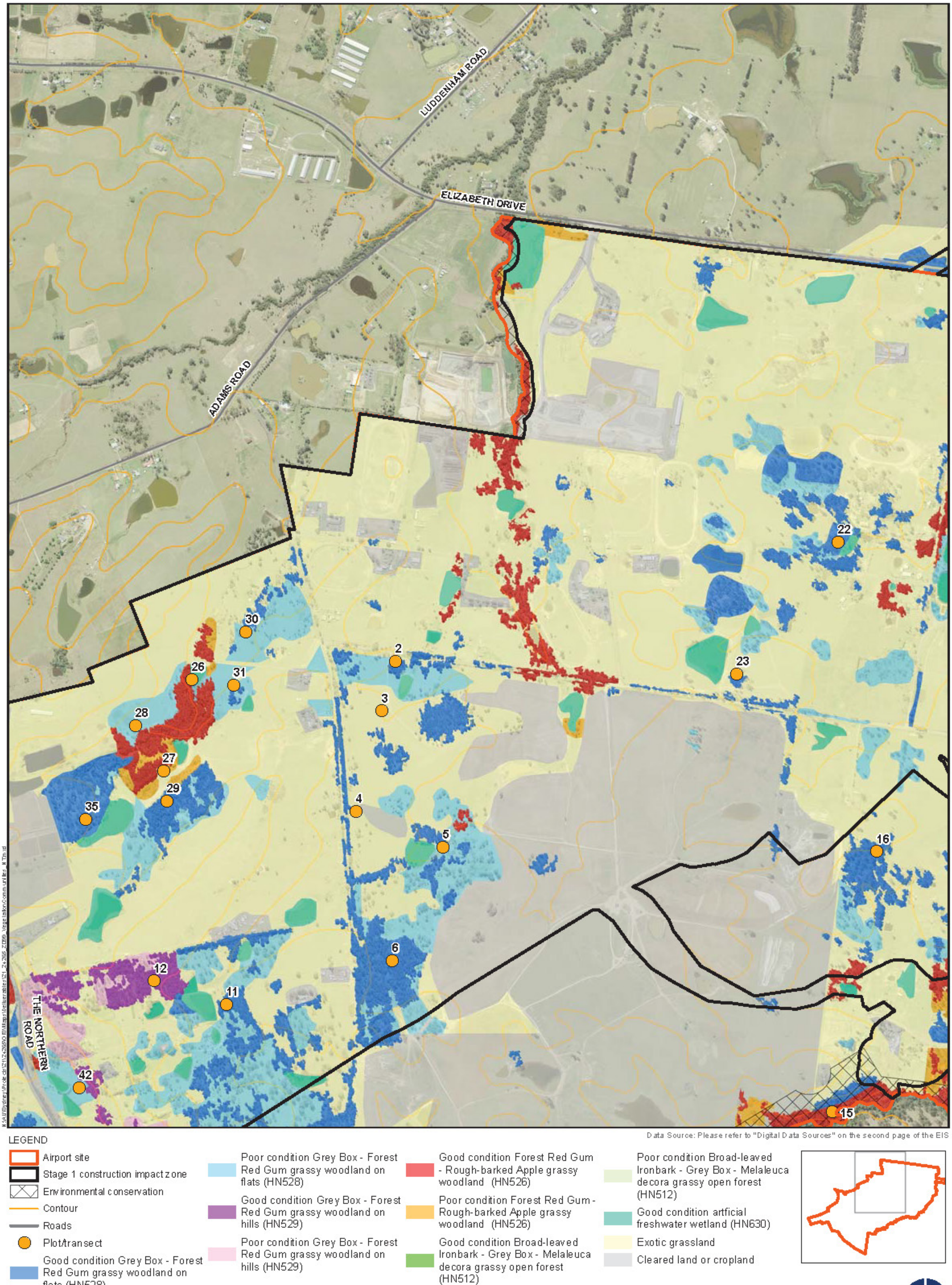
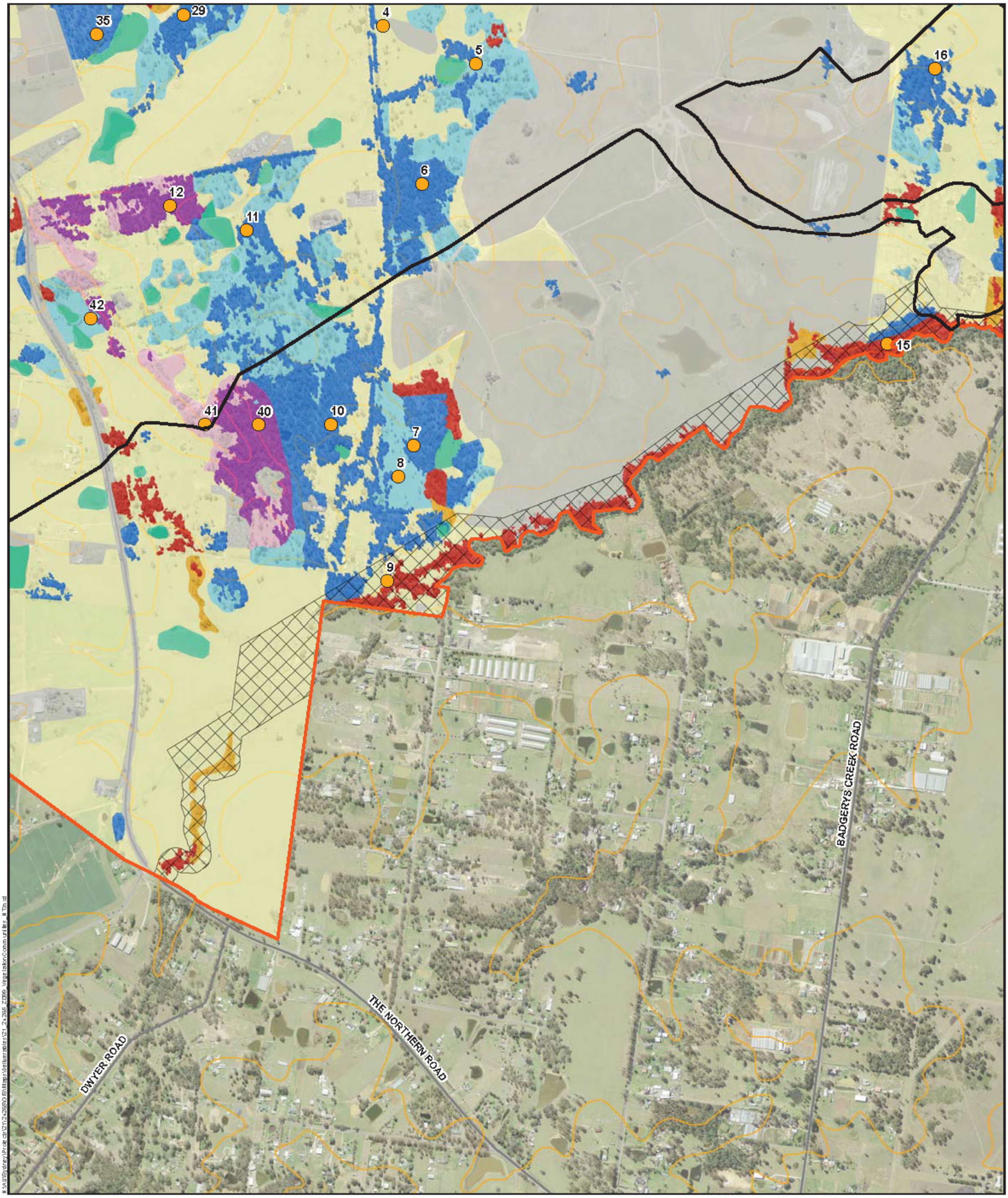


Figure 39-1C - Vegetation zones within the airport site



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

LEGEND

- Airport site
- Stage 1 construction impact zone
- Environmental conservation
- 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

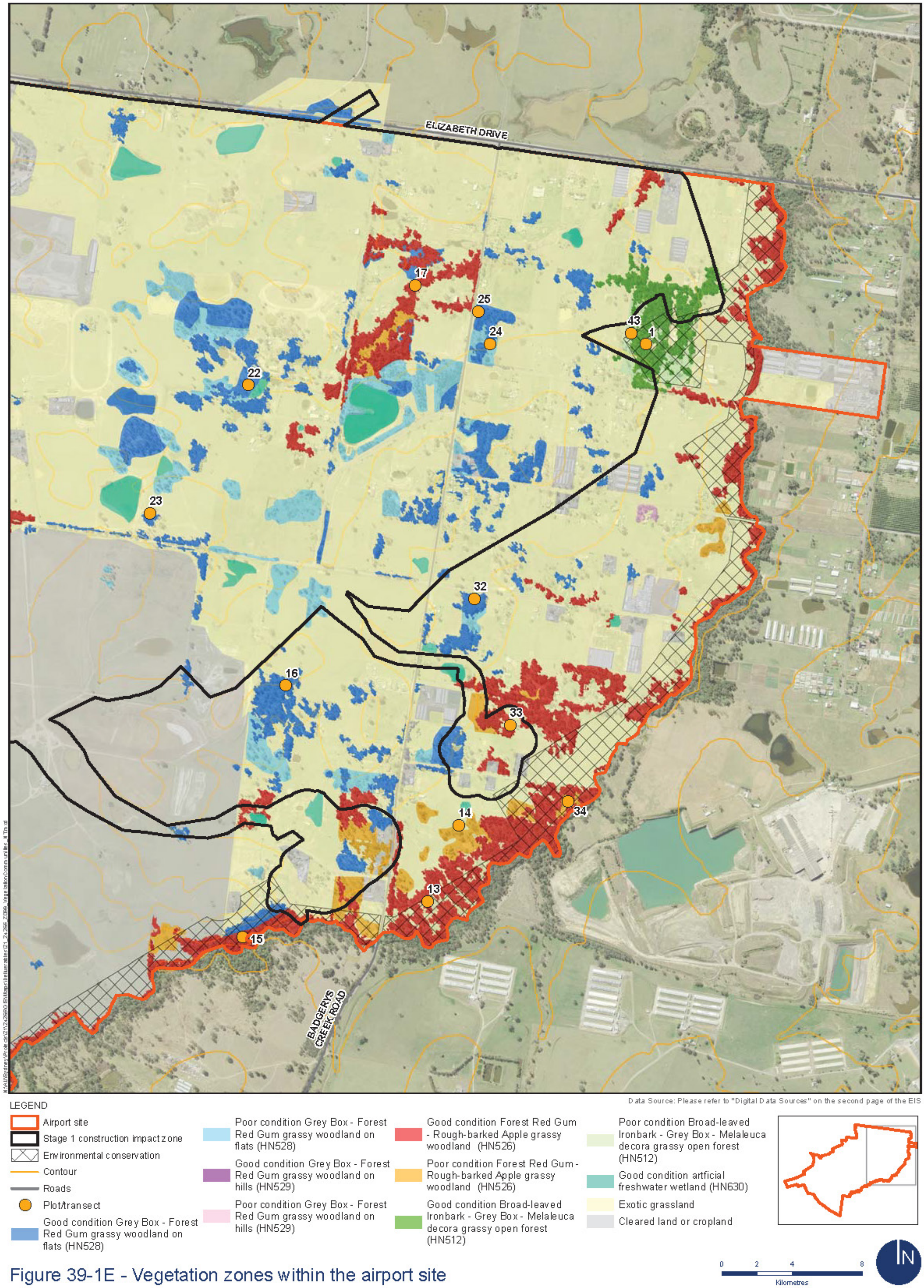


Figure 39-1E - Vegetation zones within the airport site

39.3 Topography, geology and soils

39.3.1 Existing environments

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 increased 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. Any contamination discovered during construction would be managed 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 or spill of 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 relevant measures to mitigate and manage the 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 ensuring the protection of the environmental 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 were 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 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 (Volume 2a) and in Appendix M1 (Volume 4).

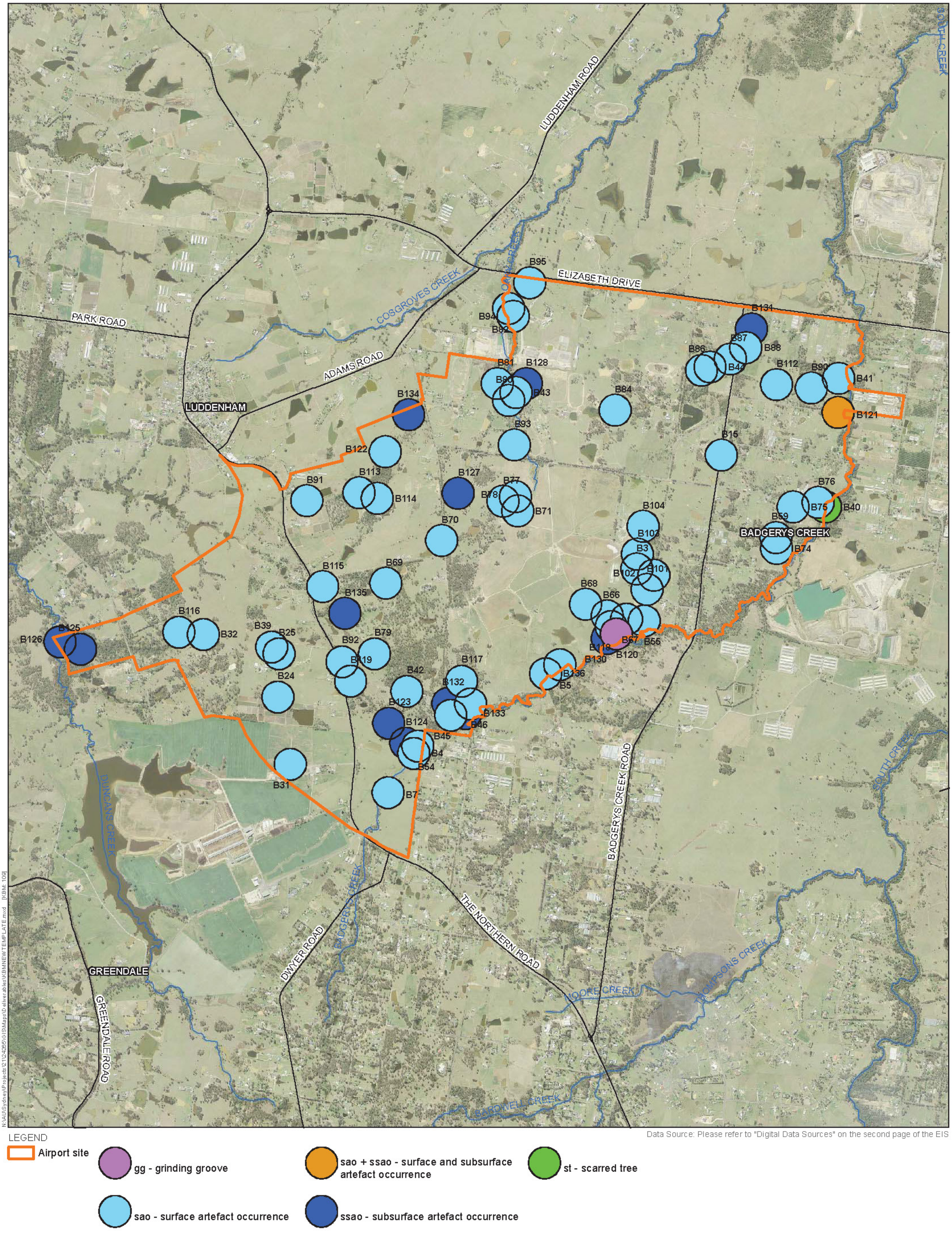


Figure 39-2 - Aboriginal heritage at the airport site

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 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
Impacted by long term development	B3, B5, B31, B42, part B45, part B46, B59, B66, B67, B68, B75, B76, B95, B103, B117, B118, part B121, B123, B124, B125, B126, B132 and B136	23
Situated in environmental conservation zone, including Badgerys Creek	B4, B7, B40, B41, part B45, part B46, B54, B55, B74, B90, B120, part 121, B130, B133 and B135	15

With regard to the predicted subsurface archaeological resource, construction of the long term development would directly affect approximately 374 hectares of archaeologically sensitive landform. This constitutes about 20 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 the south-eastern area of the airport site adjacent to Badgerys Creek. 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	Extent on airport site (hectares)	Extent affected by long term development (hectares)
Riparian corridor	369.6	108.5
Ridge and spur crests	120.3	51.3
Valley floor	184.0	133.6
Basal slopes	214.2	80.5
Total	888.1	373.9

39.4.3 Assessment of impacts during operation

Impacts during operation of the long term development would be limited to indirect impacts on sites located within the portion of the Badgerys Creek riparian zone within the environmental conservation zone on the airport site, 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.

The scarred tree (B40) and the grinding groove site (B120) are situated close to the airport site boundary fence. Given the value of these sites and potential for public interpretation, the indirect impacts of the adjacent development area on their contextual values are likely to be appreciable.

Potential impacts from the long term airport development on cultural heritage values of the Greater Blue Mountains World Heritage Area (GBMWHA) would be indirect in nature and relate to aircraft noise and visual intrusion from aircraft overflights. As discussed in Chapter 38, aircraft would generally be more than 5,000 feet above ground level when passing over the GBMWHA and a significant impact on Indigenous cultural heritage values of the area is not expected.

39.4.4 Considerations for future development stages

Chapter 19 (Volume 2a) 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 future planning and environmental assessments. 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.

39.5 European heritage

39.5.1 Existing environment

The assessment of European heritage identified 20 European heritage items at the airport site and associated sites 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.

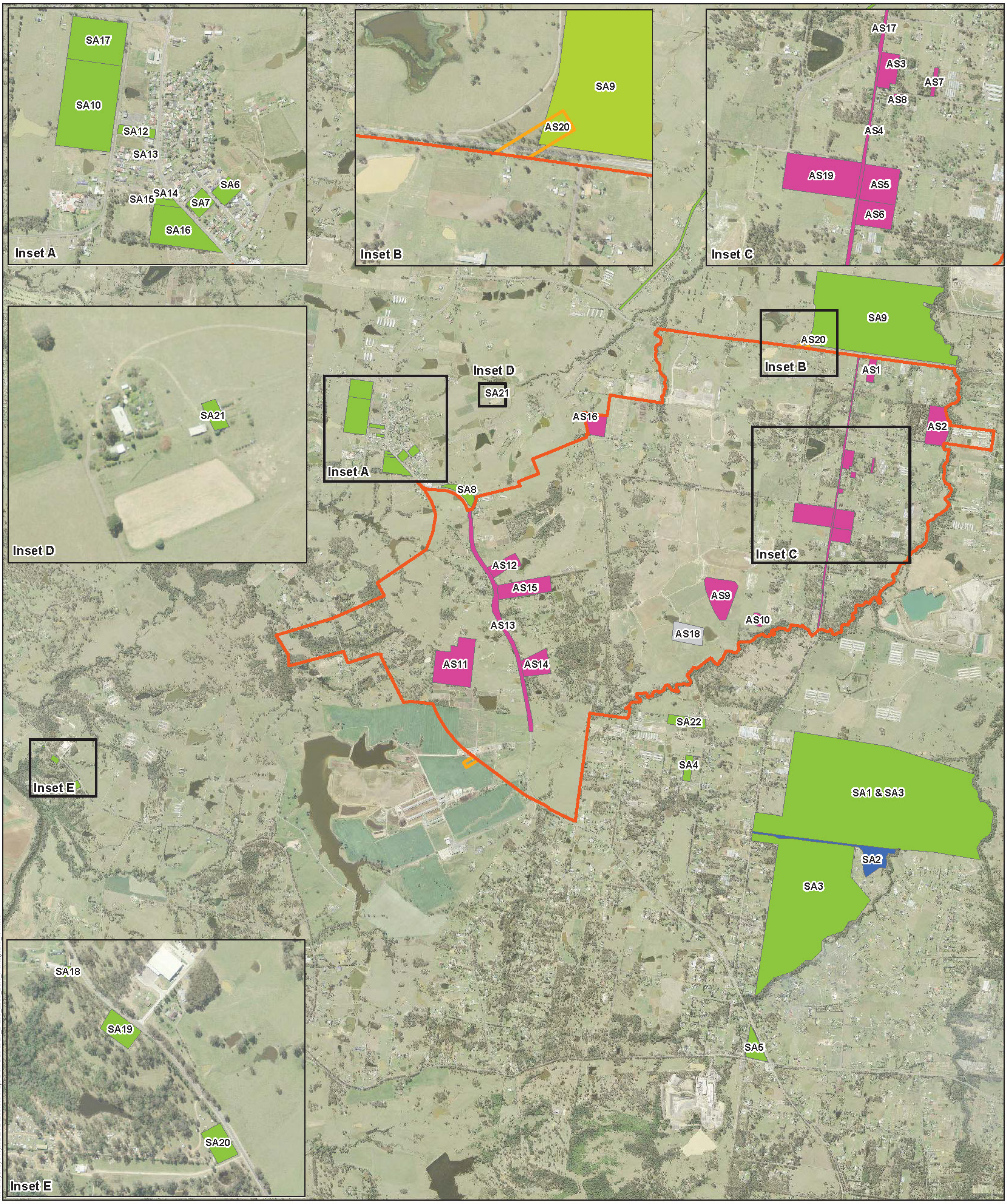
The site includes a public school, which demonstrates the development of public education from the late 1800s. The scale, material and design of the school buildings reflect the evolving fortunes of Badgerys Creek, education reform, the local community and architectural styles.

A more detailed review of the European heritage values of the site and surrounding area is provided in Chapter 20 (Volume 2a) and in Appendix M2 (Volume 4).

39.5.2 Assessment of impacts

Any remaining structures at the airport site would be removed during preparatory activities for the Stage 1 development. The European heritage items identified at the airport site would therefore not be present during the long term development.

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.



LEGEND

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

- Airport site
- HIAL

European heritage items

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

0 125 250 500
Metres

Figure 39-3 - European heritage items within and surrounding the airport site

39.5.3 Considerations for future development stages

A range of measures is 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 (Volume 2a).

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 in the southern part of the airport site. This would involve 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 (Volume 2a).

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 construction of the Stage 1 development.

The volume of waste generated during operation of the long term development would be substantially greater than during Stage 1 operations. The operational waste volume would increase from about 5,300 tonnes each year during Stage 1, to about 44,000 tonnes each year during 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 onsite and offsite 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 reviewed in the lead up to the long term development to incorporate new technologies where practicable, such as vacuum collection systems. 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 risks

An assessment of hazards and risks was undertaken for the Stage 1 development (see Appendix H, (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 and contribute to the expected growth in overall air traffic movements. The development of flight paths associated with the long term development would be subject to an airspace and flight path design process that would include safety as a principal consideration, along with environmental factors such as noise impacts. The future airspace design process for the Stage 1 development is discussed in detail in Chapter 7 (Volume 1). Future airspace design for the long term development would be subject to a similar process, which would include public consultation and further environmental assessment.

A pipeline for the supply of jet fuel would likely be required prior to the long term development in 2063. This would provide more efficient delivery of fuel to the airport site. Any proposal to construct and operate a fuel supply 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 forecast number of 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 the noise, air quality, surface water quality and groundwater impacts of the long term development was undertaken as part of the EIS (see Appendix G (Volume 4)). This health risk assessment builds upon the analysis presented for the Stage 1 development in Chapter 13 (Volume 2a).

The assessment was undertaken in accordance with the Australian Government Guidelines for Health Risk Assessment (enHealth 2012), the National Health and Medical Research Council *Approach to Hazard Assessment for Air Quality* (NHMRC 2006), the World Health Organization (WHO) Guidelines for Community Noise (WHO 2000), the WHO Night Noise Guidelines for Europe (WHO 2009) and the WHO Guidelines for Drinking Water Quality (2011). The health risk assessment uses information about pollutants to estimate a theoretical level of risk to human health at predicted levels of exposure.

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 (OEH) and the NSW Environment Protection Authority (EPA).

The risk assessment process comprises five stages: issue identification, hazard (or toxicity) assessment, exposure assessment, risk characterisation and uncertainty assessment. The issue identification stage determined that the primary risks to human health from the proposed airport were exposure to excessive noise, air emissions or pollution in surface and groundwater.

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 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 air quality component of the health risk assessment relies on the outputs of a local air quality assessment (see Appendix F1 (Volume 4)) and a regional air quality assessment (see Appendix F2 (Volume 4)). The findings of these assessments for the long term development are presented in Chapter 32. The local air quality assessment quantifies primary emissions from the proposed airport including particulate matter, nitrogen dioxide, sulfur dioxide and carbon monoxide. The regional air quality assessment primarily focuses on the formation of ozone across the Sydney basin. Further information on the methodologies and limitations of the local and regional air quality assessments are included in Appendix F1 and Appendix F2 (Volume 4) respectively.
To assess the potential air quality health risk, several residential locations were identified that represented the communities that would be most affected by air emissions from airport operations and associated road traffic. The locations used are Bringelly, Luddenham, Badgerys Creek, Greendale, Rossmore, Mount Vernon, Wallacia, Mulgoa and Kemps Creek. The total population covered by these areas is around 14,000 people.

It is important to note that the air quality modelling and thus the health risk assessment includes predicted increases in emissions from background traffic due to the broader urbanisation of Western Sydney. Therefore, the risks presented are not solely attributable to emissions from the operation of the long term development.

The analysis presented in this section should be viewed in the context of overall health in the Sydney basin. In 2006 there was a Parliamentary Inquiry into the health effects of air pollution in Sydney. Evidence provided by NSW Health at that time estimated that in Sydney there were between 600 and 1400 deaths per year due to air pollution in the Sydney basin (NSW Parliament, 2006). The focus of this report was on air pollution generally, although most of these deaths were attributed to $PM_{2.5}$. A more recent assessment conducted as part of a cost benefit analysis for the review of the *Fuel Quality Standards Act 2000* (Marsden Jacobs, 2016) estimated that in 2015 nitrogen dioxide in Sydney was responsible for 330 additional deaths per year and an additional 336 and 371 hospital admissions for respiratory disease and cardiovascular disease, respectively, in people over 65 years of age. The incremental increase in air pollution predicted for operation of the long term development is very small in this context.

Particulates

Annual average and 24-hour particulate matter have been modelled as part of the air quality assessment for the long term development. Particulate matter is typically quantified as less than 10 micrometres and 2.5 micrometres in aerodynamic diameter (PM_{10} and $PM_{2.5}$ respectively).

The health risks predicted for the long term development for both PM_{10} and $PM_{2.5}$ are higher than those predicted for the proposed Stage 1 development. The highest predicted risk associated with PM_{10} would be for all-cause mortality due to long term exposure with between one additional death per 100 years and nine additional deaths per 100 years. Similarly, the highest predicted risk for $PM_{2.5}$ would be for all-cause mortality due to long term exposure with between one additional death per 100 years and eight additional deaths per 100 years. All other risks are lower than the risk predicted for these outcomes. For both PM_{10} and $PM_{2.5}$ the highest predicted impacts are at Rossmore, Bringelly and Kemps Creek.

Nitrogen dioxide

The health assessment found that the risk from exposure to nitrogen dioxide is predicted to be higher than the risk predicted for the Stage 1 development. It is accepted that there is no threshold for nitrogen dioxide below which adverse health effects are not observed.

The highest predicted risk for nitrogen dioxide would be for all-cause mortality due to long term exposure with a maximum risk of 1.6 additional deaths per year due to the long term development. The highest risks are predicted at Luddenham, Bringelly, Kemps Creek, Mulgoa and Rossmore. When road traffic is excluded from the calculations (road traffic comprises approximately 32 per cent of NO2 emissions in 2063), the maximum level of additional deaths reduces to 1.2 per year.

As noted earlier, the incremental increase in predicted health risks for the long term development are very small in the context of existing air pollution and health outcomes in the Sydney region.

Ozone

The regional air quality assessment (see Appendix F2 (Volume 4)) predicted increased ozone concentrations for a number of days during the long term development. Increases in ozone would tend to occur downwind of the airport site which, on most days, is to the south and south-west. Decreases in daily maximum ozone concentrations attributable to suppression by emissions of nitrogen oxides could also occur in the vicinity of the airport site and are from airport operations.

There is general agreement by international agencies including the World Health Organization and the US Environmental Protection Agency that acceptable risk levels fall between one in a million and 0.5 in 100,000. For the long term development, the highest predicted risks from ozone are between five in one million for respiratory mortality and 4.5 in 100,000 for emergency department attendances for asthma in children.

Implementation of the mitigation measures outlined in Chapter 28 (Volume 2b) relating to air quality impacts will lead to improvements in ozone precursors and reduce the risk posed by ozone on peak ozone days. It should be noted that a large component of predicted ozone concentrations, and therefore health risk, is attributable to background ozone concentrations from sources other than the proposed airport such as background industrial activities and road traffic.

39.8.1.2 Noise

Sleep disturbance

Sleep disturbance impacts are quantified with the metric of electroencephalography (EEG) awakenings as well as full awakenings. An EEG awakening involves an increased level of brain activity but not an awakened state in the usual sense. For context, individuals typically exhibit about 24 EEG awakenings per eight hours of sleep (European Environment Agency 2010).

The operation of the long term development is predicted to increase this number of EEG awakenings and full awakenings for a number of communities around the airport site. The number of additional EEG awakenings due to aircraft overflight noise is predicted in the range of zero to 110 additional EEG awakenings per person per year, depending on the operating scenario. This would represent around a one per cent increase against the normal conditions of around 24 EEG awakenings per night. Of the communities assessed, Luddenham and Greendale were predicted to experience the highest increase in EEG awakenings due to aircraft overflight noise.

The number of full awakenings due to aircraft overflight noise would be significantly lower than the predicted EEG awakenings. Aircraft overflight noise associated with the long term development is predicted to result in between zero and 10 full awakenings per person per year, depending on the operating mode. The highest increase in full awakenings would occur at Luddenham, Greendale and Horsley Park each with an additional 10 full awakenings per person per year under the prefer 23 operating strategy.

Ground-based operations noise at the proposed airport would have the potential to cause further EEG awakenings at communities close to the airport site. The number of additional EEG awakenings due to ground-based operations noise is predicted in the range of zero to 150 additional EEG awakenings per person per year in the long term. The highest increase in EEG awakenings due to ground-based operations noise is predicted to be in Luddenham with a 150 additional EEG awakenings per person per year.

As with aircraft overflight noise, the number of full awakenings associated with ground-based noise is predicted to be significantly lower than the number of EEG awakenings for the long term development. Full awakenings associated with ground-based noise would be between zero and four additional full awakenings per person per year.

The highest increase would be in Luddenham with an additional four full awakenings per person per year, followed by Greendale with an additional three full awakenings and Kemps Creek with an additional two full awakenings. All other communities assessed are not predicted to have any increase in full awakenings associated with ground-based noise in the long term.

Cardiovascular effects

The WHO Night Noise Guidelines for Europe (WHO 2009) identifies the no observed adverse effects level (NOAEL) for increases for myocardial infarction (heart attacks) is 55 dB $L_{night,\ outside}$. For all receptors assessed, for both overflight and ground-based noise, the $L_{night,\ outside}$ predicted levels were below 55 dB (see Appendix G (Volume 4) for more detail). This was observed for all years assessed and all operating modes. On the basis of these results, it can be concluded that the aircraft overflight noise and ground-based noise would not lead to any increased risk in myocardial infarction in nearby communities.

Learning and cognitive development in children

Risks to cognitive development were assessed based on the WHO Community Noise Guidelines (WHO 1999) and enHealth Guidelines (enHealth 2012). The assessment calculates a hazard quotient derived from noise exposure, for both outside and inside noise levels.

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). A hazard quotient greater than one does not mean that there will be an impact on children's learning and cognitive development. Rather, it means there is an increased risk, albeit very low. Noise mitigation measures recommended in Chapter 31 would reduce this potential risk.

The assessment found that for aircraft overflight noise associated with the long term development all hazard quotients for outside noise and most hazard quotients for indoor noise are less than one, indicating that aircraft overflight noise from each of the modelled operating strategies generally do not pose an unacceptable risk. In some cases, there are marginal exceedances of one when considering indoor noise. These marginal exceedances are predicted at particular institutions in places such as Kemps Creek, Horsley Park and Luddenham.

The assessment found that the risks resulting from airport ground-based operations noise were more substantial than for aircraft overflights. In relation to ground-based operations noise, the assessment found that only Luddenham Primary School would experience a hazard quotient of greater than one, being for indoor noise. All other educational institutions would not experience a hazard quotient greater than one for indoor or outdoor noise. If, based on operational experience, the predicted noise levels are realised, mitigation measures should be implemented to reduce this risk to within acceptable levels.

39.8.1.3 Groundwater

Based on available information relating to the types of activities that 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.

The airport site has historically been used for a wide range of agricultural, industrial, commercial and rural-residential activities that generate various potential contaminants in soil and groundwater. For this reason, it is important that baseline groundwater data are collected, including for all potential contaminants that may be already present to enable identification of the current baseline conditions and from which to monitor future performance of the long term development.

39.8.1.4 Surface water

Chapter 13 (Volume 2a) provides a qualitative evaluation of the operation activities and whether there would be an impact to surface water bodies in and around the airport site, including rainwater tanks on private property. This includes an assessment of accidental spills of stored chemicals or fuels, release of stored groundwater, aircraft emissions and emergency 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 Western Sydney Airport would be developed progressively as demand increases beyond the scope of the Stage 1 development. 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 indicative long term airport concept considered in this EIS is forecast to service approximately 82 million annual passengers which is equivalent to approximately 370,000 air traffic movements per year. This is expected to occur around 2063.

It is recognised that implementation of the Stage 1 development would facilitate future growth in the aviation capacity at the proposed airport; in this regard a strategic assessment of the indicative 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 staged assessment approach provides flexibility in the master planning process for the airport 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 strategic assessment for the potential long term development centres on potential impacts of the expanded operations on the amenity of the surrounding community. Key issues considered in 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. To the extent possible 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.

40.2.1 Noise

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 experienced by the surrounding community. Taking this into account, aircraft noise impacts were considered for a 2050 scenario in which the single runway is operating close to capacity and for a long term scenario (around 2063) in which the airport layout incorporates two runways.

The assessment of noise impacts associated with the long term development of the proposed airport considers aircraft noise (based on indicative flight paths) and ground-based noise.

For the loudest aircraft operations (long-range departures by Boeing 747 aircraft or equivalent), maximum noise levels over 85 dBA would be experienced at residential locations closest to the airport site, such as Badgerys Creek. Maximum noise levels of 75 to 80 dBA are predicted for built-up areas in St Marys and Erskine Park under these worst case operating conditions. Maximum noise levels due to more common aircraft types such as the Airbus A320 or equivalent are predicted to be 60 to 70 dBA in built-up areas around St Marys and Erskine Park, and above 70 dBA in some adjacent areas to the south-west of the airport site, including 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 (around 2050). 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 a greater 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. The less populated, predominantly rural-residential areas to the south-west, including Greendale and parts of Silverdale would be most affected under the Prefer 23 strategy. Adoption of ‘head-to-head’ operations would reduce the number of residents affected when aircraft movements are low and weather conditions permit.

For night-time operations in around 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 is predicted to result in large parts of St Marys experiencing more than 20 aircraft noise events per night, on average 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 located within the noise affected areas for the indicative flight path design, particularly under the Prefer 23 operating strategy. This is because movements can be spread between two runways and the locations of flight paths are less constrained in the two runway scenario. The continuation of existing land use planning controls will limit the potential for new residential development to be impacted by a progressive increase in airport operations. The modelled 2063 Australian Noise Exposure Concept (ANEC) contours 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.

The 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.

Approaches to mitigating aircraft overflight and runway noise would generally focus on reducing noise emissions from the aircraft themselves, adjusting flight paths and airport operating modes, and developing land use planning or other controls to ensure that future noise-sensitive uses are not located in noise-affected areas.

40.2.2 Air quality

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 ground vehicle 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 (NO_X, PM_{10}, and $PM_{2.5}$) for the long term development. Several exceedances were predicted at sensitive receptors for these indicators.

The progressive increase in aircraft movements and site based activities would increase the level of emissions during the long term operations. However, no improvement in aircraft emissions, either due to improvements in fuel or engine emissions was incorporated into the modelling. As a result, 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.

40.2.3 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. Refinement of the modelled water management system 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.

40.2.4 Traffic

The long term development is expected to result in around 103,000 additional vehicle trips to and from the airport each day by 2063. These additional trips would be generated in the context of substantial urban growth in Western Sydney, particularly the development of the Greater Macarthur Land Release 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.

Significant road improvement works, including a new M12 Motorway, are being delivered as part of the Western Sydney Infrastructure Plan to cater for this demand. The long term development is also likely to require additional transport infrastructure. To this end, the Australian Government and NSW governments are undertaking a Joint Scoping Study on the rail needs for Western Sydney, including the proposed airport. The Study will consider the best options for future rail links, including decisions about timing and rail service options, both directly to the airport site and within the Western Sydney region.

40.2.5 Socio-economic

Continued development of the proposed Western Sydney Airport over the long term 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.

When considered with other employment initiatives taking place in the region, the opportunities for positive change and improved socio-economic outcomes for Western Sydney are significant. 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.

At the same time the long term development would have impacts on the social amenity and lifestyle of communities and recreational areas in proximity to the airport and those within the flight paths. Increases in aircraft overflights and ground based airport operations would generate noise and visual impacts from overflights that would potentially reduce the amenity of places where people live, work or visit for recreation.

40.2.6 Planning and land use

Construction and operation of the proposed airport would change the rural residential character of the airport site and surrounding land uses. This land use outcome has been anticipated in state and local government strategic planning for the area over a number of decades.

The proposed airport would support the continued growth of regional centres and priority growth areas.

40.2.7 Visual

Future development of the areas surrounding the airport site, under provisions of the Western Sydney Employment Area, Western Sydney Priority Growth Area and the South West Priority Land Release 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.

40.2.8 Greater Blue Mountains World Heritage Area

The Greater Blue Mountains World Heritage Area (GBMWHA) covers 1.03 million hectares of sandstone plateaus, escarpments and gorges dominated by temperate eucalypt forest. The boundary of the GBMWHA is approximately seven kilometres from the proposed airport at its closest point. The area is 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.

Potential impacts on the World Heritage, National Heritage and other values of the Greater Blue Mountains Area from the construction and operation of the proposed airport were assessed against the *Significant Impact Guidelines 1.1 – Matters of National Environmental Significance* (DoE 2013a). The assessment found that there would be no direct impacts on the values of the GBMWHA associated with the construction of the airport. Indirect noise, air quality and visual amenity impacts on the GBMWHA are predicted from aircraft overflights. Stage 1 operations are not expected to have an adverse impact on the World Heritage values or integrity of the GBMWHA.

Mitigation and management of potential noise impacts on the GBMWHA would be achieved through the planning and implementation of appropriate airspace and flight paths, airspace design and airport operating procedures to support long term 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 (see Chapter 7 (Volume 1).

The current assessment, based on indicative long term airspace management arrangements, shows that the impacts of an airport at Badgerys Creek on the Greater Blue Mountains, including the World Heritage and other values of the GBMWHA, are not likely to be significant. Opportunities to further reduce the noise and visual impact from aircraft flying over wilderness and other areas of the GBMWHA would be considered in finalising formal airspace and operational arrangements.

40.2.9 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 proposed 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. Implementation of the mitigation measures outlined in Chapter 28 (Volume 2b) relating to air quality impacts will lead to improvements in ozone precursors and reduce the risk posed by ozone on peak ozone days. It should be noted that a large component of predicted ozone concentrations, and therefore health risk, is attributable to background ozone concentrations from sources other than the proposed airport such as background industrial activities and road traffic

40.3 Future environmental assessment approval process

Part 5 of the *Airports Act 1996* 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 in such a longer period as allowed by the Infrastructure Minister. 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 Infrastructure Minister is required to seek the advice of the Environment Minister 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 seeking approval for future airport expansion and for environmental management including the responsibilities listed under Part 6 of the Airports Act.

40.4 Summary

Ongoing development of the proposed Western Sydney Airport would act as a catalyst for investment and job creation in the region by accelerating the delivery of important infrastructure and the release of employment and housing land, and providing a long term and diverse source of local jobs and economic activity. Additionally, the proposed airport would improve access to aviation services for the growing population of Western Sydney and ease existing aviation capacity constraints within the broader Sydney region.

This EIS has been prepared in accordance with Part 3 of the *Environment Protection and Biodiversity Conservation Act 1999* and the Department of the Environment guidelines for the assessment of the airport proposal (EPBC 2014/7391). This EIS will inform the determination of the Airport Plan.

An Airport Plan will provide the strategic direction for development of the proposed airport, forming the basis of the authorisation for the project under the Airports Act. The revised draft Airport Plan includes a specific proposal for Stage 1 to establish the proposed airport with a single 3,700 metre runway on a north-east/south-west orientation and aviation support facilities to provide an operational capacity of approximately 10 million annual passengers as well as freight traffic.

The revised draft Airport Plan also refers to the potential long term development of the proposed airport. As aviation demand increases beyond 10 million annual passengers, additional aviation infrastructure and aviation support precincts would be developed as required. It is anticipated that the proposed airport may eventually expand to include a second parallel runway on the same north-east/south-west orientation as the Stage 1 runway, with associated expansion in aviation support facilities. A second runway is expected to be required when the operational capacity approaches 37 million annual passengers, which is forecast to occur around 2050. Following development of the second runway, additional infrastructure, such as taxiways and increased terminal capacity, would be developed to service the long term passenger demand of approximately 82 million annual passengers, expected to occur around 2063.

The design and operation of Western Sydney Airport over the longer term would be considered as part of the airport master planning process and would be subject to approval requirements under the Airports Act. This strategic assessment has identified a number of environmental and social issues that would need to be addressed as part of any such future approval processes.

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References
Volume 3

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